GUIDELINE FOR THE

Evaluation and Management of Low Back Pain

Evidence Review

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RESEARCH
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CLINICAL GUIDELINE FOR THE EVALUATION AND MANAGEMENT OF LOW BACK PAIN

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INTRODUCTION

Purpose of evidence review

This evidence review focuses on evaluation and management of low back pain in adults. The American Pain Society (APS), which commissioned this report, used it to develop evidence-based clinical practice guidelines on evaluation and management of low back pain. The guidelines were developed in two stages. The first stage, published in October 2007, focused on initial (primary care) evaluation and management of low back pain, and was conducted in partnership with the American College of Physicians[1]. The second stage, published in May 2009, focused on use of interdisciplinary rehabilitation, interventional therapies, and surgery for low back pain[2].

BACKGROUND

Low back pain is extremely common. Though estimates vary widely, studies in developed countries report point prevalences of 12% to 33%, one-year prevalences of 22% to 65%, and lifetime prevalences of 11% to 84%[3]. In the U.S., nonspecific mechanical low back pain is the fifth most common reason for all physician visits, and the second most common symptomatic reason, accounting for approximately 2.3% of all physician visits[4, 5]. About one-quarter of U.S. adults report low back pain lasting at least a whole day in the last three months[5]. 7.6% of U.S. adults randomly surveyed by telephone had at least one occurrence of severe acute low back pain during a one-year period, with 39% of those seeking medical care for the episode[6].

Low back pain is also very costly. In 1998, total health care expenditures incurred by individuals with back pain in the U.S. were $90.7 billion, with incremental costs attributed to back pain $26.3 billion[7]. Medical treatment for chronic low back pain is estimated to cost $9,000 to $19,000 per patient annually, and interventional treatments cost a minimum of $13 billion in 1990[8]. Additional costs are associated with days lost from work due to low back pain. Low back pain is the most common cause for chronic or permanent impairment in U.S. adults under the age of 65, and the most common cause of activity limitations in persons under the age of 45[9]. Between 2% and 8% of the U.S. work force is disabled or compensated for back injuries each year[8, 9]. Approximately 5% of people with back pain disability are thought to account for 75% of the costs associated with low back pain[10].

Many patients with acute episodes of low back pain do not seek care because symptoms are often brief and self-limited. Among those who do seek medical care, rapid improvements in pain (average improvement of 58% of initial score), disability (average improvement of 58%), and return to work (82% of those initially off work return to work) are seen in the first month[11]. Further improvement generally occurs through approximately three months, after which pain or disability levels and rates of return to work tend to remain relatively constant. Up to one-third of patients report persistent back pain of at least moderate intensity one year after an acute episode requiring care, and one in five report substantial activity limitations[12]. Recurrences of pain also are common, with 60% to three-quarters of patients experiencing at least one relapse

within 12 months[11, 13]. Factors associated with the development of chronic disability due to low back pain include pre-existing psychological conditions and distress, presence of other types of chronic pain, job dissatisfaction or stress, and disputes over compensation issues[14].

Many options are available for the evaluation and management of acute or chronic low back pain. However, there has been little consensus, either within or between specialties, on appropriate uses of diagnostic tests[15] and interventions[16]. This is demonstrated by numerous studies showing unexplained variations in use of diagnostic tests and treatment. The rate of back surgery in the U.S., for example, is over five times higher than the rate in the U.K.[17]. Within Washington State, rates of back surgery vary up to 15-fold among different counties[18]. Despite wide variations in practice, several studies have shown that patients experience broadly similar outcomes, though costs of care can differ substantially both between and within specialties[19, 20]. In addition to unexplained practice variations, another historical feature of low back pain management has been the widespread uptake and use of unproven (and sometimes invasive and costly) interventions, some of which have later been shown to be ineffective, or even harmful[21]. Other interventions are widely used despite studies showing only marginal benefits[22].

Previous guidelines

The Quebec Task Force on Spinal Disorders published one of the first evidence-based clinical practice guidelines for management of low back pain in 1987[23]. This early attempt at using an explicit scientific basis for issuing management recommendations found insufficient evidence to support the use of most common diagnostic procedures and treatment modalities. In 1994, a multidisciplinary expert panel convened by the U.S. Agency for Health Care and Policy Research (AHCPR) issued its recommendations on management of acute low back pain[24]. The approach recommended by the AHCPR guidelines emphasizes history taking and physical examination to exclude 'red flag' symptoms suggestive of serious underlying pathology; targeted physical examination focusing on neurologic screening; diagnostic triage into broad categories including nonspecific low back pain, radicular syndrome, or specific pathology (which were felt to be diagnosable in only a small minority of cases); judicious use of diagnostic testing; and consideration of psychosocial factors when there is no improvement. Despite an exhaustive literature search and review, none of the 40 recommendations made for clinical care were viewed as supported by strong research evidence, and only six were judged as supported by at least moderate quality evidence. At the time, the AHCPR guidelines were subject to intense criticism and scrutiny[25]. Nonetheless, nearly all multidisciplinary guidelines published since 1994 have recommended an approach similar to the AHCPR guidelines[26].

There are now at least 11 international guidelines for management of low back pain. Most of their diagnostic and therapeutic recommendations are similar[26]. However, there are some discrepancies, particularly with regard to recommendations for exercise therapy, spinal manipulation, use of muscle relaxants, and provision of patient information. These differences may in part reflect contextual differences between countries that can affect interpretations of the evidence and how the trade-offs between benefits, side effects, and costs are weighted[27]. In

addition, systematic reviews of back pain guidelines found several important areas in which the overall quality of guidelines could be improved, including better descriptions of how the evidence was identified, selected and summarized; more attention to patient preferences; increased consideration of how guidelines could be implemented; better use of external peer review; and more transparent descriptions of editorial oversight and potential conflicts of interests[28, 29]. Most low back pain guidelines have focused on management of acute low back pain, and do not provide specific guidance for management of chronic low back pain[28].

The effects of using evidence-based clinical practice guidelines on clinical outcomes in patients with low back pain are difficult to assess. However, several trials evaluating outcomes associated with the selective imaging approach recommended in nearly all guidelines are now available (see Results, Key Question 2d). In addition, an observational study from Australia found back care based on guidelines and provided in multidisciplinary clinics was associated with improved pain scores after 12 months, decreased use of imaging and opioid medications, greater patient satisfaction, and decreased health care costs compared to usual care provided in general practice clinics[30]. A challenge in interpretation of this study is that it is difficult to know how much of the benefit was related to following guidelines and how much to provision of care by multidisciplinary clinics. Another observational study found a mass-media campaign in the state of Victoria, Australia based on evidence-based guidelines (encouragement of normal activities, exercise, and continued work while providing positive messages about likelihood of recovery) and aimed at altering back pain beliefs was associated with a decline in the number of claims for back pain, rates of days compensated, and medical payments for low back pain claims compared to a neighboring state without such a campaign[31]. Changes in clinician beliefs about back pain and reported back pain management appeared to be sustained 4.5 years after the end of the media campaign[32]. A U.S. trial found randomization of communities to an educational intervention for low back pain based on national guidelines resulted in a decline in the rate of surgery by about 9% compared to usual care[33].

The American Pain Society initiated this project to systematically review the current state of evidence and develop updated recommendations for management of acute and chronic low back pain using an evidence-based, balanced, and multidisciplinary approach. Throughout this evidence report, we highlight previous recommendations and findings from the AHCPR guidelines[24]. We also summarize recommendations from a federally funded U.S. guideline issued by the Veterans Affairs/Department of Defense (VA/DoD) in 1999[34] and a guideline issued by the U.K. Royal College of General Practitioners (RCGP), which was initially released in 1996[35] and updated in 1999[36]. The AHCPR, VA/DoD, and UK RCGP guidelines primarily focus on acute low back pain, though some recommendations for evaluation and treatment of persistent or chronic low back pain were included. We also summarize recommendations from a recent, multinational guideline from Europe issued in 2004 (the European COST B13 guidelines) addressed both acute and chronic low back pain, as well as prevention of back pain[37-39].

Methods used to grade strength of evidence by these guidelines are as follows:

AHCPR, VA/DoD, and European COST guidelines

A = Strong research-based evidence (multiple relevant and high-quality scientific studies)

B = Moderate research-based evidence (one relevant, high-quality scientific study or multiple adequate scientific studies)

C = Limited research-based evidence (at least one adequate scientific study in patients with low back pain)

D = Panel interpretation of information that did **not** meet inclusion criteria as research-based evidence

UK RCGP guidelines:

*** Generally consistent finding in a majority of multiple acceptable studies

** Either based on a single acceptable study, or a weak or inconsistent finding in some of multiple acceptable studies

* Limited scientific evidence, which does not meet all the criteria of acceptable studies

Although the European COST guidelines use the AHCPR method for grading evidence, they do not explicitly grade strength of recommendations.

SCOPE OF EVIDENCE REVIEW

Key Questions

The Key Questions used to guide this evidence review were developed by a multidisciplinary expert panel convened by the American Pain Society. The Key Questions were viewed as critical questions that needed to be answered in order to develop clinical practice guidelines.

1a. How accurate are features of the history and physical exam for predicting presence of serious underlying conditions (“red flags”) or other conditions that may be responsive to specific therapies in patients with low back pain (such as nerve root compression or spinal stenosis)?

1b. How accurate are features of the history and physical exam for predicting the development of persistent low back pain and associated disability (“yellow flags”)?

1c. How effective is identification and treatment of yellow flags for improving clinical outcomes in patients with low back pain?

2a. How accurate are different diagnostic tests for identifying serious underlying conditions (e.g., tumor, infection, compression fracture)?

2b. How accurate are different diagnostic tests for identifying other conditions (e.g. nerve root compression, herniated disc, spinal stenosis) that may respond to specific therapies?

2c. In patients with red flags, how effective are different diagnostic tests for improving patient outcomes?

2d. In patients without red flags, how effective are different diagnostic tests or test strategies (including no testing) for improving patient outcomes?

3. How effective is self-care advice, education, or other self-care interventions for improving patient outcomes?

4. How effective are different non-invasive interventions for non-radicular low back pain, radicular low back pain, or spinal stenosis, and under what circumstances?

5. How effective are decision tools or other methods for predicting which patients are more likely to respond to specific therapies like spinal manipulation or different types of exercise therapy?

6. How effective is referral from primary care providers to back specialty providers for improving patient outcomes? What are the outcomes for patients who are managed by different types of care providers or by multidisciplinary or interdisciplinary clinics?

7. What is the diagnostic accuracy and what are the potential harms associated with invasive tests for identifying patients who may benefit from invasive procedures? How effective is prior use of these tests for selecting patients for invasive procedures in improving outcomes?

8. How effective are injection procedures (and different injection interventions) and other interventional therapies for non-radicular low back pain, radicular low back pain, or spinal stenosis, and under what circumstances?

9. How effective is surgery (and different surgical interventions) for non-radicular low back pain, radicular low back pain, or spinal stenosis, and under what circumstances?

10. How effective are combinations of therapies for acute and chronic low back pain?

11. How effective are different treatment strategies for failed back surgery syndrome?

12. How effective are different methods of integrating or coordinating low back pain care?

13. How effective are interventions for secondary prevention of low back pain in patients who have had an episode of acute low back pain, or for prevention of flares of low back pain in patients with chronic low back pain?

14. How effective are interventions for managing low back pain during pregnancy and post-partum?

15. What is the cost-effectiveness associated with different interventions or management strategies (such as care provided by different types of providers) for managing low back pain?

Populations

Target populations for this review are:

- Adults (>18 years old)
- Pregnant women (not including management of back pain during labor)
- Persons with acute (less than 4 weeks), subacute (between 4 weeks and 3 months) or chronic (greater than 3 months) low back pain
- Persons with non-radicular low back pain (including presumed discogenic pain, presumed facet joint pain, spondylosis, degenerative disc disease, presumed sacroiliac joint pain, etc.), radicular low back pain (including symptomatic nerve root compression associated with lumbar disc prolapse), spinal stenosis, degenerative or isthmic spondylolisthesis, and failed back surgery syndrome

Treatment of spinal infection, cauda equina syndrome, cancer, spondyloarthropathies, systemic inflammatory disease, fibromyalgia syndrome, and vertebral compression fracture was excluded from the scope of this review, though evaluation to rule out such conditions was considered within the scope. Evaluation and management of osteoporosis without clear fracture and acute major trauma was also outside the scope of this review. Evaluation and management of children and adolescents with low back pain was also excluded, because diagnostic and therapeutic considerations are substantially different than in adults[40, 41].

Low back pain presents as a continuum ranging from acute (often defined as less than 4 weeks in duration) to chronic (often defined as greater than three months in duration). Patients may present to providers at any stage on this continuum, have mixed presentation (e.g., chronic low back pain with an acute exacerbation), or unclear date of onset. In addition, many trials evaluate mixed populations of patients with different durations of symptoms. Therefore, we reviewed evidence on low back pain of any duration.

Interventions

Target interventions (see Glossary for how interventions were defined) for this review are:

Non-invasive interventions

Medications

Acetaminophen

Non-selective non-steroidal anti-inflammatory drugs (NSAIDs)

Cyclo-oxygenase-2 selective NSAIDs

Aspirin

Skeletal muscle relaxants

Antidepressants

Opioid analgesics

Tramadol

Antiepileptic drugs

Systemic corticosteroids

Topical lidocaine

Interventions involving injection of medications into the back (such as botulinum toxin; local, epidural or intradiscal steroid injections; and intrathecal administration of medications) are covered under invasive, non-surgical interventions (see below).

Other non-invasive interventions

Herbal therapies

Brief educational interventions

Back schools

Exercise

Hydrotherapy

Spa therapy

Acupuncture

Acupressure

Neuroreflexotherapy

Spinal manipulation

Massage

Shortwave diathermy

Interferential therapy

Ultrasound

Psychological therapies

Interdisciplinary (multidisciplinary) rehabilitation

Functional restoration/physical conditioning programs/work hardening

Traction

Low-level laser therapy

Self-care interventions (including advice for bed rest or on remaining active and self-care books)

Modified work

Invasive, non-surgical interventions

Epidural steroid injection

Intradiscal steroid injection

Chemonucleolysis

Local anesthetic injections (including tender or trigger point injections)

Facet (zygapophysial) joint injection

Therapeutic medial branch block

Prolotherapy (sclerosant injection)

Botulinum toxin

Adhesiolysis and forceful epidural injection

Radiofrequency denervation

Intradiscal electrothermal therapy (IDET)

Percutaneous intradiscal radiofrequency thermocoagulation

Intrathecal therapy

Spinal cord stimulation

(Percutaneous discectomy and related procedures were considered surgical interventions)

Surgical interventions

Fusion and vertebral disc replacement for non-specific low back pain and degenerative disc disease

Surgery for degenerative spondylolisthesis

Surgery for spinal stenosis and lumbar isthmic spondylolisthesis

Discectomy for lumbar disc prolapse (including open discectomy, microdiscectomy, laser- or endoscopic-assisted discectomy, percutaneous automated discectomy with nucleotome, Coblation® nucleoplasty, and disc Dekompressor™)

Invasive diagnostic tests

Provocative discography

Selective nerve root block

Facet joint block and medial branch block

Sacroiliac joint block

Outcomes

We selected target outcomes based on the five core domains for low back pain suggested in recent recommendations: back specific function, generic health status, pain, work disability, and patient satisfaction[42, 43]. The two most commonly used measures of back-specific function are the Roland Morris Disability Questionnaire (RDQ) and the Oswestry Disability Index (ODI)[44]. The RDQ is reported on a 0 to 24 scale and the ODI on a 0 to 100 scale. Improvements of 2-3 points on the RDQ and 10 points on the ODI have been proposed as minimal clinically important differences[45].

Studies usually evaluate generic health status with the Medical Outcomes Study Short Form-36 (SF-36) or other multi-question assessments. These questionnaires measure how well an individual functions physically, socially, cognitively, and psychologically. The SF-36 measures 8 dimensions, each on a 0 to 100 scale[46]. The individual dimensions can also be combined into several commonly reported subscales (such as the Physical Component Summary and Mental Component Summary).

Most studies measure pain intensity using either visual analogue or categorical pain scales (using either numbers or a list of adjectives describing different levels of pain intensity)[47]. Visual analogue scales (VAS) usually consist of a line on a piece of paper labeled 0 at one end, indicating no pain, and a maximum number (commonly 10 or 100) at the other, indicating excruciating pain. Patients designate their current pain level on the line. Categorical pain scales, on the other hand, consist of several pain category options from which a patient must choose (e.g., no pain, mild, moderate, or severe for a verbal rating scale, 0 to 10 for a numerical rating scale such as the Brief Pain Inventory). Many studies also report the proportion of patients with "significant" improvement in pain, often defined as at least a 20-point (or 20%) improvement on a VAS[48]. The SF-36 bodily pain scale has been recommended as a preferred method for reporting pain outcomes because it measures both pain intensity and interference with activities[42].

Work status is often measured by employment status, days off work, or time before returning to work. Patient satisfaction is usually assessed using a generic global scale, though more formal methods have been developed. Some studies also report effects of interventions on mood or the preference for one medication over another. We also reviewed evidence on adverse events and safety as well as costs. We converted cost data using other currencies to U.S. dollars using conversion rates as of January 2007 (£1 British pound=$1.96 U.S., €1 Euro=$1.30 U.S., kr 1 kroner=$0.143 U.S.)

CONFLICT OF INTEREST

The evidence review was conducted at the Oregon Evidence-based Practice Center with funding from APS. None of the investigators conducting this review (RC and LHH) have any known conflicts of interest to disclose.

METHODS

Literature search and strategy

We searched the topic of low back pain using multiple electronic databases. The searches were performed in stages. All searches were initially conducted from 1966 (the start date of MEDLINE) through July 2005 and updated through November 2006. Searches for Key Questions 7 (invasive diagnostic tests), 8 (interventional therapies), and 9 (surgery) were subsequently updated through July 2008. In addition to MEDLINE, we searched for systematic reviews using the Cochrane Database of Systematic Reviews and the NHA Health Technology Assessment Programme and for primary studies using the Cochrane Central Register of

Controlled Trials, EMBASE, PsychINFO (mental health topics), CINAHL (nursing and allied health topics), and PEDro (physical therapy topics), as appropriate. Searches for primary studies initially targeted only those interventions for which we identified no relevant, recent, higher-quality systematic review. We later modified our approach so that searches for primary studies were conducted for all invasive diagnostic tests, interventional therapies, and surgery, regardless of availability of previously published systematic reviews. Detailed search strategies are shown in Appendix 1 (systematic reviews) and Appendix 2 (primary studies).

Electronic searches were supplemented by reviews of reference lists and additional citations suggested by experts.

Inclusion and exclusion criteria

All identified citations were imported into an electronic database (EndNote® 9.0) and considered for inclusion. Papers were selected for full review if they met all of the following criteria:

1. Were about low back pain and evaluated a target population
2. Were relevant to a Key Question
3. Evaluated prognostic factors for low back pain, at least one target diagnostic test, or at least one target low back pain intervention
4. Reported predictive values for prognostic factors, accuracy of diagnostic tests, or at least one target outcome (pain, function, generic health status, work disability, or patient satisfaction) associated with a low back pain intervention

We included relevant controlled clinical trials and systematic reviews. We excluded outdated systematic reviews, which we defined as systematic reviews with a published update, or systematic reviews published before the year 2000. Because of the large scope and body of literature covered by this review, we included controlled observational studies only for surgical interventions and for assessment of adverse events. Other observational studies (such as uncontrolled case series and pre-post analyses) were excluded. Studies of cost were included if they were conducted alongside a randomized trial or were a full economic analysis (cost-effectiveness, cost-minimization, or cost-utility study)[49].

For prognosis or diagnostic accuracy, we only included systematic reviews. The exception was for invasive diagnostic tests (discography, facet joint block, medial branch block, diagnostic selective nerve root block and diagnostic sacroiliac joint block), where we also included primary studies that focused on clinical outcomes. We only included non-English language trials if they were already included in English-language systematic reviews. Studies of non-human subjects and those without original data were excluded. We also excluded studies published only as conference abstracts.

Data extraction and synthesis

Systematic reviews

For each systematic review, we abstracted the following information:

1. Purpose of the review
2. Databases searched
3. Dates of the searches
4. Language restrictions, if any
5. Number of studies included
6. Criteria used to include studies
7. Limitations of the included studies
8. Methods for rating the quality of included studies
9. Methods for synthesizing the evidence
10. The interventions evaluated
11. Main efficacy outcomes (including number and quality of studies for each comparison and outcome)
12. Adverse events

The reliability of systematic reviews depends on how well they are conducted. We used predefined criteria to assess the internal validity of included systematic reviews. We assessed the internal validity (quality) of systematic reviews using the methods developed by Oxman and Guyatt (Appendix 3)[50]. Each study was scored between 1 and 7 based on the following criteria: comprehensiveness of search strategy; application of pre-defined inclusion criteria to select studies; appropriate assessment of validity; and use of appropriate methods to synthesize the evidence. Using this system, systematic reviews with a score of four or less are considered to have potential major flaws and we classified these as "lower quality." Systematic reviews with major flaws are more likely to produce positive conclusions about the effectiveness of interventions[51-53]. We considered systematic reviews with scores of five or more "higher quality."

Individual trials on efficacy and safety of interventions

We independently abstracted all randomized trials of interventional therapies versus placebo or sham therapy, surgery versus non-surgical therapy, and artificial disc replacement versus fusion. We also abstracted recent, large (N > 250) trials of non-invasive therapies and active-controlled trials of interventional therapies and surgeries that were not included in a previously published, higher-quality systematic review. We did not abstract randomized trials (placebo- or active-controlled) of non-invasive therapies or active controlled trials of interventional therapies or surgery if they were included in a higher-quality systematic review. Instead, we relied on the

systematic reviews to determine the number and quality of trials and estimate the magnitude of effects for each comparison and outcome of interest. Although methods for rating internal validity varied across systematic reviews, we considered studies that received more than half of the maximum possible quality score to be "higher-quality" for any quality rating system used[54, 55]. For systematic reviews that only assigned a categorical overall grade for quality, we considered studies "higher-quality" if they were rated "good," "high-quality," or the equivalent.

For each clinical trial not included in a higher-quality systematic review, we abstracted the following information:

1. Study design
2. Purpose of study
3. Inclusion and exclusion criteria
4. Number of patients approached, eligible, and randomized
5. Demographics and baseline characteristics
6. Setting
7. Funding source
8. Interventions evaluated
9. Main efficacy results
10. Adverse events (including withdrawal due to adverse events)
11. Duration of follow-up
12. Loss to follow-up
13. Compliance to treatment.

We assessed internal validity of randomized clinical trials using the eleven criteria proposed by the Cochrane Back Review Group (see Appendix 4 for details on how we operationalized the criteria)[56]. We rated the internal validity of each trial based on the methods used for randomization, allocation concealment, and blinding; the similarity of compared groups at baseline; the use of co-interventions; compliance to allocated therapy; adequate reporting of dropouts; loss to follow-up; non-differential timing of outcome assessment; and the use of intention-to-treat analysis. Trials were scored between zero and eleven, according to the number of criteria met. For interventions for which blinding was not feasible, we removed blinding of providers (acupuncture, acupressure, neuroreflexotherapy, spinal manipulation, massage, trials of surgery and some interventional therapies), blinding of patients and providers (brief educational interventions, back schools, coordination of care, exercise, hydrotherapy, spa therapy, psychological therapies, interdisciplinary rehabilitation, functional restoration, interventions involving different types of self-care advice, trials comparing an interventional therapy to non-interventional therapy, trials comparing surgery to non-surgical interventions), or blinding of patients and provider and use of co-interventions (trials of different imaging

strategies) as quality criteria, so the maximum score was ten, nine, or eight, respectively. We considered trials that received more than half of the total possible score to be "higher-quality" and those that received less than or equal to half "lower-quality"[54, 55].

Observational studies of treatment efficacy

To assess the internal validity of observational studies, we evaluated whether they used nonbiased selection methods; whether rates of loss to follow-up were acceptable; whether pre-defined outcomes were specified; whether they used appropriate methods for ascertaining exposures, potential confounders, and outcomes; and whether they performed appropriate statistical analyses of potential confounders. Although many tools exist for quality assessment of nonrandomized trials, there is no consensus on optimal quality rating methods[57]. We therefore did not use a formal scoring system to rate the quality of the observational studies included in this review, but noted methodological deficiencies in any of the above areas when present.

Studies of invasive diagnostic tests

Studies of invasive diagnostic tests (provocative discography, diagnostic facet joint block, medial branch block, diagnostic selective nerve root block, and diagnostic sacroiliac joint block) differ from typical studies of diagnostic test accuracy because there is no clearly accepted reference standard for the conditions these tests are meant to identify. We assessed the quality of these studies using nine criteria adapted from methods developed by the U.S. Preventive Services Task Force[58] and on empiric studies[59, 60] of sources of variation and bias in studies of diagnostic tests. For each study, we determined if it: 1) evaluated a consecutive series of patients or a random subset, 2) evaluated patients prospectively, 3) evaluated patients with a broad spectrum of symptoms, 4) adequately described the diagnostic test technique, 5) used current diagnostic techniques, 6) adequately described criteria for a positive diagnostic test, 7) used an appropriate definition for a positive diagnostic test, 8) performed statistical analysis on potential predictors or confounders of positive diagnostic tests, and 9) performed testing blinded to patient symptoms and other clinical characteristics. Studies that met at least five of the nine criteria were considered "higher-quality."

Dual review

Two reviewers independently rated the quality of each systematic review and primary study. Discrepancies were resolved via a consensus process.

Assessing research applicability and clinical relevance

To assess the applicability of trials, we evaluated whether the publication adequately described the study population and interventions, whether the setting or population was so different from typical U.S. settings that results might not be applicable, whether the differences were clinically (as well as statistically) significant, and whether the treatment received by the control group was reasonably representative of standard practice[61]. We also recorded funding sources and the roles of the sponsors.

Data synthesis

We assessed the overall strength of evidence for the body of literature, addressing each comparison and outcome evaluated for the Key Questions, using methods adapted from the U.S. Preventive Services Task Force[58]. To assign an overall strength of evidence (good, fair, or poor) for each comparison and outcome, we examined the type, number, size and quality of studies; strength of association; consistency of results within and between study designs; and directness of evidence.

Rating of good quality: Evidence includes consistent results from well-designed, well-conducted studies in representative populations that directly assess effects on health outcomes (at least two consistent, higher-quality RCTs or studies of diagnostic test accuracy).

Rating of fair quality: Evidence is sufficient to determine effects on health outcomes, but the strength of the evidence is limited by the number, quality, size, or consistency of included studies; generalizability to routine practice; or indirect nature of the evidence on health outcomes (at least one higher-quality trial or study of diagnostic test accuracy of sufficient sample size; two or more higher-quality trials or studies of diagnostic test accuracy with some inconsistency; at least two consistent, lower-quality trials or studies of diagnostic test accuracy, or multiple consistent observational studies with no significant methodological flaws).

Rating of poor quality: Evidence is insufficient to assess effects on health outcomes because of limited number or power of studies, large and unexplained inconsistency between higher-quality trials, important flaws in trial design or conduct, gaps in the chain of evidence, or lack of information on important health outcomes.

Consistent results from higher-quality studies across a broad range of populations suggest a high degree of certainty that the results of the studies are true (that is, the entire body of evidence would be considered “good-quality”). Large effect sizes on important, patient-centered outcomes generally increases confidence in study findings, particularly when they are reported by large, higher-quality studies. For a fair-quality body of evidence, consistent results could be due to true effects or to biases present in some or all studies. Inconsistent results between studies can lower confidence that the results of any particular study are true because of methodological flaws or other issues, or reflect diversity between studies in the populations or interventions evaluated. For a poor quality body of evidence, reliable conclusions are not possible because of insufficient evidence. There is low certainty that the results are not due to bias or other methodologic shortcomings in the studies.

To evaluate consistency, we classified conclusions of trials and systematic reviews as positive (the intervention is beneficial), negative (the intervention is harmful or not beneficial), or uncertain (imprecise estimates, unclear evidence, or inconsistent results)[51]. We defined “inconsistency” as >25% of higher-quality studies reaching discordant conclusions on efficacy (positive versus negative), two or more higher-quality systematic reviews reaching discordant conclusions, or unexplained heterogeneity (for pooled data). When results between systematic

reviews or individual trials were discordant, we investigated potential sources of discordance including differences in the populations, interventions, or outcomes addressed and (for systematic reviews) differences in methods for identifying, including, rating and synthesizing the evidence.

Sparse data lowers confidence in conclusions from a body of evidence because of imprecise estimates of effects, lack of statistical power, and a greater likelihood that conclusions will be influenced by new evidence. When evaluating low back pain interventions, we defined "sparse data" as ≤2 placebo- or active-controlled trials (any sample size), or ≤3 trials with no trial having >100 subjects. If the body of evidence consisted of a single, small (N<100) study, we rated it poor quality, even if the study itself was rated higher-quality. We also downgraded studies using unvalidated assessment techniques because it is difficult to know how accurately or reliably they estimate the true magnitude of benefit or harm. Primarily relying on indirect evidence, including evidence from patients with other (non-low back) pain conditions or evidence involving indirect comparisons (effect of intervention A versus intervention C estimated from studies comparing intervention A to intervention B and studies comparing intervention B to intervention C) also generally lowers the overall quality of a body of evidence[62].

In the first stage of this review (focused on non-invasive therapies), data synthesis was primarily based on evaluation of evidence from higher-quality, previously published systematic reviews, supplemented by data from randomized trials not included in the reviews. In the second stage of this review, which focused on interventional therapies and surgery, we modified our approach to base our data synthesis on an independent abstraction and evaluation of placebo- and sham-controlled randomized trials. We compared our synthesis with conclusions from previously published systematic reviews and evaluated for sources of discrepancy when inconsistency was present.

Assessing magnitude of benefits or harms

Although trials varied widely in how outcomes were assessed and reported, we used pre-specified criteria to categorize magnitude of effects for the most commonly reported outcomes. For pain relief, we considered mean differences in effects of 5 to10 points on a 100 point VAS pain scale (or equivalent) as small/modest, 10 to 20 points as moderate, and >20 points as large/substantial. For back-specific functional status, we considered mean improvements in the RDQ of 2 to 5 points or 10 to 20 points on the ODI as moderate[45]. Mean improvements of >5 points on the RDQ and >20 points on the ODI were considered large/substantial.

In order to compare and combine results across trials using different measures for the same outcome (such as pain relief or functional status), some systematic reviews report standardized mean differences (SMD). The SMD permits consistent interpretation across studies because mean differences are adjusted by within-group standard deviations. When SMD's were reported, we considered values from 0.2 to 0.5 small/modest, 0.5 to 0.8 moderate, and >0.8 large/substantial[63]. Though interpretation of the SMD can vary across different interventions and outcomes, there is some evidence that our classifications for SMD's and changes on pain

scores and functional status are roughly concordant. In trials of bed rest for low back pain, for example, an SMD between 0.2 and 0.3 was equivalent to 5 to 7.5 points on a 100 point VAS pain scale, and 1.2 to 1.8 points on the RDQ (all classified as small/slight)[64, 65]. A Cochrane review of spinal manipulation for low back pain estimated an SMD of 0.2 as equivalent to 5 mm on a 100 point VAS pain scale (both classified as small/slight using our system)[66, 67] and two different systematic reviews of acupuncture calculated an SMD of 0.54[68] and weighted mean difference of 17.8 on a 100 point pain scale[69, 70] for the same treatment comparison (both classified as moderate). Because few trials reported the proportion of patients meeting specific thresholds (such as >50% reduction in pain score) for target outcomes, it was usually not possible to report numbers needed to treat or harm. When reported, we considered a relative risk (RR) of 1.25 to 2.00 for the proportion of patients reporting >30% pain relief or improvement in function (or similar outcome) a moderate benefit.

Size of effect	Definition
Small/slight	Pain scales: Mean 5-10 mm improvement on a 100 mm visual analogue scale (VAS), or equivalent Back-specific functional status: Mean 5-10 mm improvement on the Oswestry Disability Index (ODI), 1-2 points on the Roland-Morris Disability Questionnaire (RDQ), or equivalent All outcomes: Standardized mean difference (SMD) 0.2 to 0.5
Moderate	Pain scales: Mean 10-20 mm improvement on a 100 mm VAS, or equivalent Back-specific functional status: Mean 10-20 mm improvement on the ODI, 2-5 points on the RDQ, or equivalent All outcomes: SMD 0.5 to 0.8
Large/substantial	Pain scales: Mean >20 mm improvement on a 100 mm VAS, or equivalent Back-specific functional status: Mean >20 mm improvement on the ODI, >5 points on the RDQ, or equivalent All outcomes: SMD >0.8

RESULTS

Size of literature reviewed

In the first stage of this review (searches performed through November 2006), the literature search for systematic reviews identified 913 citations. Search strategies are shown in Appendix 1. From these citations, we reviewed 265 full-text articles for inclusion; of those, 186 met inclusion criteria. A list of systematic reviews included for this report, along with our quality rating assignments, is shown in Appendix 5. A list of excluded reviews is shown in Appendix 6, along with reasons for exclusion. Main results of included systematic reviews are summarized at the end of Key Questions 3 (self-care therapies) and 4 (non-invasive therapies). We also identified 7591 citations from 44 searches for primary studies. From these citations, 202 primary studies were relevant and met inclusion criteria. Search strategies for primary studies are shown in Appendix 2. A list of included primary studies, along with quality rating assignments, is shown in Appendix 7.

In the second stage of this review, we updated searches on interventional therapies and surgery through July 2008. For interventional therapies, the updated literature search yielded a total of 1,331 citations. We retrieved 174 articles based on examination of titles and abstracts. Of 116

full-text articles that potentially reported a relevant randomized controlled trial, we judged 105 to meet inclusion criteria. Of 58 full-text articles potentially reporting a relevant systematic review, we judged 30 (reporting 26 systematic reviews) to meet inclusion criteria[71-100]. Main results of included systematic reviews are summarized at the end of Key Question 8. 75 trials (reported in 83 articles) were included in one or more previously published systematic reviews. 22 trials not included in any previous systematic review also met inclusion criteria[101-122]. Of 97 total trials, 52 (reported in 56 articles) were placebo-controlled (Appendix 5 shows quality ratings)[104-106, 108, 112, 123-145113, 114, 117-121, 146-169]. We excluded 28 potentially relevant reviews[170-197] (Appendix 6) and twelve trials[198-209] of interventional therapies.

For surgical interventions, the updated literature search yielded a total of 1,449 citations. We retrieved 125 articles based on examination of titles and abstracts. Of 91 full-text articles that potentially reported a relevant randomized trial, we judged 85 to meet inclusion criteria. Of 36 full-text articles that potentially reported a relevant systematic review, we judged 26 (reporting 24 systematic reviews) to meet inclusion criteria (23 systematic reviews evaluated efficacy [72, 79-82, 210-229] and one focused on harms[230]). Main results of included systematic reviews are summarized at the end of Key Question 9. 62 trials (reported in 71 articles) were included in one or more previously published systematic reviews. Twelve trials (reported in thirteen articles) not included in any previous systematic review also met inclusion criteria[110, 231-242]. Of 74 total trials, fourteen[231, 236-239, 241, 243-251] compared surgery to non-surgical therapy and two[252, 253] compared artificial disc replacement to fusion (Appendix 7 shows quality ratings). We excluded 12 potentially relevant reviews[176, 177, 190, 191, 254-261] (Appendix 6) and four trials[262-265] of surgery.

RESULTS

Key Question 1a

How accurate are features of the history and physical exam for predicting presence of serious underlying conditions (“red flags”) or other conditions that may be responsive to specific therapies in patients with low back pain (such as nerve root compression or spinal stenosis)?

In primary care, about 0.7% of patients will have spinal malignancy (primary or metastatic), 4% compression fractures, and 0.01% spinal infection[266]. Estimates for prevalence of ankylosing spondylitis in primary care patients range from 0.3%[266] to 5%[267]. Spinal stenosis and symptomatic herniated disc are present in about 3% and 4%, respectively[268]. Up to 90% of patients have non-specific low back pain, for which there is imprecise or poor correlation with any specific pathology[268]. Features of history and physical exam that can identify patients more likely to have serious conditions such as cancer or infection (“red flags”) or other conditions that may respond to specific treatments (such as nerve root compression from lumbar disc prolapse, spinal stenosis, ankylosing spondylitis, and vertebral compression fracture) are important for guiding diagnosis and therapy.

Results of search: systematic reviews
We identified five systematic reviews (four higher quality[269-272], one lower-quality[268]) on the accuracy of history and physical exam for diagnosing various conditions associated with low back pain. We excluded three systematic reviews that were outdated[273], did not clearly describe systematic methods for identifying or synthesizing the literature[273], did not report diagnostic accuracy[274], or reported duplicate information from another published review[275]. Studies of spinal palpatory maneuvers (to identify patients likely to benefit from manipulation) and physical exam maneuvers for sacroiliac joint pain are discussed in Key Question 5.

Results of search: primary studies
All of the systematic reviews noted important methodological shortcomings in the primary literature, such as spectrum bias (for example, only evaluating patients who underwent surgery, patients from referral settings, or those with more severe disease), little attention to inter- or intra-rater reliability, verification bias, non-blinded assessment of the index or reference tests, poor description of the index test, and lack of attention to reproducibility of findings over time. These deficiencies could explain some of the observed variation between studies in reported diagnostic accuracy. Another limitation of the literature is that the specific features of history and physical exam that were assessed varied, and for several features only a single or few studies are available. Only one systematic review (rated higher-quality), on the accuracy of the straight leg raise test for disc herniation, pooled data quantitatively[270]. We did not search for additional studies.

Accuracy of history and physical exam features for identifying specific diagnoses associated with low back pain

Cancer

Two systematic reviews evaluated diagnostic accuracy of clinical history for identifying patients with cancer[268, 271]. Based on one higher-quality study[266], both systematic reviews found failure to improve after 1 month of therapy, unexplained weight loss, and previous history of cancer each associated with high specificity (>0.90) for cancer. Previous history of non-skin cancer was associated with the highest positive likelihood ratio at 14.7, increasing the post-test probability of cancer from about 0.7% to 9%. Only age >50 years and no relief with bed rest were associated with sensitivities greater than 0.50 (0.77 and >0.90, respectively). Having any of the following was associated with a sensitivity of 1.0 and specificity of 0.60 for diagnosing vertebral cancer: age >50, history of cancer, unexplained weight loss, or failure of conservative therapy (positive likelihood ratio 2.5). For physical exam findings, one systematic review found the sensitivity of spinal tenderness for vertebral cancer varied widely across four studies (range 0.15 to 0.80), though specificity was relatively consistent (0.60 to 0.78)[271]. Other physical exam findings (such as muscle spasm, radiculopathy, Babinski's sign, or urinary retention) had poor sensitivity, though certain neuromuscular (weakness, atrophy, reflex changes) or sensory deficits were associated with high specificity in some studies.

Infection

Few studies evaluated accuracy of history for diagnosing spinal osteomyelitis or other infections causing low back pain. One systematic review found a sensitivity of 0.40 for a history of intravenous drug abuse, urinary tract infection, or skin infection (specificity not reported)[268].

Cauda equina syndrome

Cauda equina syndrome is most commonly caused by massive midline intervertebral disc herniation. Though there is little data on accuracy of history and physical exam for identifying patients with this condition, the most frequent finding in cauda equina syndrome is urinary retention (sensitivity 90%)[273]. In patients without urinary retention, the probability of cauda equina syndrome is approximately 1 in 10,000.

Compression fracture

For diagnosis of compression fracture, one systematic review included one unpublished study that found corticosteroid use associated with a higher predictive value (positive likelihood ratio 12.0) than age or history of trauma[268]. Age >50 years was associated with a sensitivity of 0.84 and specificity of 0.61 (positive likelihood ratio 2.2 and negative likelihood ratio 0.26) and age >70 years was associated with a sensitivity of 0.22 and specificity of 0.96 (positive likelihood ratio 5.5 and negative likelihood ratio 0.81).

Ankylosing spondylitis

Two systematic reviews evaluated diagnostic accuracy of history for identifying patients with ankylosing spondylitis[268, 271]. Both found younger age of onset associated with high sensitivity but poor specificity (sensitivity and specificity 0.92 and 0.30 for onset <35 years, 1.00 and 0.07 for onset <40 years). Most other historical features had only modest predictive value or gave inconsistent results. For example, the specificity of a history of sacral pressure varied from 0.68 to 0.92 in three studies. Combined historical findings (positive response to 4 of 5 of the following screening questions: onset before age 40, chronic onset, duration >3 months, morning stiffness, and improvement with exercise) did not improve diagnostic accuracy (positive likelihood ratio of 1.3 and negative likelihood ratio of 0.94). All physical exam findings (including Schober's test, degree of chest expansion, reduced lateral mobility, and sacral or lumbar pressure) were associated with poor sensitivity. In single studies, chest expansion ≤2.5 cm, Schober's sign <4 cm, and restricted anteroposterior compression, lateral compression, or hip extension were associated with relatively high specificities (>0.80).

One recent study found a positive likelihood ratio of 3.7 for inflammatory low back pain associated with ankylosing spondylitis when at least two of the four criteria are met: morning stiffness of >30 minutes' duration, improvement in back pain with exercise but not with rest, awakening because of back pain during the second half of the night only, and alternating buttock pain[276]. The positive likelihood ratio increased to 12.4 when at least 3 parameters are met.

Revised criteria for diagnosing early ankylosing spondylitis (prior to the development of sacroiliac changes on imaging studies) have recently been proposed[277]. Their adoption is likely to affect estimates of diagnostic accuracy of history and physical exam findings for ankylosing spondylitis.

Herniated disc or radiculopathy

For diagnosing a herniated disc or radiculopathy, three systematic reviews found a history of sciatica had fairly high (79% to 99%) sensitivity and widely varying specificity (14% to 88%)[268, 271, 272]. One systematic review also included one higher-quality study that found a typical distribution for radiculopathy on a pain drawing had modest sensitivity (46%), but high specificity (84%)[272].

The best-evaluated physical exam findings for herniated disc are the straight leg raise (Laseague's test) and the crossed straight leg raise tests. In a higher-quality, recent systematic review of 17 studies, the pooled sensitivity and specificity of the straight leg raise test for diagnosing herniated disc were 0.91 (95% CI 0.82 to 0.94) and 0.26 (95% CI 0.16 to 0.38)[270]. The pooled diagnostic odds ratio was 3.74 (95% CI 1.2 to 11.4). For the crossed straight leg raise test, the pooled sensitivity and specificity were 0.29 (95% CI 0.24 to 0.34) and 0.88 (95% CI 0.86 to 0.90), with a pooled diagnostic odds ratio of 4.39 (95% CI 0.74 to 25.9). Three other systematic reviews reached similar conclusions[268, 271, 272]. Other physical exam findings (such as decreased reflexes, strength, muscle atrophy, or sensory deficits) have been less well studied. In general, the presence of such neurological deficits is an insensitive finding for diagnosing radiculopathy or herniated disc[268, 271, 272]. Isolated studies found iliopsoas or tibialis anterior weakness associated with high (97% and 89%) specificity[272]. The specificity of gastrocnemius weakness, calf atrophy, and depressed ankle or knee jerks for diagnosing herniated disc ranged from slight to high[268, 271, 272].

The accuracy of combined history and physical examination findings to diagnose herniated disc varied across studies, in part because of inconsistencies in how the clinical findings were defined across studies[272]. For example, the sensitivity and specificity were 27% and 97% in one study that defined a positive "cluster" as two or more positive findings[278], but 98% and 7% in another that defined a positive cluster as "probable diagnosis" based on clinical exam and history[279].

Spinal stenosis

One recent, higher-quality systematic review found limited evidence (7 studies, 2 rated higher-quality) on diagnostic accuracy of history and clinical findings or tests for spinal stenosis[269]. In the two higher-quality studies, the presence of radiating leg pain (sensitivity 94%) and changes in neurologic status on a downhill walking treadmill test (sensitivity 100%) were associated with the highest sensitivity, but neither finding was specific (21% and 33%, respectively)[280, 281]. Findings that were >80% specific (such as changing symptoms, bilateral paresis, or bilateral reflex changes on treadmill testing) were not sensitive (38% to 63%). The highest positive predictive value (3.1) was associated with changing symptoms during downhill treadmill testing.

Pseudoclaudication and radiating leg pain were associated with positive likelihood ratios of 1.2 and 2.2, respectively. In one lower-quality study, lack of pain when seated and a wide-based gait were associated with positive likelihood ratios of 6.6 and 14.3 (respectively)[282], though the positive likelihood ratio for pain relieved by sitting was only 0.96 in another lower-quality study[283]. This study also found age greater than 65 years associated with a positive likelihood ratio of 2.5 and negative likelihood ratio of 0.33. In another lower-quality study, a combination of factors on two stage treadmill test based on time to onset of symptoms and recovery time was associated with a positive predictive value of 15, but this finding has not yet been replicated[283].

Summary of evidence

- For diagnosis of cancer in primary care patients with acute low back pain, previous history of non-skin cancer (positive likelihood ratio 14.7), unexplained weight loss (positive likelihood ratio 2.7), and failure to improve after 1 month of therapy (positive likelihood ratio 3.0) were each associated with specificity >0.90. In a primary care setting, a history of non-skin cancer increased the likelihood of cancer from about 0.7% to 9% in one study (level of evidence: fair).
- For diagnosis of cancer in primary care patients with acute low back pain, the presence of any of the following was associated with a high sensitivity (1.00) and moderate specificity (0.60) in one higher-quality study: age >50 years, history of non-skin cancer, unexplained weight loss, or failure of standard non-invasive therapy (positive likelihood ratio 2.5, negative likelihood ratio 0.0). Physical exam findings (such as vertebral tenderness or neurologic deficits) generally have poor or inconsistent sensitivity for cancer, but high specificity in some studies (level of evidence: fair).
- For diagnosis of infection in patients with low back pain, few studies evaluated the accuracy of history and physical exam, though history of intravenous drug use, skin infection, or urinary tract infection only had modest sensitivity in one study (level of evidence: poor).
- For diagnosis of vertebral compression fracture, older age and history of corticosteroid use were the best predictors (level of evidence: fair).
- For diagnosis of ankylosing spondylitis, younger age at onset of back pain was sensitive but not specific. Physical exam findings for ankylosing spondylitis were generally associated with poor sensitivity and relatively high specificities. Presence of at least two of the following was associated with a positive likelihood ratio of 3.7: morning stiffness of >30 minutes duration, improvement in back pain with exercise but not with rest, awakening because of back pain during the second half of the night only, and alternating buttock pain (positive likelihood ratio of 12.3 when at least 3 findings present). Recently proposed changes in criteria used to diagnose early ankylosing spondylitis (i.e. prior to the development of sacroiliitis) are likely to affect estimates of diagnostic accuracy (level of evidence: fair).
- For diagnosis of radiculopathy, describing typical symptoms of sciatica has a relatively high sensitivity but inconsistent specificity. A positive straight leg raise (the best-studied physical exam maneuver) was associated with a pooled sensitivity of 0.91 and specificity of 0.26 in one higher-quality systematic review. A positive crossed straight leg raise was associated with a

pooled sensitivity of 0.29 and a specificity of 0.88. The specificity of neurologic deficits consistent with nerve root compression ranges from modest to high (level of evidence: fair).

- For diagnosis of spinal stenosis, higher-quality studies found features of the history and clinical exam associated with high sensitivity (such as radiating leg pain) generally associated with low specificity, or vice versa, resulting in modest or poor predictive values. Changing symptoms on downhill treadmill testing was associated with the highest positive likelihood ratio (3.1). In lower-quality studies, a wide-based gait and a combination of findings on treadmill testing were associated with higher likelihoods for spinal stenosis. Age greater than 65 years was associated with a positive likelihood ratio of 2.5 and negative likelihood ratio of 0.33. The predictive value of pain relieved by sitting ranged from poorly to highly (level of evidence: fair).

Recommendations and findings from other guidelines

- The AHCPR guidelines recommend inquiring about features of the history and clinical exam suggestive of cancer or infection (history of cancer, unexplained weight loss, intravenous drug use, history of urinary infection, pain increased by rest, fever), particularly in patients over the age of 50 (strength of evidence: B).
- The AHCPR guidelines recommend inquiring about features suggestive of cauda equina syndrome such as bladder dysfunction, saddle anesthesia, and major limb motor weakness (strength of evidence: C).
- The AHCPR guidelines recommend inquiring about significant trauma or minor fall or heavy lift in potentially osteoporotic or older patients to avoid delays in diagnosing fractures (strength of evidence: C).
- The AHCPR guidelines recommend straight leg raise testing to assess sciatica in young adults, but notes that it may be normal in older patients with spinal stenosis (strength of evidence: B).
- The AHCPR guidelines recommend a focused neurologic exam emphasizing ankle and knee reflexes, ankle and great toe dorsiflexion strength, and distribution of sensory complaints to document the presence of neurologic deficits (strength of evidence: B).
- The VA/DoD and UK RCGP guidelines adopted an approach nearly identical to the one suggested by the AHCPR guidelines (history and physical with focus on identifying red flags and focused neurologic examination).
- The European COST guidelines also recommend diagnostic triage in patients with acute low back pain as recommended by other guidelines. In patients with chronic low back pain, diagnostic triage is recommended at the first assessment and at reassessment to exclude specific spinal pathology and nerve root pain.

Key Question 1b

How accurate are features of the history and physical exam for predicting the development of persistent low back pain and associated disability ("yellow flags")?

Rapid improvements in low back pain typically occur in the first month after presentation. However, a small proportion of patients develop chronic and disabling back pain, and many patients continue to have back pain at lower intensity or recurrent low back pain episodes[11-13]. One systematic review found that 82% of those initially off work returned to work within one month, and 93% had returned to work by three to six months, with little subsequent improvement[11]. "Yellow flags" describe features of the history or physical examination that could help identify patients more likely to develop chronic and disabling low back pain. This identification can be used in order to provide interventions that might help retain or improve functionality.

Results of search: systematic reviews
We identified 14 systematic reviews on features of the clinical history or physical exam predictive of a high risk for persistent low back pain and related disability. Thirteen systematic reviews evaluated prognostic factors based on clinical history[11, 284-295]. Five were rated higher-quality[11, 286, 287, 291, 294]. Four lower-quality systematic reviews evaluated prognostic factors based on the physical exam[284, 293, 295, 296].

Results of search: additional studies
All of the systematic reviews reported important methodological shortcomings in the primary literature evaluating prognostic factors for low back pain including lack of blinding, small sample sizes, inadequate analyses of confounders, and incomplete follow-up of patients. In addition, the populations and settings were heterogeneous. Due in part to these limitations, only one systematic review quantitatively pooled trials[294]. We did not search for additional studies.

Accuracy of history and physical exam features for identifying patients more likely to develop chronic and disabling low back pain

The most comprehensive, higher-quality systematic review (based on 54 studies meeting minimum methodologic criteria) found strong evidence that each of the following was a predictor for persistent low back pain, non-return to work, or disability: low back pain associated with increased pain severity, longer duration of symptoms, associated disability, or leg pain; low back pain-related sick leave; history of spinal surgery; low job satisfaction; and poor general health (Table 1)[286]. There was moderate evidence that work-related and psychological factors (such as employment status, amount of wages, workers' compensation, and depression) and physical factors (such as time spent lifting per day and work postures) were also associated with worse outcomes. Findings of other systematic reviews were generally concordant. For example, a second higher-quality systematic review of 18 prospective cohort studies (six rated at least acceptable quality) found increased psychological distress, somatization, and poorer coping strategies associated with unfavorable outcomes[291]. Several systematic reviews found receipt of

benefits or worker's compensation associated with poorer outcomes[284, 290, 295]. Other systematic reviews found modest evidence for an association between more severe pain[290, 295], presence of radiating pain[284, 293, 294] or presence of continuous pain[293] and poorer outcomes. Evidence regarding associations between age or gender and poorer outcomes was mixed and inconsistent[284, 290, 293, 294].

Only a handful of studies assessed the usefulness of specific scales to predict poorer outcomes. One recent higher-quality systematic review found that the Vermont disability prediction questionnaire appeared promising[11]. Higher scores on the Vermont prediction questionnaire (>0.48) were associated with a positive likelihood ratio for return to work at 3 months of 5.7 (95% CI 3.9 to 8.5) and a negative likelihood ratio of 0.07 (95% CI 0.01 to 0.50) in one higher-quality study[297]. Fear avoidance (avoidance of activity because of fears that it will worsen symptoms or outcomes) predicted worse outcomes in two[284, 293] of four[291, 292] systematic reviews.

Evidence on the prognostic value of physical exam findings for prediction of poorer outcomes associated with low back pain is sparser than evidence regarding psychosocial factors. Presence of positive sham tests for pain (such as Waddell's nonorganic signs) consistently predicted disability in three studies included in one systematic review[293], though a more recent study found Waddell's signs and symptoms inaccurate for predicting delayed return to work[298]. Other physical exam findings such as positive straight leg raise tests, absence of neurological signs, and intact range of motion were inconsistently associated with poorer outcomes[284, 296]. One systematic review found physical exam findings to be weaker predictors of outcomes than psychosocial factors[295].

Main results of the 14 systematic reviews on prognostic factors for low back pain are summarized in Table 1.

Table 1. Systematic reviews of prognostic factors for identifying patients more likely to develop chronic and disabling low back pain

Author, year	Number of included studies	Prognostic factors evaluated	Main results	Quality*
Borge, 2001[296]	10	Physical examination tests and physical examination observations	Range of motion tests: 3 of 8 (or 3 of 9) studies found that lumbar range of motion tests predicted outcomes Nerve root tension tests: 1 study found no predictive value Neurologic symptoms (reflexes and sensitivity): 1 study found no predictive value Painful spots in the lumbar area: 1 study found no predictive value Palpation of spinous processes: 1 study found no predictive value 7 different tests: 1 study found no predictive value Spine-hip ratio or hip flexion: 1 study found no predictive value McKenzie protocol (centralizer vs. noncentralizer): 1 study found that protocol predicted outcome for self-reported pain intensity or return to work, but not for treatment outcome as measured by Oswestry scale or lifting capacity	2/7
Crook, 2002[284]	19 studies of prognostic factors for low back pain	Grouped into categories: sociodemographics, medical/physical, history of back pain, pain, psychological, social/family, functional disability, health status, workplace, lifestyle, compensation, intervention	Predictors of slower return to work: psychological distress (1 study), older age and/or female gender (4), functional disabilities (4), job problems or problems with colleagues (3), previous hospitalization (1), previous episode of back pain (1) Predictors of faster return to work: availability of modified jobs (1), light mobilization (1), more than 2 years on the job or referral to occupational injury, and less than 30 days from injury to treatment (1), no pain (1), no sprain (1), good flexion (1), absence of neurological signs (1) Mixed results: workers compensation status (1 study negative predictor of return to work and 1 study positive predictor)	4/7
Dionne, 2001[285]	18 studies of prognostic factors for low back pain	Formal education	Education as a predictor of outcomes of low back pain episodes (11 'major' studies): Worse outcomes significantly associated with low education for 20 outcomes in 11 studies, negative results for 5 outcomes in 2 studies, and no studies reported worse outcomes among better educated.	4/7
Fayad, 2004[286]	54	Individual factors (medical/demographic, clinical exam, psychological characteristics, socio-cultural factors), professional factors (socio-professional and physical)	Predictive factors for recurrence, chronicity of low back pain, and non-return to work: Strong evidence: History of low back pain (including pain severity, increased duration, associated disability, leg pain, related sickness leave, and history of spinal surgery), low job satisfaction, and poor general health. Moderate evidence: Socioprofessional and psychological factors (employment status, amount of wages, workers' compensation, and depression) and physical factors (lifting time per day and work postures)	4/7

Table 1. Systematic reviews of prognostic factors for identifying patients more likely to develop chronic and disabling low back pain

Author, year	Number of included studies	Prognostic factors evaluated	Main results	Quality*
Hartvigsen, 2004[287]	22 studies of prognostic factors for low back pain	30 different psychosocial variables grouped into the categories: perception of work, organizational aspects of work, social support at work, and stress at work	Predictive factors for 'consequences' of low back pain Perception of work: 3 of 6 higher-quality studies reported moderate positive associations (OR range 1.20 to 1.95), 3 of 13 lower-quality studies reported moderate positive associations (OR range 1.53 to 1.87) (insufficient evidence) Organizational aspects of work: 0 of 4 higher-quality studies reported positive associations; 2 of 5 lower-quality studies reported moderate positive associations (OR range 1.40 to 1.79) (strong evidence for no association) Social support at work: 2 of 5 higher-quality studies reported strong positive associations (OR range 3.40 to 5.75); 0 of 4 lower-quality studies reported positive associations (moderate evidence for no association) Stress at work: 0 of 3 studies (1 higher-quality) reported a positive association) (moderate evidence for no association)	6/7
Kuijer, 2006[288]	17	Sociodemographic factors, lifestyle, medical history, pain, observed disability, self reported disability, health belief, physical work demands, psychological work demands, emotions, and expectations	Consistent evidence for patient expectations of recovery as a predictor for return to work. No other factors consistently predicted sickness absence or return to work.	4/7
Linton, 2000[289]	16 studies of prognostic factors for low back pain	Psychosocial factors (variously defined)	Acute or subacute pain (16 studies of LBP): 15 studies found a significant link between a psychological variable (including stress, family factors, coping, depression, avoidance, pain fear-avoidance, somatization, catastrophizing, hysteria) and outcome (Level A evidence)	3/7
McIntosh, 2000[290]	9	Pain measurements, functional status, age, gender, occupational and/or industry measures	Pain measurements predictive in 3 studies, functional status predictive in 1 study, age predictive in 5 studies, gender predictive in 5 studies (2 found females slower to recover, 1 found opposite results), occupational and/or industry measures (not defined) predictive in 5 studies (including delayed working seen in construction workers (3 studies), benefits predictive in 1 study,	4/7
Pengel, 2003[11]	6 studies of prognostic factors for low back pain	Vermont disability prediction questionnaire; other factors not reported	Vermont disability prediction questionnaire (1 methodologically strong study), score >0.48: Odds ratio for return to work at 3 months 76.3 (95% CI 9.6 to 604.9), positive likelihood ratio 5.7 (95% CI 3.9 to 8.5), negative likelihood ratio 0.07 (95% CI 0.01 to 0.50) Other prognostic factors (not specifically stated) (2 studies): Odds ratios ranged from 0.04 to 10.4	5/7

Table 1. Systematic reviews of prognostic factors for identifying patients more likely to develop chronic and disabling low back pain

Author, year	Number of included studies	Prognostic factors evaluated	Main results	Quality*
Pincus, 2002[291]	18	Psychological distress/depressed mood, somatization, personality, and cognitive factors	Distress (8 studies, 4 rated unacceptable): Defined as composite of psychological distress, depressive symptoms, or depressed mood. Predictor of unfavorable outcome, especially in primary care (OR: approx 3; 2 high, 2 acceptable quality studies). Somatization (4 studies, 2 rated unacceptable): 1 high and 1 acceptable quality study found somatization scales to predict unfavorable outcome. Cohen's effect size statistic (d) 0.2 to 0.6 at 1 year and 0.9 at 2 year follow-up. Personality (3 studies, 2 rated unacceptable): In 1 acceptable quality study, the hysteria subscale of the MMPI was reported to be a predictor of return to work (OR 1.5), but this was considered statistically unreliable. Cognitive factors (6 studies, 5 rated unacceptable): 1 acceptable quality study found subscales from the Coping Strategies Questionnaire predicted unfavorable outcome: effect size 1.09 for praying/hoping, 1.88 for catastrophizing. Fear avoidance not significant in 1 study when entered into multivariate model.	5/7
Pincus, 2006[292]	9	Fear, fear avoidance, catastrophizing	Fear avoidance: None of the studies that measured fear avoidance provided convincing evidence that fear-avoidance beliefs are a risk factor for poor outcomes; 6 of 9 studies failed to show a statistically significant association or only a week association.	4/7
Shaw, 2001[293]	22	Age, gender, work (occupation, employer size), injury, symptom (pain vs. function), clinician exam (range of motion, nonorganic signs), psychological (job satisfaction, pain beliefs)	Factors predicting disability Age (16 studies): 8 supporting studies, 8 non-supporting Gender (16 studies): 12 non-supporting studies, 3 studies found females had slower recovery, 1 study found males had slower recovery Marital status (5 studies): 3 non-supporting studies Work environment (worker perceptions of coworker cohesion, problems with coworkers, social isolation, 'trouble at work') (3 studies): 3 supporting studies Occupation/industry (9 studies): 6 supporting studies (4 of 6 studies found construction associated with longer disability compared to other 'blue-collar' workers) Physical demands (11 studies): 5 supporting studies found association with worker self-report (not objective measures) Tenure (6 studies): 2 supporting studies (newer employees) Greater work satisfaction (6 studies): 1 supporting study Salary (4 studies): 2 supporting studies Injury type (5 studies): 4 supporting studies Functional and overall clinical assessment (8 studies): 8 supporting studies, but substantial variation in types of functional tests related to prolonged worse absence. Consistent predictors of disability were Waddell nonorganic signs and other sham tests of pain (3 studies).	3/7

Table 1. Systematic reviews of prognostic factors for identifying patients more likely to develop chronic and disabling low back pain

Author, year	Number of included studies	Prognostic factors evaluated	Main results	Quality*
Steenstra, 2005[294]	14	69 different prognostic factors related to characteristics of current episode, workers' health, psychosocial factors, work characteristics, and work organization	Longer duration of sick leave associated with: radiating low back pain, higher disability levels, older age, female gender, more social dysfunction and isolation, heavier work, and higher compensation. Not associated with duration of sick leave: history of low back pain, job satisfaction, educational level, marital status, number of dependents, smoking, working more than 8 hour shifts, occupation, and size of industry or company.	6/7
Truchon, 2000[295]	18	Medical factors, ergonomic and psychosocial work-related factors, psychosocial factors not related to work, sociodemographic variables	"Promising" predictors of no return to work: previous history of low back pain, results of certain clinical tests, a subjective negative self-appraisal of ability to work, and job dissatisfaction.	2/7

*Using Oxman criteria, maximum score 7 on a 1 to 7 scale

Summary of evidence

- There is consistent evidence from multiple systematic reviews that psychological distress or depression, impaired function, job dissatisfaction, high levels of "fear avoidance" beliefs, disputed compensation claims, and somatization are associated with worse low back pain outcomes (level of evidence: good).
- Increased duration or severity of pain and presence of leg pain are modestly associated with poorer outcomes (level of evidence: fair).
- Physical exam findings were inconsistently associated with outcomes and are weaker predictors of unfavorable outcomes than psychosocial factors (level of evidence: fair).
- Evidence on validated tools or scales for identifying patients likely to have poorer outcomes is sparse, though one study found the Vermont disability questionnaire promising (level of evidence: poor).

Recommendations and findings from other guidelines

- The AHCPR guidelines recommend inquiring about psychological and socioeconomic problems, as nonphysical factors can complicate assessment and treatment (strength of evidence: C).
- The AHCPR guidelines found that social, economic, and psychological factors can significantly alter a patient's response to back symptoms and to treatment of those symptoms (strength of evidence: D).
- The VA/DoD, UK RCGP and European COST guidelines also recommend assessing psychological and socioeconomic factors and reviewing them if there is no improvement.

Key Question 1c

How effective is identification and treatment of yellow flags for improving clinical outcomes in patients with low back pain?

Results of search: systematic reviews
We found no systematic review on effects of interventions for identification and treatment of yellow flags in patients with acute or subacute low back pain. Although several systematic reviews evaluated interventions that addressed psychosocial issues in patients with subacute or mixed duration low back pain, identification and treatment of yellow flags was usually not the main goal of therapy or was included as part of an interdisciplinary biopsychosocial approach (see discussions of psychological, interdisciplinary, and functional restoration interventions in Key Question 4)[299-303].

Results of search: trials
We identified two higher-quality trials on brief interventions for identifying and treating yellow flags[304, 305]. A third, higher-quality trial evaluated an intensive, interdisciplinary intervention in patients identified as higher-risk for developing chronic back pain with disability[306]. Two other trials (one lower-quality[307]) evaluated efficacy of fear-avoidance based therapy[307, 308]. All trials were conducted in patients with acute or subacute low back pain. We excluded two trials of

cognitive-behavioral interventions in patients who perceived themselves to be at high risk for developing chronic problems because they included all types of spinal pain (neck, upper back, and lower back) and did not clearly specify duration of symptoms[309, 310].

Efficacy of interventions for identifying and treating yellow flags

Although several recent trials assessed interventions for identification and treatment of yellow flags in patients with low back pain, it is difficult to draw general conclusions about their effectiveness because of differences in the treatments (ranging from brief interventions administered by a primary care clinician to intensive, interdisciplinary interventions) and populations studied. Two higher-quality trials found brief interventions no more effective than standard practice or conventional physical therapy in patients with back pain of less than 12 weeks duration (Table 2)[304, 305]. One trial (n=314) found no differences through 12 months between usual care and a minimal (20 minute) intervention aimed at identifying, providing information about, and promoting self-care of psychosocial risk factors for any outcome including back-specific functional status (RDQ score), pain, sick leave, perceived general health (SF-36), or general practitioner visits[305]. The minimal intervention also failed to show a benefit in higher-risk subgroups of patients with increased baseline psychological distress or recurrent back pain. The second trial (n=402) found no differences on back-specific functional status (ODI score), pain, time off work, depression scores, use of health care resources, or satisfaction with care after either 3 or 12 months among patients randomized to a brief pain management program (aimed at identifying psychosocial risk factors, emphasizing return to normal activity through functional goal setting, and using educational strategies to overcome psychosocial barriers to recovery as well as a tailored exercise program) versus a physical therapy intervention (with an emphasis on spinal manipulation)[304] The number of physical therapy sessions was slightly lower with the brief intervention. All patients improved regardless of which treatment they were randomized to.

Table 2. Trials of brief interventions for identifying and treating yellow flags

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Hay, 2005[304]	n=402 12 months	**Brief pain intervention vs. manual physical therapy** (results at 12 months unless otherwise noted) ODI score, mean change from baseline: 7.8 vs. 8.1 at 3 months, p=0.755; 8.8 vs. 8.8 at 12 months, p=0.994 Overall assessment 'much better' or 'completely better' at 12 months: 68% vs. 69% Back pain (0 to 100 scale): 78 vs. 70, p=0.401 Took time off work in last 12 months: 54% vs. 58%, p=0.45 Satisfaction with treatment (0 to 100 scale), median: 93 vs. 93	7/9
Jellema, 2005[305]	n=314 12 months	**Minimal intervention vs. usual care** (results at 12 months unless otherwise noted) RDQ score (0 to 24 scale): 1 vs. 1, mean difference 0.25 (-0.77 to 1.28) No recovery (rated recovery as slightly improved, no change, slightly worse, much worse, or very much worse): 42/132 (32%) vs. 43/156 (28%), odds ratio 1.16 (0.63 to 2.17) Sick leave due to low back pain: 8/107 (8%) vs. 9/128 (7%), odds ratio 0.69 (0.43 to 1.13) Pain severity: mean difference 0.015 (-0.41 to 0.44)	6/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Several factors could explain the lack of an effect in these two trials. In one study, patients randomized to the minimal intervention were not permitted to receive physical therapy for the first six weeks[305]. In addition, general practitioners randomized to the minimal intervention arm were only moderately successful in identifying psychosocial factors, and were no more effective than practitioners randomized to usual care in improving outcomes measured by psychosocial scales[311]. It is possible that additional training or a more intense intervention could result in more effective treatment. In addition, targeting the intervention to high-risk patients could improve outcomes compared to treating a less selected group of patients[312]. These hypotheses are supported in part by a third, small (n=70), higher-quality trial which found a more intense (including three physician evaluations and a total of up to 45 physical therapy, biofeedback/pain management, group didactic, and case manager/occupational therapy sessions), interdisciplinary functional restoration intervention associated with improved pain and decreased disability after 12 months (Table 3) compared to usual care in patients with acute (<8 weeks) low back pain identified as being at higher risk for chronic disability using a screening tool[306].

Table 3. Trials of intensive multidisciplinary functional restoration in patients at higher risk for chronic disability

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Gatchel, 2003[306]	n=70 12 months	**Multidisciplinary functional restoration vs. usual care** Return to work at 12 months: 91% vs. 69% (p=0.027) Average number of healthcare visits: 26 vs. 29 (p=0.004) Average number of healthcare visits related to low back pain: 17 vs. 27, p=0.004 Average number of disability days due to back pain: 38 vs. 102, p=0.001 Average most “intense pain" at 12 month follow-up: 46 vs. 67, p=0.001 Average self-rated pain over last 3 months: 27 vs. 43, p=0.001 Taking opioid analgesics: 27% vs. 44%, p=0.020	6/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Two other trials evaluated interventions aimed at reducing fear avoidance behaviors (Table 4). In one lower-quality trial, 240 patients with persistent low back pain and activity limitations 8 to 10 weeks after the initial visit were randomized to four sessions of an individualized fear avoidance intervention with a psychologist and physical therapists versus usual care[307]. The fear avoidance intervention was superior for disability outcomes, with the proportion of patients experiencing a greater than one-third reduction in RDQ score: 28% vs. 13% at 2 months (p=0.0007) and 49% vs. 37% at 24 months (p=0.08). Average pain intensity was slightly better in patients randomized to the intervention after two months, though the difference was no longer significant at 24 months. There was no difference in SF-36 scores or ability to work, though a lower proportion of patients randomized to the fear avoidance intervention reported activity limitations due to back pain for 30 or more days after 24 months (8.5% vs. 14.3%, p=0.04). Patients randomized to the fear avoidance intervention also reported lower scores on fear-avoidance and worry rating scales. The second, smaller (n=67), higher-quality trial found no differences on the ODI scale or pain intensity after 6 months between low back pain (less than 8 weeks duration) patients randomized to fear avoidance-based physical therapy (encouraging patient to take an active role in treatment and to view back pain as common, along with a self-care booklet and graded exercise) and standard exercise[308]. The fear avoidance intervention was associated with lower fear avoidance beliefs in the subgroup of patients with high baseline fear avoidance scores.

Table 4. Trials of fear-avoidance based interventions

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
George, 2003[308]	n=67 6 months	**Fear avoidance exercise program vs. standard exercise** ODI score (0 to 100), mean change: 18.0 vs. 17.1 at 4 weeks (NS), 23.9 vs. 23.0 at 6 months (NS) Present pain intensity (0 to 10), mean change: 2.4 vs. 2.0 at 4 weeks (NS), 2.6 vs. 3.0 at 6 months (NS) Fear Avoidance Beliefs Questionnaire, Physical Activity Scale (0 to 24), mean change: 5.0 vs. 1.8 at 6 months, p=0.037 Fear Avoidance Beliefs Questionnaire, Work Scale (0 to 42), mean change: 3.1 vs. 1.9 at 6 months, p=0.352	7/9
Von Korff, 2005[307]	n=240 24 months	**Fear avoidance intervention vs. usual care** RDQ score (0 to 24): 10.2 vs. 11.5 at 2 months, p=0.0002; 8.1 vs. 9.1 at 24 months, p=0.0078 Proportion of patients with greater than one-third reduction in RDQ score: 28% vs. 13% at 2 months, p=0.0007; 49% vs. 37% at 24 months, p=0.08 Fear-avoidance (17-68): 36.4 vs. 39.9 at 2 months, p<0.0001; 34.3 vs. 38.4 at 24 months, p=0.0001 Average pain intensity (0 to 10): 4.9 vs. 5.3 at 2 months (p=0.020); 4.3 vs. 4.6 at 24 months (p=0.115) SF-36 social functioning and SF-36 mental health inventory: no differences Unable to work: No differences Unable to carry out usual activities due to back pain for 30 or more days: 24% vs. 26% at 2 months, p=0.06, 8.5% vs. 14.3% at 24 months, p=0.04	4/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Harms
No trial reported harms.

Costs
A cost-benefit analysis of the trial comparing an intensive, early multidisciplinary intervention in patients identified as higher risk for chronic disability calculated a net gain of $9,122, mostly related to a reduction in lost wages in the intervention group[306].

Summary of evidence

- In unselected patients with acute or subacute low back pain, two higher-quality trials found no benefits after 12 months from brief interventions designed to identify and treat yellow flags compared to usual care or physical therapy with an emphasis on manipulation or mobilization (level of evidence: good).
- In patients with back pain for less than 8 weeks identified as being at higher risk for chronic disability using a screening tool, one higher-quality trial found an intensive interdisciplinary functional restoration program more effective than usual care after 12 months (level of evidence: poor).

- In patients with persistent activity limitations due to low back pain, one lower-quality trial found fear-avoidance based therapy slightly superior to usual care for back specific functional status after 24 months, though beneficial effects on pain were only short-lived (level of evidence: poor).
- For subacute (<8 weeks) low back pain, one higher-quality trial found no difference between fear-avoidance therapy and standard physical therapy after 6 months, though fear-avoidance beliefs were decreased in the intervention group (level of evidence: fair).

Recommendations and findings of other guidelines

- No guidelines make recommendations about specific interventions in patients with acute or subacute low back pain identified as having yellow flags.

Key Questions 2a – 2d

Diagnostic testing

Because anatomic abnormalities of the spine are quite common in healthy persons, diagnostic imaging often identifies radiographic abnormalities that are only loosely associated with symptoms. In one systematic review of findings from plain radiography, degenerative changes (disc space narrowing, osteophytes, and sclerosis) were only modestly associated with low back pain (OR 1.2 to 3.3)[313]. Other findings, such as spondylolysis, spondylolisthesis, spina bifida, transitional vertebrae, spondylosis, and Scheuermann's disease also did not appear to be associated with symptoms. Another systematic review found advanced imaging methods (such as magnetic resonance imaging [MRI] or computed tomography [CT]) more likely to identify radiologic abnormalities in asymptomatic patients than plain radiography[268]. The proportion of asymptomatic patients with herniated disc on MRI, for example, ranged from 9% to 76%, degenerative disc from 46% to 93%, and stenosis from 1% to 21%. Greater use of advanced diagnostic imaging may therefore be associated with additional testing and interventions. For example, a significant proportion of the geographic variation in spinal surgery rates across the U.S. appears to correlate with differential rates of obtaining MRI[314]. On the other hand, patients and providers may be reassured by obtaining imaging tests, even if the findings don't necessarily alter management[315].

Key Question 2a

How accurate are different diagnostic tests for identifying serious underlying conditions (e.g., tumor, infection, compression fracture)?

Results of search: systematic reviews
We identified one recent systematic review that evaluated diagnostic accuracy of plain radiography, MRI, CT, or radionuclide scanning for identifying serious underlying conditions associated with low back pain[268]. We also identified one higher-quality systematic review on diagnostic accuracy of erythrocyte sedimentation rate testing in patients with low back pain[271]. We excluded four other systematic reviews because they were outdated[273, 316, 317] or reported duplicate information[275] from another systematic review[268].

Results of search: primary studies
The systematic review found numerous flaws in diagnostic studies, with the most common being failure to apply a single reference test to all patients, test review bias (study test was reviewed with knowledge of the final diagnosis), diagnosis review bias (determination of the final diagnosis was affected by the study test), and spectrum bias (only severe cases of disease were evaluated)[268]. Additional limitations of primary studies include heterogeneous populations, small sample sizes, and small numbers of studies. Estimates of diagnostic accuracy were therefore considered imprecise, and ranges rather than pooled estimates were reported. We did not search for additional primary studies.

Accuracy of imaging for diagnosing cancer

The accuracy of diagnostic imaging for diagnosing vertebral cancer is summarized in Table 5. Plain radiography was associated with lower sensitivity for metastatic cancer than MRI or radionuclide scanning (with planar imaging or single photon emission computed tomography [SPECT]), though it was associated with high specificity[268]. Magnetic resonance imaging and SPECT were associated with similar diagnostic accuracy. Planar imaging was less accurate than SPECT.

Table 5. Estimated accuracy of different imaging techniques for diagnosing cancer (ranges)

Technique	Sensitivity	Specificity	Positive likelihood ratio	Negative likelihood ratio
Plain radiography	0.6	0.95-0.995	12-120	0.40-0.42
MRI	0.83-0.93	0.90-0.97	8.3-31	0.07-0.19
Radionuclide scanning with planar imaging	0.74-0.98	0.64-0.81	3.9	0.32
SPECT	0.87-0.93	0.91-0.93	9.7	0.14

Source: Jarvik and Deyo, 2002[268]

Accuracy of imaging for diagnosing vertebral infection

For diagnosing vertebral infection, plain radiography was less accurate than MRI or radionuclide scanning (Table 6)[268]. MRI was more accurate than either plain radiography or radionuclide scanning.

Table 6. Estimated accuracy of different imaging techniques for diagnosing vertebral infection (ranges)

Technique	Sensitivity	Specificity	Positive likelihood ratio	Negative likelihood ratio
Plain radiography	0.82	0.57	1.9	0.32
MRI	0.96	0.92	12	0.04
Radionuclide scanning	0.90	0.78	4.1	0.13

Source: Jarvik and Deyo, 2002[268]

Accuracy of imaging for diagnosing vertebral compression fracture

For vertebral compression fracture, plain radiography appears sensitive, but its ability to distinguish acute from chronic fracture is poor, and asymptomatic fractures are frequently

identified[268]. Although radionuclide scanning is insensitive for diagnosing fractures, it can help distinguish recent from old fractures. MRI can also provide additional information about the acuity of compression fractures.

Accuracy of elevated erythrocyte sedimentation rate for diagnosing cancer

One systematic review[271] included one higher-quality study[266] that found an ESR ≥20 mm/hr associated with a sensitivity of 0.78 and specificity of 0.67 for diagnosing vertebral cancer.

Costs

A decision analysis found that for diagnosing cancer in patients with low back pain, a strategy of selectively imaging patients with a positive clinical finding (history of cancer, age ≥50 years, weight loss, or failure to improve with conservative therapy) in combination with either an elevated ESR (≥50 mm/hr) or a positive x-ray was associated with the best cost-effectiveness ratio ($5,283 per case found)[318]. Using a similar strategy but directly imaging patients with a history of cancer resulted in similar estimates of cost-effectiveness. A decision analysis of diagnostic strategies for excluding cancer found rapid MRI associated with an incremental cost-effectiveness of nearly $300,000/QALY relative to lumbar radiography[319].

Summary of evidence

- For diagnosing vertebral cancer, MRI and radionuclide scanning are more sensitive than plain radiography, though plain radiography is associated with high specificity (level of evidence: good).
- For diagnosing vertebral infection, MRI is more accurate than either lumbar radiography or radionuclide scanning (level of evidence: fair).
- For diagnosing vertebral compression fracture, lumbar radiography appears sensitive, but is unable to provide information about acuity (level of evidence: fair).
- For diagnosing vertebral cancer, an elevated erythrocyte sedimentation rate was associated with moderate sensitivity and specificity in one higher-quality study (level of evidence: fair).

Recommendations and findings from other guidelines

- The AHCPR guidelines state lumbar radiography in combination with CBC and ESR may be useful for ruling out tumor or infection in patients with acute low back problems when any of the following are present: prior cancer or recent infection, fever over 100 ºF, IV drug abuse, prolonged steroid use, low back pain worse with rest, or unexplained weight loss (strength of evidence: C).
- The AHCPR guidelines recommend prompt CT or MRI in the presence of red flags suggesting cauda equina syndrome or progressive motor weakness, preferably in consultation with a surgeon (level of evidence: C).
- The AHCPR guidelines recommend CT or MRI when clinical findings strongly suggest tumor, infection, fracture, or other space-occupying lesions of the spine (strength of evidence: C).

- The AHCPR guidelines state that in the presence of red flags, especially for tumor or infection, the use of other imaging studies such as bone scan, CT, or MRI may be clinically indicated even if lumbar radiography is negative (strength of evidence: C).
- The AHCPR guidelines recommend against CT-myelography and myelography because they are invasive and have an increased risk of complications, except in special situations for preoperative planning (strength of evidence: D).
- The European COST guidelines recommend MRI in patients with chronic low back pain with serious red flags.

Key Question 2b

How accurate are different diagnostic tests for identifying other conditions (e.g. nerve root compression, herniated disc, spinal stenosis) that may respond to specific therapies?

Results of search: systematic reviews
We identified the same systematic reviews described for Key Question 2a. In addition, we identified one other recent, higher-quality systematic review on diagnostic accuracy of imaging tests for spinal stenosis[269], one higher-quality systematic review on accuracy of thermography for diagnosing lumbar radiculopathy[320], and one lower-quality systematic review on accuracy of surface electromyogram[321]. Two other systematic reviews of surface electromyogram were excluded because they primarily evaluated whether the test could distinguish patients with low back pain from those without low back pain[322, 323]. Two outdated systematic reviews of imaging tests were also excluded[324, 325].

Results of search: trials
We did not search for additional trials

Accuracy of imaging for diagnosing nerve root compression, herniated disc, and spinal stenosis

Plain radiography cannot directly visualize intervertebral discs and is therefore insensitive for diagnosis of disc herniation[268]. Similarly, facet osteophytes or severe spondylolisthesis on plain radiography can suggest nerve root impingement, but additional imaging is required to confirm the diagnosis. Plain radiography is also unable to detect compromise of the vertebral canal caused by soft tissue.

One recent systematic review evaluated the accuracy of CT and MRI for diagnosis of herniated disc and spinal stenosis[268]. It found magnetic resonance imaging and computed tomography associated with similar accuracy for diagnosing either condition (Table 7). Another recent systematic review reached similar conclusions[269]. However, MRI is not associated with ionizing radiation and provides better visualization of soft tissues, vertebral marrow, and the spinal canal.

Table 7. Estimated accuracy of different imaging techniques for diagnosing disc herniation and spinal stenosis (ranges reported)

Technique	Sensitivity	Specificity	Positive likelihood ratio	Negative likelihood ratio
Herniated disc				
MRI	0.6-1.0	0.43-0.97	1.1-33	0-0.93
CT	0.62-0.9	0.7-0.87	2.1-6.9	0.11-0.54
Spinal stenosis				
MRI	0.9	0.72-1.0	3.2-not defined	0.10-0.14
CT	0.9	0.8-0.96	4.5-22	0.10-0.22

Source: Jarvik and Deyo, 2002[268]

Accuracy of imaging for diagnosing ankylosing spondylitis

Evidence on diagnostic accuracy of different imaging methods for diagnosis of ankylosing spondylitis is sparse. In addition, interpretation of available evidence is difficult because new criteria for diagnosis of early disease prior to the development of radiographic findings of sacroiliitis have only recently been proposed[277].

One systematic review found plain radiography associated with a sensitivity of 0.26 to 0.45 and specificity of 1 for diagnosis of ankylosing spondylitis, but spectrum bias could have resulted in overestimates of accuracy[268]. Radionuclide scanning with planar imaging was associated with low sensitivity but high specificity in two studies (sensitivity 0.25 and 0.26, specificity 0.95 to 1.0)[326, 327]. In one other study, SPECT increased sensitivity to 0.85 but decreased specificity to 0.90[326]. MRI was associated with a sensitivity of 0.45 for diagnosis of ankylosing spondylitis in one study, but specificity could not be calculated[327].

Diagnostic accuracy of other (non-imaging) tests

One higher-quality systematic review found an elevated ESR associated with a sensitivity of 0.69 and specificity of 0.68 for diagnosis of ankylosing spondylitis in patients suspected of having the disease[271]. Although the HLA-B27 antigen is present in approximately 90% of persons of western European ancestry who have ankylosing spondylitis, both the prevalence of HLA-B27 and the strength of its association with ankylosing spondylitis vary substantially in different ethnic groups[328].

A systematic review on diagnostic accuracy of thermography found major methodological flaws, inconsistent results, and no clear evidence supporting its use in diagnosis of radiculopathy[320]. Another systematic review found inconclusive and inadequate evidence to support the use of surface electromyography for diagnostic evaluation of low back pain[321]. Though electrophysiologic testing is often used when imaging and clinical exam findings are discordant or the diagnosis of radiculopathy or spinal stenosis is uncertain, we found no systematic reviews on its diagnostic accuracy[329].

Summary of evidence

- For diagnosis of herniated disc or spinal stenosis, MRI and CT scan are associated with similar diagnostic accuracy. However, MRI is associated with no ionizing radiation and

permits better visualization of soft tissues, vertebral marrow, and the spinal canal (level of evidence: good).

- For diagnosis of ankylosing spondylitis, evidence on diagnostic accuracy of different imaging methods (including MRI) is sparse. Plain radiography may have high specificity, but higher-quality studies are needed. Estimates of diagnostic accuracy are likely to be affected by adoption of recently proposed criteria for diagnosis of early ankylosing spondylitis (prior to the development of radiographic evidence of sacroiliitis) (level of evidence: fair).
- For diagnosis of ankylosing spondylitis in patients suspected of having the disease, an elevated ESR was associated with moderate sensitivity and specificity. In persons of western European ancestry, the HLA-B27 antigen is associated with a sensitivity of about 90% (level of evidence: fair).
- There is no evidence supporting the use of thermography or surface electromyography for diagnosis of low back pain (level of evidence: fair).
- For diagnosis of radiculopathy or spinal stenosis, we found no systematic reviews evaluating diagnostic accuracy of electrophysiologic testing.

Recommendations and findings of other guidelines

- The AHCPR guidelines recommend against thermography for assessing acute low back problems (strength of evidence: C).
- The AHCPR guidelines recommend against electrophysiologic testing when the diagnosis of radiculopathy is obvious and specific on clinical examination (strength of evidence: D).
- The AHCPR guidelines recommend against surface electromyogram (EMG) and F-wave tests in patients with acute low back symptoms (strength of evidence: C).
- The AHCPR guidelines found needle EMG and H-reflex tests of the lower limb may be useful in assessing questionable nerve root dysfunction in patients with leg symptoms for longer than 4 weeks (regardless of presence of back pain) (strength of evidence: C).
- The AHCPR guidelines found that sensory evoked potentials (SEPs) may be useful in assessing suspected spinal stenosis and spinal cord myelopathy (strength of evidence: C).
- The VA/DoD recommendations for diagnostic imaging are essentially identical to the AHCPR recommendations.
- The European COST guidelines do not recommend EMG for evaluating chronic nonspecific low back pain.
- The European COST guidelines recommend MRI for evaluation of radicular symptoms, and plain radiography for evaluation of structural deformities. They recommend against MRI or CT for the diagnosis of facet joint pain.

Key Question 2c

In patients with red flags, how effective are different diagnostic tests for improving patient outcomes?

Results of search: systematic reviews
We found no systematic reviews addressing this question.

Results of search: trials
No trials are available.

Efficacy of diagnostic testing in patients with red flags

We found no studies that compared outcomes associated with use of different diagnostic tests in patients with low back pain and associated cancer, vertebral infection, or cauda equina syndrome. All guidelines recommend prompt and appropriate work-up (including advanced imaging techniques) and management of patients strongly suspected of having these conditions or with a history of significant vertebral trauma, because delayed diagnosis and treatment can be associated with poorer outcomes[24, 34, 35, 39].

Summary of evidence

- There is no direct evidence on use of different diagnostic tests in patients with worrisome red flags, though all guidelines recommend prompt and appropriate work-up (including advanced imaging) because delayed diagnosis and treatment can be associated with poorer outcomes.

Recommendations and findings of other guidelines

- The AHCPR, VA/DoD, UK RCGP, and European COST guidelines all recommend prompt work-up and immediate action in patients with low back pain suspected of having a red flag condition.
- The European COST guidelines recommend MRI in patients with chronic low back pain with serious red flags.

Key Question 2d

In patients without red flags, how effective are different diagnostic tests or test strategies (including no testing) for improving patient outcomes?

Results of search: systematic reviews
We found no systematic reviews addressing this question.

Results of search: trials
From 430 potentially relevant citations, we identified four randomized controlled trials on routine lumbar radiography versus clinical care without routine imaging in patients without red flags who present for initial evaluation of low back pain[330-333]. Routine lumbar radiography was compared to usual care in three trials (two higher-quality[332, 333] and one lower-quality[331]) and to a brief educational intervention in one higher-quality trial[330]. Four other trials evaluated different strategies for using MRI in patients with low back pain. One higher-quality trial (n=782)

compared early routine versus delayed selective MRI or CT in patients presenting to surgical clinics for evaluation of low back pain[334]. A higher-quality trial performed MRI in all patients, and compared outcomes when MRI findings were routinely provided to clinicians and patients versus disclosure only if clinically indicated[335, 336]. Two higher-quality trials (conducted by the same investigators and using the same study design) evaluated effects of rapid MRI versus plain radiography in patients with low back pain in whom imaging was clinically felt appropriate[337, 338].

Efficacy of routine, early plain radiography versus usual care or imaging only if clinically necessary (or without improvement)

For acute[330], acute or subacute[331], subacute or chronic[332], or back pain of unspecified duration[333], routine lumbar radiography in patients without red flags was not associated with improved patient functioning, time off work, severity of pain, or overall health status in any of the trials (Table 8). One higher-quality trial (n=153) found routine lumbar radiography slightly superior to usual care for psychological well-being[333]. Another large (n=421), higher-quality trial found routine radiography associated with increased physician visits in the 3 months after imaging and a trend towards a higher likelihood of pain at six months, but also increased patient satisfaction, though differences were small[332]. Results of a third, higher-quality trial found routine lumbar radiography was not associated with increased anxiety, dissatisfaction, dysfunction or differences in subsequent clinical treatments compared to a brief educational intervention and no routine imaging[330]. No serious missed diagnoses were identified in any patient enrolled in the three trials that recorded low-back pain diagnoses based on clinical follow-up through at least 6 months of follow-up[330, 332, 333].

Table 8. Trials of early plain radiography versus imaging only if clinically necessary

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Deyo, 1987[330]	n=101 3 months	**Routine plain radiography vs. selective imaging + brief educational intervention** Sickness Impact Profile (0 to 100, higher indicating worse function): 16.6 vs. 13.6 at 3 weeks (NS), 12.3 vs. 10.3 at 3 months (NS) Days of work absenteeism: 4.1 vs. 4.4 at 3 weeks (NS) Additional days of work loss: 0.28 vs. 0.05 at 3 months (NS) Self-rated improvement (1 to 6 scale): 2.7 vs. 2.7 at 3 weeks, 2.6 vs. 2.6 at 3 months Duration of pain: 9.4 vs. 10.8 days at 3 weeks (NS), 13.3 vs. 18.4 additional days of pain at 3 months (NS) Total physician visits: 1.07 vs. 0.42 at 3 months Overall satisfaction score (9 to 27 scale): 23.7 vs. 24.0 No differences for other measures of patient perceptions and attitudes (including worry that pain is due to serious illness)	5/8
Djais, 2005[331]	n=101 3 weeks	**Routine plain radiography vs. usual care (median values, 3 week outcomes)** RDQ: 6.5 vs. 4.5 (p=0.21) VAS pain score: 4 vs. 3 (p=0.07) EQ-5D: 0.63 vs. 0.74 (p=0.15) Health status scale: 70 vs. 80 (p=0.02) Pain "much improved": 25.5% vs. 40.0% (p=0.11)	2/8
Kendrick, 2001[332]	n=421 9 month	**Routine plain radiography vs. usual care (9 month data)** Still has pain at 6 months: 65% vs. 57% (p=0.11) Taken time off work: 13% vs. 13% (p=0.87) Median days off work: 11.5 vs. 8.5 (p=0.84) Median RDQ score: 3 vs. 2 (p=0.06) Median pain score: 1 vs. 1 (p=0.17) Median health status score: 80 vs. 80 (p=0.30) Median satisfaction with consultation: 21 vs. 19 (p<0.01, favors routine radiography) ≥3 visits to doctor: 5% vs. 5% Visited provider within 3 months: 53% vs. 30% (RR 1.62, 95% CI 1.33 to 1.97)	6/8
Kerry, 2002[333]	n=153 1 year	**Routine plain radiography vs. usual care (1 year data)** SF-36, adjusted difference (not referred - referred): no subscale significant except for mental health -8, p<0.05 EuroQol, adjusted difference: 1 (NS) RDQ score (0 to 24), adjusted difference: -0.3 (NS) Consulted for back pain 6 weeks to 1 year: 32% vs. 39%, AOR 0.7 (0.3 to 1.4) Referred to other health professional 6 weeks to 1 year: 45% vs. 46%, AOR 1.1 (0.5 to 2.3) Very satisfied at 6 weeks: 33% vs. 28%, AOR 1.3 (0.6 to 3.0) Days off work, 0-12 months: 8.46 vs. 6.16 GP consultations: 1.6 vs. 1.1, p=0.06 Other consultations: 5.9 vs. 2.9, p=0.003	4/8

*Excludes criteria involving blinding of patients and providers and similarity of co-interventions, for maximum score of 8

Efficacy of routine MRI versus MRI only if clinically necessary (or without improvement)

One higher-quality trial (n=782) found that in patients with low back pain of varying duration (40% with symptoms for >1 year) referred to surgeons with uncertain need for advanced imaging, routine early MRI or CT was associated with statistically significant but small differences in the Aberdeen Low Back Pain Score, SF-36 Bodily Pain Scale, and Euro-Qol after 8 and 24 months relative to delayed, selective imaging (Table 9)[334]. Effects on pain averaged about 3 points on 0 to100 scales. There were no differences in the proportion of patients who underwent surgery or received injections, or on other measures of health care use. A higher-quality trial that obtained MRI in all patients with acute low back pain or radiculopathy found routine disclosure of MRI findings to patients and physicians was not associated with greater improvements in RDQ function scores compared to not disclosing MRI results unless clinically necessary[335, 336]. There were also no differences on any of the SF-36 subscales other than general health, which favored the no routine disclosure arm (6.0 vs. 4.2 point improvement at 6 weeks, p=0.008).

Table 9. Trials of early MRI versus imaging only if clinically necessary

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Gilbert, 2004[334]	n=782 2 years	**Early imaging (90% had MRI or CT) vs. delayed (30% had MRI or CT)** (24 month data) Subsequent outpatient appointment: 84% vs. 68%, p<0.001 Total number of consultations: 1.91 vs. 1.88 (NS) Hospital admissions: 7.9% vs. 6.7% (NS) Surgical operation: 6.9% vs. 5.1% (NS) Injections: 17.8% vs. 19.3 % (NS) Aberdeen Low Back Pain score (0 to 100 scale), adjusted mean difference: -3.62, p=0.002 EQ-5D score (-0.59 to +1 scale), adjusted mean difference: 0.057, p=0.01 SF-36, bodily pain (0 to 100 scale), adjusted mean difference: 5.14, p=0.004 No differences on other SF-36 subscales	6/8
Modic, 2005[335, 336]	n=246 6 weeks	**Unblinded vs. blinded MR results** >50% improvement in RDQ function: 60% vs. 67% (p=0.397) Proportion 'satisfied' with condition: 23% vs. 31% (p=0.207) Self-efficacy, fear-avoidance beliefs, and SF-36: similar between arms except for general health subscale of SF-36, mean improvement 4.2 vs. 6.0 at 6 weeks (p=0.008)	4/8

*Excludes criteria involving blinding of patients and providers and similarity of co-interventions, for maximum score of 8

Efficacy of rapid MRI versus lumbar radiography in patients with low back pain referred for imaging

In the larger (n=380) of two higher-quality trials comparing rapid MRI to lumbar radiography in patients with low back pain referred for imaging (duration of symptoms not specified), there was no difference in any outcomes including functional status, pain intensity, or rate of spinal surgery (Table 10)[337]. There was a trend towards increased lumbar spine operations in the rapid MRI

group (risk difference=0.34, 95% CI -0.06 to 0.73). The smaller (n=62) trial (conducted by the same investigators) did not assess rates of lumbar spine operations, but otherwise reported similar findings[338].

Table 10. Trials of rapid MRI versus lumbar radiography in patients referred for imaging

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Jarvik, 1997[338]	n=62 3 months	**Rapid MRI vs. lumbar radiography (3 month data)** Modified RDQ score: 12.5 vs. 12.1 (p=0.40) SF-36: No differences Pain bothersomeness (0 to 24): 9.7 vs. 10.0 (p=0.79) Pain frequency (0 to 24): 10.1 vs. 9.9 (p=0.35) Disability days: No differences for number of home days, limited activity days, or bed days Patient satisfaction: Only differences among 12 questions about patient satisfaction were proportion who thought clinicians were concerned (75% vs. 100%, p=0.01) and proportion who felt reassured (72% vs. 37%, p=0.03) Proportion of patients referred to back specialists: 32% vs. 36%	5/8
Jarvik, 2003[337]	n=380 6 weeks	**Rapid MRI vs. lumbar radiography** RDQ Scale score, adjusted (12 month): 9.34 vs. 8.75 (NS) (score better for MRI at 3 months) SF-36: No differences at 12 months for bodily pain, physical functioning, role-physical Pain-bothersomeness: 9.68 vs. 9.75, NS Pain-frequency: 10.09 vs. 10.21, NS Lost work, days past 4 weeks: 1.57 vs. 1.26, NS Patient satisfaction: 7.04 vs. 7.34, NS Patient reassurance score: 3.18 vs. 2.50, p<0.05 favoring MRI Proportion reporting reassurance from imaging: 74% vs. 58% (p=0.002) Lumbar spine surgery: 6% vs. 2% (risk difference=0.34, 95% CI -0.06 to +0.73)	7/8

*Excludes criteria involving blinding of patients and providers and similarity of co-interventions, for maximum score of 8

Costs

Several recent RCTs of routine versus selective imaging also conducted cost-effectiveness analysis. In one trial,[332] the cost-effectiveness of routine lumbar radiography was estimated at £20 (equivalent to about $39 U.S. in January 2007) per additional point on a patient satisfaction scale (scored between 9 and 27), the only outcome for which there was a difference in efficacy[339]. The increased cost was mostly related to direct costs associated with the imaging procedure itself. In another trial, early MRI or CT imaging was associated with a mean of 0.041 additional QALY during 24 months compared to selective MRI or CT, with an incremental cost-effectiveness of $2,124/QALY[334]. An older decision analysis found that costs associated with routine lumbar radiography in patients with acute low back pain did not appear to justify the small benefits ($2,072 to avert one day of physical suffering)[340]. Finally, rapid MRI imaging was associated with additional costs of about $300 relative to lumbar radiography in patients with

low back pain referred for imaging, with nearly identical clinical outcomes (essentially a cost-minimization analysis)[337].

Summary of evidence

- For acute low back pain, the combination of delayed selective imaging with a brief educational intervention was not associated with differences in any outcomes relative to routine lumbar radiography, including patient satisfaction and psychological distress (one higher-quality trial) (level of evidence: fair).
- For acute or subacute back pain (one lower-quality trial), subacute or chronic back pain (one higher-quality trial) and back pain of unspecified duration (one higher-quality trial), routine lumbar radiography did not improve outcomes including pain and functional status, though small beneficial effects on patient satisfaction and psychological well-being were present in two trials (level of evidence: good).
- No serious missed diagnosis was identified in any patient enrolled in trials of routine lumbar radiography versus clinical care without routine imaging after at least 6 months of follow-up (level of evidence: fair).
- For back pain of varying duration, routine MRI was associated with only small benefits on pain and functional status outcomes compared to selective MRI in one higher-quality trial. For acute low back pain, one higher-quality trial found that in patients who underwent MRI, knowledge of imaging results was not associated with improved outcomes compared to non-disclosure unless clinically necessary (level of evidence: fair).
- In patients for whom imaging was felt to be indicated (duration of symptoms not specified), two higher-quality trials found rapid MRI associated with no significant benefits compared to plain radiography, and a trend towards increased surgeries in one of the trials (level of evidence: good).

Recommendations and findings from other guidelines

- The AHCPR guidelines recommend against lumbar radiography for routine evaluation of patients with acute low back problems within the first month of symptoms, unless a red flag is noted on clinical examination (strength of evidence: B).
- The AHCPR guidelines state that in patients without red flags, after 1 month of symptoms, an imaging test is acceptable when surgery is being considered (or to rule out a suspected serious condition) (strength of evidence: B).
- The UK RCGP guidelines recommend avoidance of unnecessary or repeated imaging, noting that lumbar spine radiography results in 150 times the gonadal radiation exposure of chest radiography in women (strength of evidence: ***).
- The European COST guidelines recommend against routine diagnostic imaging for acute or chronic nonspecific low back pain.

Key Question 3

How effective are self-care advice, education, or other self-care interventions for improving patient outcomes?

Goals of patient education and patient self-care methods for low back pain are to reduce fear of normal activity, encourage exercise, and promote self-management of pain. A range of interventions have been defined as self-care for low back pain, including individual consultation with a professional or team of professionals, group treatment and/or education by professionals or trained lay leaders, group exercise classes, mini-back school and other approaches. For this report, we defined self-care advice and education as individual or group educational sessions that involve two sessions or fewer with a professional in a routine clinic visit and provides advice that is readily implemented independently by patients. We also included self-care groups led by trained or untrained non-medical lay persons. We defined self-care interventions as interventions that could be readily implemented by patients without seeing a health provider (lumbar supports, application of superficial heat or cold, use of different types of mattresses).

Self-care advice or education

Advice to rest in bed

Search results: systematic reviews
We identified a higher-quality Cochrane review (11 trials) on advice to rest in bed in patients with low back pain[64, 65]. We excluded an earlier version of the Cochrane review[341] and seven other outdated systematic reviews[193, 342-347].

Search results: trials
The Cochrane review included 11 trials of advice to rest in bed[64, 65]. Eight trials were rated higher-quality. All trials evaluated patients with acute low back pain, except for one trial of bed rest versus epidural anesthesia in patients with subacute or chronic sciatica[348]. Six trials compared advice to rest in bed versus advice to remain active, four versus exercise, two versus other interventions, and two compared different durations of bed rest. We did not search for additional trials.

Efficacy of advice to rest in bed versus advice to remain active

For acute non-specific low back pain, the Cochrane review included two-higher quality trials[349, 350] that found advice to rest in bed associated with slightly inferior outcomes compared to advice to remain active for pain intensity (SMD=0.22, 95% CI 0.02 to 0.41 at 3 to 4 weeks and SMD=0.25, 95% CI 0.05 to 0.45 at 12 weeks) and functional status (SMD=0.29, 95% CI 0.09 to 0.49 at 3 to 4 weeks and SMD=0.24, 95% CI 0.04 to 0.44 at 12 weeks)[64, 65]. Differences were roughly equivalent to 5 to 7.5 points on a 100 point VAS pain scale and 1.2 to 1.8 points on the RDQ. Both trials also found advice to stay active superior to advice to rest in bed for sick leave and one trial[349] found no difference in satisfaction with care or costs.

For low back pain with sciatica, the Cochrane review included two higher-quality trials that found little or no difference between advice to rest in bed and advice to stay active for pain intensity, functional status, or sick leave[351, 352].

The Cochrane review excluded two lower-quality trials from pooled analyses because of low internal validity[353, 354]. In addition, one of the trials (n=80) evaluated army combat trainees and may not be applicable to patients encountered in routine practice[353]. It found bed rest superior to remaining ambulatory with restricted duties for rate of recovery, pain and days off work. The other trial found no statistically significant difference between advice to rest in bed and advice to remain active in family practice clinic patients with acute low back pain, though trends in rate of recovery and disability favored advice to remain active[354].

Efficacy of advice to rest in bed versus other interventions

For acute non-specific low back pain, the Cochrane review[64, 65] included two higher-quality trials that found no significant differences in pain intensity or functional status between advice to rest in bed and exercise therapy[349, 355]. A third, lower-quality trial found no difference on a combined pain, disability, and physical exam score between bed rest and manipulation, drug therapy, physiotherapy, back school, or placebo[356]. Another lower-quality trial found bed rest inferior to epidural anesthesia for time to recovery (31 versus 11 days, $p<0.001$)[348].

For back pain with sciatica, one higher-quality trial included in the Cochrane review[64, 65] found physiotherapy (activity advice, mobilization, hydrotherapy, and disc unloading and loading exercises) slightly superior (WMD=6.9 points on a 0 to 100 scale) to advice to rest in bed for functional status at four weeks, though the difference was no longer significant at 12 weeks[351]. There were no differences in pain intensity.

Efficacy of different durations of bed rest

For acute[357] or mixed duration[358] low back pain, the Cochrane review[64, 65] included two higher-quality trials that found advice for shorter duration of bed rest (2 or 3 days) associated with similar effects on pain intensity compared to advice for longer duration of bed rest (7 days). One of the trials found advice for shorter bed rest associated with fewer days off work (mean 3.1 days) compared to advice for longer bed rest (mean 5.6 days) after 3 weeks, with benefits persisting through 12 weeks[358]. Only one-quarter of patients assigned to 7 days of bed rest actually rested for 7 days, which may have attenuated differences between advice for shorter versus longer durations of bed rest.

Harms

One trial reported one case of pulmonary embolus in patients assigned to bed rest[351].

Costs

One trial found no significant differences in costs of health care and home help between advice for bed rest and either exercise or usual activities (usual activities associated with more rapid recovery in this trial)[349].

Summary of evidence

- For acute non-specific low back pain, advice to rest in bed was consistently associated with slightly inferior pain and functional status compared to advice to remain active in two higher-quality trials (level of evidence: good).

- For acute non-specific low back pain, advice to rest in bed was associated with similar outcomes compared to exercise programs in three trials (two higher-quality) (level of evidence: good).
- For acute non-specific low back pain, there is insufficient evidence (one lower-quality trial) to accurately judge efficacy of advice to rest in bed compared to interventions other than exercise (level of evidence: poor).
- For back pain with sciatica, one higher-quality trial found no difference between advice to rest in bed and advice to remain active, and advice to rest in bed was associated with slightly inferior functional status at 3 weeks compared to a combined physiotherapy intervention, though this difference was no longer present after 12 weeks (level of evidence: good).
- Advice for seven days of bed rest was not associated with better pain outcomes compared to advice for two to three of bed rest in two higher-quality trials, and increased the number of days off work in one of these trials (level of evidence: fair).
- There is no evidence to judge efficacy of advice to rest in bed in patients with chronic low back pain.

Recommendations and findings from other guidelines

- The AHCPR guidelines found that a gradual return to normal activities is more effective than prolonged bed rest for treating acute low back problems (strength of evidence: B).
- The AHCPR guidelines found that prolonged bed rest for more than 4 days may lead to debilitation and is not recommended for treating acute low back problems (strength of evidence: B).
- The AHCPR guidelines found that the majority of low back patients will not require bed rest, though bed rest for 2 to 4 days may be an option for patients with severe initial symptoms of primarily leg pain (strength of evidence: D).
- The VA/DoD and UK RCGP guidelines are similar to the AHCPR guidelines, but found stronger evidence that bed rest for 2-7 days is inferior to placebo or ordinary activity (strength of evidence: A and ***, respectively).
- The European COST Guidelines recommend against prescribing bed rest for acute nonspecific low back pain.

Advice to remain active

For this section, we included studies of advice to remain active (maintaining usual activities as much as possible) or advice on exercises provided in a typical clinic visit or a clinic session lasting less than one hour. Advice and education that require more than an hour-long clinic session are reviewed in the section on brief educational interventions (Key Question 4).

Search results: systematic reviews
We identified one higher-quality Cochrane review on efficacy of advice to remain active[359, 360]. Another higher-quality Cochrane review on advice to rest in bed[64, 65] included two additional trials (both higher-quality) that compared advice to remain active with bed rest[350, 351].

Search results: trials
A total of 6 trials on advice to remain active were included in the two systematic reviews[64, 65, 359, 360]. Five were rated higher-quality[349-352, 354]. All six trials compared advice to remain active to advice to rest in bed for acute low back pain. Two trials also compared advice to remain active to formal exercise therapy[349, 351]. We identified four additional trials not included in the systematic review. One higher-quality trial evaluated advice to stay active versus a combined physical therapy intervention[361], one higher-quality trial evaluated advice to remain active, exercise, or both versus sham therapies[362], one lower-quality trial evaluated exercise advice versus usual care or a self-care book[363], and one lower-quality trial evaluated exercise advice versus supervised McKenzie exercise[364, 365].

Efficacy of advice to remain active versus advice to rest in bed
Results of trials that compared advice to stay active with advice to rest in bed are discussed in the section on advice to rest in bed.

Efficacy of advice to remain active versus other interventions
For acute non-specific low back pain, the Cochrane review included one higher-quality trial[349] that found advice to remain active associated with similar improvements in pain intensity compared to a formal exercise program[359, 360]. Short-term functional status (ODI) initially slightly favored advice to stay active (WMD=-8.6, 95% CI -13.9 to -3.3), but differences were no longer present after 3 weeks. Average length of sick leave was lower in the advice to remain active group, but differences were not statistically significant. One lower-quality trial not included in the Cochrane review found a single back education session with advice to remain active (45 minutes) associated with slower return from sick leave (22 vs.12 days, $p<0.001$) and more back pain recurrences through five years compared to supervised McKenzie exercise (Table 11)[364, 365].

For subacute non-specific low back pain, a higher-quality trial not included in the Cochrane review found no clear differences between physiotherapist-provided advice to remain active and supervised exercise therapy (including aerobic exercise, stretches, functional activities, strength, speed, coordination, and endurance training) (Table 11)[362]. At 6 weeks, advice to remain active was slightly superior to sham advice for pain, the patient specific functional scale, and global perceived effect, and exercise was slightly superior to sham ultrasound plus diathermy on the same three outcomes. However, benefits with either intervention were no longer statistically significant by 12 months. Neither intervention was more effective than sham therapies on the RDQ or the Depression Anxiety Stress Scale at any assessment.

For nonspecific back pain of more than 6 weeks' duration, a higher-quality trial not included in the Cochrane review found no differences between advice to remain active and a physical

therapy intervention (consisting of any combination of stretching, spinal mobility, and strengthening exercises, manipulation and/or mobilization, superficial heat or cold, and advice) on pain or functional status through 12 months, though perceived benefit was greater in the physical therapy group (Table 11)[361].

For acute sciatica, one higher-quality trial found no differences in pain or functional status between advice to stay active and physical therapy (consisting of advice, mobilization, disc unloading and loading exercises, and hydrotherapy) through 6 months follow-up (Table 11)[351].

Table 11. Trials of advice to remain active vs. exercise therapy not included in Cochrane review

Author, year Type of LBP	Number of patients Duration of follow-up	Main results	Quality score*
Frost 2004[361] Nonspecific low back pain	n=286 12 months	**Advice to remain active vs. 'standard' physical therapy (any combination of exercises, mobilization and/or mobilization, superficial heat or cold, and advice)** ODI (0 to 100 scale), mean change: -1.33 vs. -2.65 at 2 months, -2.23 vs. -3.27 at 12 months (NS) RDQ (0 to 24 scale), mean change: -0.56 vs. -1.13 at 2 months, -0.99 vs. -1.36 at 12 months (NS) SF-36: No significant differences Perceived benefit (proportion reporting 'yes'): 60% vs. 77% at 2 months (p=0.002), 50% vs. 65% at 6 months (p=0.007) Perceived benefit (0 to 10 scale): 3.66 vs. 5.42 at 2 months (p<0.001); 4.13 vs. 5.02 at 12 months (p=0.011)	7/9
Pengel, 2007[362] Nonspecific low back pain	n=259 12 months	**Advice versus sham advice (mean change reported for all results)** Pain (0 to 10 scale): -0.7 (95% CI -1.2 to -0.2) at 6 weeks, -0.4 (95% CI -1.0 to +0.3) at 12 months Patient-specific functional scale (0 to 10 scale): +0.7 (95% CI +0.1 to +1.3) at 6 weeks, +0.6 (95% CI +0.1 to +1.2) at 12 months Global perceived effect (-5 to +5 scale): +0.8 (95% CI +0.3 to +1.2) at 6 weeks, +0.3 (95% CI -0.2 to +0.9) at 12 months RDQ (0 to 24 scale): -0.5 (95% CI -1.6 to +0.5) at 6 weeks, -0.6 (95% CI -1.9 to +0.6) at 12 months Depression Anxiety Stress Scale (0 to 42 scale): +0.8 (95% CI -1.0 to +2.7) at 6 weeks, +0.3 (95% CI -1.7 to +2.2) at 12 months **Exercise versus sham ultrasound plus sham diathermy (mean change reported for all results)** Pain: -0.8 (95% CI -1.3 to -0.3) at 6 weeks, -0.5 (95% CI -1.1 to +0.2) at 12 months Patient-specific functional scale: +0.4 (95% CI -0.2 to +1.0) at 6 weeks, +0.5 (95% CI -0.1 to +1.0) at 12 months Global perceived effect: +0.5 (95% CI +0.1 to +1.0) at 6 weeks, +0.4 (95% CI -0.1 to +1.0) at 12 months RDQ: -0.8 (95% CI -1.8 to +0.3) at 6 weeks, -0.3 (95% CI -1.6 to +0.9) at 12 months Depression Anxiety Stress Scale: -0.7 (95% CI -2.5 to +1.2) at 6 weeks, -0.6 (95% CI -2.6 to +1.3) at 12 months	8/9

Table 11. Trials of advice to remain active vs. exercise therapy not included in Cochrane review

Author, year Type of LBP	Number of patients Duration of follow-up	Main results	Quality score*
Stankovic, 1990, 1995[364, 365] Nonspecific low back pain	n=100 5 years	**Advice to remain active vs. McKenzie exercise** Mean duration of sick leave: 22 vs. 12 days (p<0.001) Pain: decreased in exercise group (p<0.001), data not reported Recurrences: 74% (37/50) vs. 44% (22/50) after 1 year; 88% (37/42) vs. 64% (30/47) between 1 and 5 years (p<0.01) Sick leave between 1 and 5 years: 74% (31/42) vs. 51% (24/47) (p<0.03)	3/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Efficacy of exercise advice versus usual care or a self-care book

For low back pain present less than 3 months, one lower-quality trial not included in the Cochrane review found advice for regular exercise superior to usual care for pain and function after one week (Table 12)[363]. Differences were no longer present after three weeks, when most patients in both groups reported resolved pain. Advice to exercise also improved patient satisfaction compared to usual care (p=0.03). There were no differences between advice to exercise and a self-care book. Adding a self-care education book to exercise advice also did not improve outcomes compared to either intervention alone.

Table 12. Trial of exercise advice vs. self-care book vs. usual care

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Little 2001[363]	n=311 3 weeks	**Self-care book vs. exercise advice vs. both vs. neither (control) (mean changes versus control)** Pain/function scale (0 to 100): -8.7 vs -7.9 vs -0.1 at 1 week, -6.3 vs -1.4 vs -4.0 at 3 weeks (NS) Aberdeen pain and function scale (0 to 100): -3.8 vs -5.3 vs. -1.9 at 1 week (NS)	4/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Harms

No trial reported adverse events.

Costs

One of the trials included in the Cochrane review found no significant differences in costs of health care and home help between advice to remain active and either advice to rest in bed or an exercise program[349].

Summary of evidence

- See section on advice for bed rest for summary of evidence on advice for bed rest versus advice to remain active.
- For acute low back pain, one higher-quality trial found advice to remain active associated with similar effects on functional status and pain compared to exercise therapy, but one lower-quality trial found more back pain recurrences. Effects on sick leave were mixed, with the no differences between advice to remain active and exercise therapy in the higher-quality trial (level of evidence: poor).
- For subacute low back pain or back pain present for longer than 6 weeks, advice to remain active was associated with similar effects on functional status and pain compared to exercise therapy or a combined physical therapy intervention in two higher-quality trials (level of evidence: fair).
- For acute sciatica, advice to remain active was not associated with clear benefits compared to a combined physiotherapy intervention in a single, higher-quality trial (level of evidence: fair).
- In patients with low back pain for less than 90 days, advice to exercise was superior to usual care in one lower-quality trial. There were no differences between advice to exercise and a self-care book, and combining the two interventions did not improve outcomes (level of evidence: poor).

Recommendations and findings from other guidelines

- The AHCPR guidelines recommend providing acute low back pain patients accurate information about expectations for both rapid recovery and recurrence of symptoms based on the natural history of low back symptoms; safe and effective methods of symptom control; safe and reasonable activity modifications; best means of limiting recurrent low back problems; the lack of need for special investigations unless red flags are present; and effectiveness and risks of commonly available diagnostic methods and further treatment measures to be considered should symptoms persist (strength of evidence: B).
- The AHCPR guidelines suggest that patients with acute low back problems may be more comfortable if they temporarily limit or avoid specific activities known to increase mechanical stress on the spine, especially prolonged unsupported sitting, heavy lifting, and bending or twisting the back while lifting (strength of evidence: D).
- The AHCPR guidelines suggest consideration of the patients' age and general health, as well as the physical demands of required job tasks, when evaluating activity recommendations for employed workers with acute low back problems (strength of evidence: D).
- The VA/DoD and UK RCGP guidelines recommend an approach to patient advice and return to normal activity very similar to the AHCPR guidelines.
- The UK RCGP guidelines found stronger evidence than the AHCPR guidelines for advice to continue ordinary activity (strength of evidence: ***).

- The European COST guidelines recommend providing adequate information and reassurance to patients with acute low back pain. They also recommend advising patients to stay active and continue normal daily activities including work if possible.

Self-care back education books

We defined self-care back education books as reading material (books, booklets, or leaflets) that provides education and self-care advice for patients with low back pain. Although the specific content varies, self-care books are generally based on principles from published clinical practice guidelines and encourage return to normal activity, adoption of a fitness program and appropriate lifestyle modification, and provide advice on coping strategies and managing flares.

Results of search: systematic reviews
We identified no systematic reviews on efficacy of self-care books for low back pain.

Results of search: trials
From 611 potentially relevant citations, we identified ten trials (seven higher-quality[309, 366-371]) on self-care books for low back pain[363, 372, 373]. Nearly all of the trials evaluated patients with mixed acute, subacute, and/or chronic low back pain, or did not specify duration of symptoms. Five trials (two rated higher-quality[368, 370]) compared a self-care book to usual care and four trials (three rated higher-quality[367, 369, 371]) compared a self-care book to another intervention. Two trials compared different methods of providing information from self-care books[366, 368]. Three trials that compared a self-care book combined with another intervention versus a self-care book alone are reviewed in Key Question 10.

Efficacy of self-care books versus usual care

Five trials (two rated higher-quality[368, 370]) of patients with acute or subacute low back pain or back pain of unspecified duration found no significant differences between a self-care book versus usual care for pain or symptom bothersomeness scores (Table 13)[363, 368, 370, 372, 373]. There were also no differences in functional status[363, 368] or time lost from work[368, 370] in the trials that assessed these outcomes. Effects on health care use were mixed. One higher-quality trial found no difference between a self-care book and usual care on number of health care visits[370], but one lower-quality trial found fewer patients receiving a self-care book consulted for back pain over a one-year period[373]. Effects of self-care books on self-reported behaviors were also mixed. One trial found patients randomized to a self-care book more likely to report recommended back care behaviors[373]. However, another trial found no difference between a self-care book and usual care in the proportion of patients who reported exercising, even though the self-care book group was associated with higher scores on perceived knowledge[368].

Table 13. Trials of a self-care book versus usual care

Author, year Duration of LBP	Number of patients Duration of follow-up	Main results	Quality score*
Cherkin, 1996[368] Not specified	n=300 1 year	**Self-care book vs. nurse education + self-care book vs. usual care (mean change from baseline)** RDQ score (0 to 24 scale): -5.4 vs -5.2 vs -5.3 (NS) at 1 week Symptom bothersomeness score (0 to 10 scale): -3.3 vs -3.3 vs -3.6 (NS) at 1 week Health care visits for low back pain: 45% vs. 46% vs. 47% in first 7 weeks after intervention (NS) Work loss days: 24% vs. 36% vs. 29% in first 7 weeks after intervention (NS)	6/9
Hazard, 2000[370] Not specified	n=1108 6 months	**Self-care book vs. usual care** Current pain severity, improvement in pain since maximum severity: no differences (data not reported) Number of health care visits: no differences (data not reported) Proportion not working at 6 months: 6.5% vs. 5.9% (p=0.84) Lost work days through 6 months: 19.1 vs. 18.1	5/9
Little, 2001[363] Acute or subacute (<3 months)	n=311 3 weeks	**Self-care book vs. exercise advice vs. both vs. neither (control) (mean changes versus control)** Pain/function scale (0 to 100): -8.7 vs -7.9 vs -0.1 at 1 week, -6.3 vs -1.4 vs -4.0 at 3 weeks (NS) Aberdeen pain and function scale (0 to 100): -3.8 vs -5.3 vs. -1.9 at 1 week (NS)	4/9
Roberts, 2002[372] Acute (not defined)	n=64 12 months	**Self-care book vs. usual care** Aberdeen Low Back Pain Scale (0 to 100): 42.7 vs. 42.6 at 2 days, 11.0 vs. 8.1 at 1 year (NS)	4/9
Roland, 1989[373] Acute and chronic	n=936 1 year	**Self-care book vs. usual care** Patients initiating consultation for back pain: 23% vs 25% (NS) after 2 weeks,35.6% vs. 42.2% (p<0.05) over 1 year Days certified sickness absence: 10.3 vs 10.1 (NS) Referral to hospital or to physiotherapy: 19.9% vs. 24.7% (p>0.05)	2/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Efficacy of self-care books versus other interventions

Five trials (four higher-quality[309, 367, 369, 371]) compared a self-care book to other treatments (Table 14)[363]. For chronic low back pain, one higher-quality trial found a self-care book associated with moderately lower functional status at 26 weeks compared to yoga (difference of 3 to 4 points on the RDQ), and exercise therapy (difference of about 2 points on the RDQ)[371]. Yoga (but not exercise) was substantially superior to a self-care book on symptom bothersomeness scores at 26 weeks (by about 2 points on a 0 to 10 scale). For back pain of at least seven days duration, another higher-quality trial found no significant differences between a self-care book and either spinal manipulation or McKenzie exercise on symptom bothersomeness (0 to 10 scale) and RDQ scores, though trends favored spinal manipulation by about one point on both scales at 4 and 12 weeks[367]. For back pain of at least six weeks duration, a third higher-quality trial found massage, but not acupuncture, superior to a self-care book and videotape advice at 10 weeks in patients with low back pain for at least one week (difference of about 1 point on a 0 to 10 symptom bothersomeness scale and 2.5 points on the RDQ), though no differences between the self-care book and the other two interventions were observed after one year[369]. A fourth

higher-quality trial found a self-care book and weekly information packets inferior to weekly cognitive-behavioral therapy for long-term disability and the number of health care visits (but not for pain or functional status)[309]. Even though this trial was rated higher-quality because it met more than half of the quality criteria, it had an important flaw. About 20% of the patients randomized to cognitive-behavioral therapy never participated in the intervention and were excluded from the analysis. This could result in overestimates of benefits from cognitive-behavioral therapy if subjects who withdrew prior to receiving the intervention were less likely to respond to therapy. One lower-quality trial of patients with acute or subacute back pain found no short-term differences between a self-care book and physician advice to exercise on either a combined pain and function scale or the Aberdeen pain scale[363].

Table 14. Trials comparing a self-care book to other interventions

Author, year Duration of LBP	Number of patients Duration of follow-up	Main results	Quality score*
Cherkin, 1998[367] >7 days	n=323 2 years	**Self-care book vs. spinal manipulation vs. McKenzie exercise** Symptom bothersomeness (0 to 10 scale), mean scores: 3.1 vs. 1.9 vs. 2.3 at 4 weeks (NS), 3.2 vs. 2.0 vs. 2.7 at 12 weeks (NS), no differences at 2 years RDQ score (0 to 24 scale), mean scores: 4.9 vs. 3.7 vs. 4.1 at 4 weeks (NS), 4.3 vs. 3.1 vs. 4.1 at 12 weeks (NS), no differences at 2 years Proportion reporting reduced activity in 11 months after intervention: 36% vs. 33% vs. 35% Proportion needing bed rest: 9% vs. 8% vs. 11% Proportion who missed work: 17% vs. 7% vs. 13% Visits for back pain in second year after intervention: 24% vs. 29% vs. 20% Total costs over 2 years: $153 vs. $429 vs. $437	7/9
Cherkin, 2001[369] Subacute or chronic	n=262 1 year	**Self care book vs. acupuncture vs. massage** Symptom bothersomeness (0 to 10 scale), mean scores: 4.6 vs. 4.0 vs. 3.6 at 10 weeks (p=0.01 for self care book versus massage, no other significant differences), 3.8 vs. 4.5 vs. 3.2 at 1 year (p=0.002 for acupuncture vs. massage, no other significant differences) RDQ score (0 to 24 scale), mean scores: 8.8 vs. 7.9 vs. 6.3 at 10 weeks (p<0.001 for self care book vs massage, p=0.01 for acupuncture vs. massage, p=0.75 for self care book vs. acupuncture), 6.4 vs. 8.0 vs. 6.8 at 1 year (p=0.05 for acupuncture vs. massage, no other significant differences) Provider visits:1.5 vs.1.9 vs.1.0 (p=0.17)	8/9

Table 14. Trials comparing a self-care book to other interventions

Author, year Duration of LBP	Number of patients Duration of follow-up	Main results	Quality score*
Linton, 2000[309] Unspecified	n=272 1 year	**Self care book vs. weekly information package vs. cognitive behavioral therapy** Average pain (0 to 10, mean change from baseline): 0.8 vs. 0.8 vs. 0.9 Pain free days (0 to 7, mean change from baseline): 0.9 vs. 0.9 vs. 0.7 Days of sick leave in last six months (0 to 184, mean change from baseline): +10.0 vs. +14.4 vs. -0.4 Doctor visits in last six months (0 to 11, mean change from baseline): +0.5 vs. +0.4 vs. -0.5 Activities of Daily Living (0 to 60, mean change from baseline): -0.2 vs. +0.8 vs. +0.6 Modified Fear Avoidance Behavior Questionnaire (0 to 24, mean change from baseline): -2.0 vs. -2.7 vs. -3.5 Long-term disability: 10.4% (information package plus self-care book groups combined) vs. 1.1%, RR 9.3, 95% CI 1.2 to 70.8	5/9
Little, 2001[363] Acute or subacute	n=311 3 weeks	**Self-care book vs exercise advice vs. both (mean changes versus control)** Pain/function scale (0 to 100): -8.7 vs -7.9 vs -0.1 at 1 week, -6.3 vs -1.4 vs -4.0 at 3 weeks (NS) Aberdeen pain and function scale (0 to 100): -3.8 vs -5.3 vs. -1.9 at 1 week (NS)	4/9
Sherman, 2005[371] Chronic	n=101 26 weeks	**Yoga vs. self-care book**, mean differences RDQ score (0 to 24 scale): -2.6 (-4.6 to -1.6) at 6 weeks, -3.6 (-5.4 to -1.8) at 26 weeks Symptom bothersomeness score (0 to 10 scale): -1.6 (-2.6 to -0.5) at 6 weeks, and -2.2 (-3.2 to -1.2) at 26 weeks **Exercise vs self-care book**, mean differences RDQ score (mean difference): -1.7 (-3.7 to 0.4) at 6 weeks, -2.1 (-4.1 to -0.1) at 26 weeks Symptom bothersomeness score: -0.9 (-1.9 to -0.1) at 6 weeks, -0.8 (-2.1 to 0.5) at 26 weeks **Yoga vs. exercise vs. self-care** Visits to health care providers for low back pain: 4/34 (12%) vs 6/32 (19%) vs 9/29 (31%) at 26 weeks (NS) Medication use at week 26: 21% vs. 50% vs. 59% ($p<0.05$ for yoga vs. exercise or self-care) SF-36: No differences	8/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Efficacy of different methods for providing information in self-care books

For back pain of unspecified duration, one higher-quality trial found no differences between a self-care book plus a 15-minute nurse education session and brief telephone follow-up versus a self-care book alone in RDQ scores, symptom bothersomeness scores, days lost from work, or number of health care visits (Table 15)[368]. However, patients in the nurse education group perceived themselves to be more knowledgeable and a higher proportion reported they had tried exercises recommended in the booklet (74% vs. 45%, $p<0.001$) in the first week after the intervention. A second higher-quality trial found no differences in pain or functional status through one year in patients with acute or subacute low back pain randomized to an experimental back book (*the Back Book,* developed to accompany the UK's 1996 Royal College of General Practitioners guidelines) aimed at changing beliefs and behaviors, compared to a

traditional self-care book mainly targeted at providing factual information[366]. However, patients randomized to the experimental book were more likely to report at least a 4-point reduction in fear avoidance beliefs, and patients with high baseline fear avoidance beliefs were more likely to report improvements of at least three points on the RDQ score.

Table 15. Trials evaluating different methods of providing information in a self-care book

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Burton, 1999[374]	n=188 1 year	**Experimental self-care book ("The Back Book") vs. traditional self-care book** Pain at worst (0 to 100), mean scores: 53.9 vs. 53.9 at 2 weeks, 50.9 vs. 50.8 at 1 year (NS) RDQ scores: No significant differences, data not reported Fear avoidance beliefs score, >4 point improvement: RR 2.72 (1.57 to 4.72) at 2 weeks, RR 1.47 (1.02 to 2.11) at 1 year	6/9
Cherkin, 1996[368]	n=300 1 year	**Self-care book vs. nurse education + self-care book vs. usual care (mean change from baseline)** RDQ score (0 to 24 scale): -5.4 vs -5.2 vs -5.3 (NS) at 1 week Symptom bothersomeness score (0 to 10 scale): -3.3 vs -3.3 vs -3.6 (NS) at 1 week Health care visits for low back pain: 45% vs. 46% vs. 47% in first 7 weeks after intervention (NS) Work loss days: 24% vs. 36% vs. 29% in first 7 weeks after intervention (NS)	6/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Harms

Three trials that reported information on adverse events reported none with a self-care book[367, 369, 371].

Costs

One trial estimated an average total cost (including the cost of the intervention and health care utilization) lower with a self-care book ($153) compared to either chiropractic therapy or physical therapy (around $430)[367]. Another trial found no significant differences in estimated costs between a self-care book ($200), massage ($139), and acupuncture ($252)[369].

Summary of evidence

- For acute or subacute low back pain or back pain of unspecified duration, five trials (two higher-quality) found no differences between a self-care book and usual care in pain or symptom bothersomeness scores (level of evidence: fair).
- In patients with back pain of varying duration, four trials (three higher-quality) that compared a self-care book to acupuncture, exercise, exercise advice, or manipulation found no significant differences, or the self-care book was only slightly inferior on symptom bothersomeness scores and functional status. Larger differences were seen in single higher-quality trials that found a self-care book inferior to yoga and to massage (level of evidence: good).

- For acute or subacute low back pain, there was no difference between a self-care book and advice to exercise in one lower-quality trial (level of evidence: poor).
- Different methods for providing information in a self-care book were not associated with significant differences in pain or functional status. A brief nurse education visit increased the proportion of patients who exercised compared to the self-care book without the nurse education visit in one higher-quality trial. In another higher-quality trial of patients with acute or subacute low back pain, an experimental self care book targeted at changing beliefs and behaviors reduced fear avoidance beliefs more than a traditional self-care book (level of evidence: fair).

Recommendations and findings from other guidelines

- The other guidelines do not specifically address self-care books. General recommendations on advice are listed in the bed rest section.

Self-care e-mail discussion groups

Results of search: systematic reviews
We identified no relevant systematic reviews.

Results of search: trials
From 611 potentially relevant citations, we identified one lower-quality trial comparing a self-care e-mail discussion group versus usual care for chronic low back pain[375].

Efficacy of an e-mail discussion group versus usual care

One trial found that participation in a closed, moderated e-mail discussion group (along with a self-care book and videotape) was slightly superior to usual care for pain (p=.045), back-specific functional status (p=.02), role function (p=.007), and health distress (p=.001) after 12 months compared to usual care (Table 16)[375]. Differences averaged about 1 point on the 24 point RDQ and about 0.5 points on a 10 point pain scale. There were no differences in physician visits for back pain or average number of hospital days over a 12-month period.

Table 16. Trial of e-mail discussion group versus usual care

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Lorig, 2002[375]	n=580 12 months	**E-mail discussion, book and video vs. usual care** (mean changes from baseline at 12 months) RDQ (0 to 23): -2.77 vs -1.51 (p=.01) Health distress (0 to 5): -0.92 vs -0.57 (p=.001) Pain interference (0 to 10): -1.50 vs -1.02 (p=.05) Role function (0 to 7): -0.83 vs -0.53 (p=.007) Physician visits for back in last 6 months: -1.54 vs -0.65 (NS) Chiropractor visits for back in last 6 months: -1.32 vs -0.797 (NS) Physical therapist visits for back in last 6 months: -1.99 vs -1.31 (NS) Hospital days in recent 6 months: -0.198 vs 0.04 (NS)	2/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- For chronic low back pain, one lower-quality trial found an e-mail discussion group intervention plus a self-care book and videotape slightly superior to usual care for pain, disability, role function and health distress after one year (level of evidence: poor).

Recommendations and findings from other guidelines

- The other guidelines do not specifically address e-mail discussion groups. General recommendations on advice are listed in the bed rest section.

Self-care exercise videotape

Results of search: systematic reviews
We identified no relevant systematic reviews.

Results of search: trials
From 611 potentially relevant citations, we identified one lower-quality trial comparing a self-care exercise videotape to face-to-face instruction for back pain of unspecified duration[376].

Efficacy of self-care exercise videotape versus face-to-face advice

One lower-quality trial found no differences between a self-care exercise video (featuring either the treating physiotherapist or an anonymous physiotherapist) and face-to-face advice in RDQ scores after 4 to 6 weeks (Table 17)[376]. On one subscale of the SF-36 (pain), the self-care video group had greater improvements than the face-to-face advice group ($p<0.005$, absolute differences not reported).

Table 17. Trial of self-care video advice versus face-to-face advice

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Miller, 2004[376]	n=550 4-6 weeks	**Self-care video with treating physiotherapist vs. self-care video with anonymous physiotherapist vs. face-to-face advice** RDQ score (0 to 24), mean change: -3.58 vs -3.00 vs -2.47. Neither video group improved more than the face-to-face active group (p=.06) SF-36 pain subscale: Either video intervention experienced greater improvement compared to face-to-face advice (p<0.005, data not reported)	3/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- For back pain of unspecified duration, one-lower quality trial found no differences in functional status between videotaped and face-to-face exercise advice through 4 to 6 weeks (level of evidence: poor).

Recommendations and findings from other guidelines

- The other guidelines do not specifically address videotaped exercise advice. General recommendations on advice are listed in the bed rest section.

Advice to restrict early morning flexion

Results of search: systematic reviews
We identified no relevant systematic reviews.

Results of search: trials
From 611 potentially relevant citations, we identified one lower-quality trial that compared advice to restrict early morning lumbar flexion to sham exercise advice for chronic low back pain[377, 378].

Efficacy of advice to restrict early morning flexion versus sham exercise advice

One lower-quality trial found a single 45-minute instructional session on restriction of early morning flexion (with supplemental videotape and written instructions) superior to sham exercise advice for mean pain intensity, days with disability, as well as medication use (Table 18)[377, 378]. Results are difficult to interpret because of large baseline differences between groups (baseline medication use and disability days two times higher in the sham exercise advice group).

Table 18. Trial of advice to restrict early morning flexion versus sham exercise advice

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Snook, 1998[377, 378]	n=85 6 months	**Advice to restrict early morning flexion vs. sham exercise advice (mean at 6 months)** Pain intensity (0 to 10): 1.52 vs. 1.36 (p<0.05) Pain days: 102 vs. 150 Disability days: 3.0 vs. 10.7 Impairment days: 3.0 vs. 10.7 Medication days: 16.7 vs. 49.9	2/10

*Excludes criteria involving blinding of care providers, for maximum score of 10

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- For chronic low back pain, one lower-quality trial found advice to restrict early morning flexion superior to sham exercise advice for pain intensity and disability, but these findings are difficult to interpret because of marked baseline differences between groups (level of evidence: poor).

Recommendations and findings from other guidelines

- The other guidelines do not specifically address advice to restrict early morning flexion. General recommendations on advice are listed in the bed rest section.

Lay-facilitated groups for self-care

We defined lay-facilitated groups as sessions run by non-medical professionals, either with or without training in self-care group facilitation or specific self-care approaches for low back pain management.

Results of search: systematic reviews
We identified no relevant systematic reviews.

Results of search: trials
From 611 potentially relevant citations, we identified two trials that evaluated lay-facilitated self-care groups versus wait-list control[379] or usual care[380].

Efficacy of lay-facilitated groups for self-care versus usual care

In patients invited to enroll 6 to 8 weeks after presentation with low back pain, one higher-quality trial found a four-session lay-facilitated self-care group supplemented by a self-care book and videotapes slightly superior to usual care plus a self-care book on RDQ scores (difference about 1.5 points) after 6 months, though not after 3 or 12 months[380]. A higher proportion of patients in the self-care group reported a >50% reduction in RDQ scores at 6 months, but there was no difference between groups in pain intensity.

A lower-quality trial found a 6-week lay-facilitated self-care group (2½ hours each session) no better than wait-list control for chronic low back pain in older adults (60 years or older)[379].

Table 19. Trials of lay-led self-care group versus wait-list control or usual care

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Haas, 2005[379]	n=109 6 months	**Lay-led group vs wait-list control** Modified Von Korff pain score, mean (0 to 100): 41.4 vs 42.3 (p=.059),adjusted mean difference -1.0 (p=.835) at 6 months (NS) Modified Von Korff disability score, mean (0 to 100): 32.8 vs 35.8 (p=.303) at 6 months (NS)	3/9
Von Korff, 1998[380]	n=255 12 months	**Lay-led group + self-care book vs usual care + self-care book** RDQ Questionnaire (0 to 24), mean score: 6.56 vs 7.40 at 3 months (NS), 5.83 vs 7.23 at 6 months (p=0.007), 5.75 vs 6.75 at 12 months (p=0.092). ≥50% decrease in RDQ score: 48% vs. 33% (p=0.02) at 6 months Pain intensity (0 to 10), mean score: 3.87 vs. 4.02 at 3 months, 3.22 vs. 3.79 at 12 months (NS)	5/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Harms
No trial reported adverse events.

Costs
A cost analysis based on the trial estimated a mean cost of $9.70 per additional low-impact back day in the lay-led group relative to usual care[381].

Summary of evidence

- For subacute or chronic low back pain, a four-session lay-led self-care group was associated with small improvements in functional status (but not pain intensity) compared to usual care after 6 months (but not 3 or 12 months) in one higher-quality trial (level of evidence: fair).
- For elderly patients with chronic low back pain, a six-session lay-led self-care group was associated with no differences in pain or function compared to wait-list controls in one lower-quality trial (level of evidence: poor).

Recommendations and findings from other guidelines

- The other guidelines do not address lay-led self-care groups.

Self-help tools for back surgery decisions

Results of search: systematic reviews
We identified no systematic reviews on tools for helping guide back surgery decisions.

Results of search: trials
From 611 potentially relevant citations, we identified one higher-quality trial that compared patient outcomes associated with a video and a self-care book for informing back surgery decisions versus a self-care book alone[382]. We excluded another higher-quality trial on a video program for informing surgery decisions because it did not evaluate clinical outcomes[383].

Efficacy of a video plus self-care book for informing back surgery decisions versus a self-care book alone

In potential back surgery candidates, one higher-quality trial found no difference in back-specific functional status between an interactive video plus self-care book and a self-care book alone through 1 year (Table 20)[382]. The video intervention was superior to the self-care book alone for the proportion of patients reporting 'extreme' or 'quite a bit' of pain (28% versus 37%, p=0.04). However, no difference was found between the interventions for resolution of back or leg pain at 3 months or 1 year. There was no difference in the proportion of patients who underwent surgery except for in those diagnosed with herniated disc, who were less likely to have surgery if randomized to the interactive video (32% vs. 47%, p=0.05).

Table 20. Trial of interactive video + self-care book versus self-care book alone for informing surgical decisions

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Deyo, 2000[382]	n=393 1 year	**Videodisc program + booklet vs booklet alone** RDQ Score: no differences between groups at 3 months or 1 year Back pain severity 'extreme' or 'quite a bit' at 1 year: 27.6% vs. 37.2% (p=0.04) Resolution of back or leg pain: no differences between groups at 3 months or 1 year Surgery rate: 26% vs 33% (p=0.08, NS). In those with herniated disks: 32% vs 47% (p=0.05) Health care utilization (Seattle patients only): Except for surgery data reported above, no differences between groups for number of physician visits, physical therapy, spine imaging, overall lab or pharmacy use, hospitalizations for back pain. Satisfaction with treatment, decision-making process: no differences Satisfaction with amount of information received: 71.8% vs 57.1% (p=0.005)	6/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- In patients considered candidates for surgery, one higher-quality trial found no differences in function 1 year after randomization to an interactive video plus self-care book versus a self-care book alone for informing back surgery decisions. A lower proportion of patients with herniated disc randomized to the interactive video underwent surgery. The video was associated with a lower proportion of patients with severe pain at one year, though there was no difference in rates of resolution of back or leg pain (level of evidence: fair).

Recommendations and findings from other guidelines

- The other guidelines do not address tools to help patients with back care decisions.

Other self-care interventions

Lumbar supports

We defined lumbar support as a back brace, corset, or orthotic device worn to passively support the back.

Results of search: systematic reviews
We identified one higher-quality Cochrane review evaluating effectiveness of lumbar supports for low back pain[384, 385]. We excluded two outdated systematic reviews[343, 386] and one systematic review that didn't evaluate efficacy or safety[387].

Results of search: trials
The Cochrane review included six trials (two higher-quality) of lumbar supports for treatment of low back pain[384, 385]. We did not search for additional trials.

Efficacy of lumbar supports versus no lumbar support

For low back pain of unspecified duration, the Cochrane review included one small (n=30), lower-quality trial[388] that found a lumbar support superior to no intervention for improvement in pain after 1 hour, 3 weeks, and 6 weeks in patients[384, 385].

Efficacy of lumbar supports versus other interventions

Three[389-392] of four[393] trials included in the Cochrane review[384, 385] did not find lumbar supports to be more effective than a variety of other non-invasive interventions in reducing pain or improving functional outcomes, or rates of return to work. In the only higher-quality trial[390, 391], a lumbar support was superior to minimal massage in patients with subacute or chronic low back pain on the RDQ, but there were no significant differences on the revised ODI or in pain relief. There were no differences between a lumbar support and spinal manipulation or transcutaneous muscular stimulation. Two lower-quality trials found no differences between lumbar supports and usual care (for chronic low back pain[389]) or either spinal manipulation, physiotherapy (any technique except manipulation), or acetaminophen (for back pain of varying duration[393]). One lower-quality trial found a lumbar support superior to advice on rest and lifestyle for pain relief, return to work, and overall improvement in patients with acute low back pain[392].

Efficacy of one type of lumbar support versus another

The Cochrane review[384, 385] included one higher-quality trial that found a lumbar support with a rigid insert associated with significantly more global improvement than a lumbar support without a rigid insert[394].

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- For acute low back pain, one lower-quality trial found a lumbar support superior to advice on lifestyle and bed rest for pain relief, return to work, and overall improvement (level of evidence: poor).
- For low back pain of unspecified duration, there is insufficient evidence from one lower-quality trial to determine whether lumbar supports are effective compared to no intervention (level of evidence: poor).
- For low back pain of varying or unspecified duration, three trials (one higher-quality) found no clear differences between lumbar supports and other interventions (minimal massage, spinal manipulation, physiotherapy with any intervention other than manipulation, acetaminophen, TENS, or usual care). Most comparisons were evaluated in only one lower-quality trial (level of evidence: poor to fair).
- For chronic low back pain, one higher-quality trial found a lumbar support with a rigid insert associated with superior global improvement compared to a support without a rigid insert (level of evidence: fair).

Recommendations and findings from other guidelines

- The AHCPR guidelines found that lumbar corset and support belts had not been proven beneficial for treating patients with acute low back problems (strength of evidence: D).
- The VA/DoD and UK RCGP guidelines make similar recommendations.
- The European COST guidelines found insufficient evidence to recommend lumbar supports for nonspecific chronic low back pain.

Mattresses

Results of search: systematic reviews
We identified no relevant systematic reviews.

Results of search: trials
From 198 potentially relevant citations, we identified two randomized[395, 396] and one quasi-randomized trial[397] on efficacy of different mattress types for chronic low back pain. One trial was rated higher-quality[395].

Efficacy of different mattress types

For chronic low back pain, one higher-quality trial (n=313) found a medium-firm mattress associated with greater likelihood for improvement in pain-related disability after 90 days compared to those randomized to a firm mattress (82% vs. 68%, p=0.005)[395]. In unadjusted analyses, there were no differences between mattresses in the proportion of patients with improvement in pain while lying in bed or on rising (Table 21). The medium-firm mattress was superior for pain while lying in bed when results were adjusted for perceived firmness of the new

mattress and baseline pain scores. One lower-quality randomized trial compared a soft interior sprung mattress to an isometric mattress[396] and a quasi-randomized trial compared four different mattresses (orthopedic hard, standard, waterbed, hybrid water-foam)[397]. However, we could not reliably interpret results because of methodological flaws, use of nonstandardized outcome measures, and poor reporting of outcomes.

Table 21. Trials of different mattresses in patients with low back pain

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Atherton, 1983[396]	n=30 2 weeks followed by crossover	**Isometric versus soft inferior sprung mattress** Proportion reporting pain 'least': 40% (10/25) vs. 28% (7/25) Proportion reporting comfort 'best': 40% (10/25) vs. 52% (13/25)	4/11
Garfin, 1981[397]	n=15 2 weeks per intervention	**Orthopedic hard mattress versus standard box spring and mattress versus water-filled mattress versus hybrid (combination water-foam) mattress** Results not interpretable	0/11
Kovacs, 2003[395]	n=313 90 days	**Medium-firm versus firm mattress** Proportion with improvement in pain-related disability: 82% vs. 68%, p=0.005; adjusted OR=2.10 (95% CI 1.24 to 3.56) Proportion with improvement in pain while lying in bed: 83% vs. 78%, p=0.29; adjusted OR=2.36 (95% CI 1.13 to 4.93) Proportion with improvement in pain on rising: 86% vs. 80%, p=0.20; adjusted OR=1.93 (95% CI 0.97 to 3.86)	11/11

Harms
The higher-quality trial found firm mattress associated with a higher proportion of patients with worsening of pain in bed (17% vs. 9.0%) and worsening of disability (24% vs. 9%) compared to the medium-firm mattress[395].

Costs
We found no studies evaluating costs.

Summary of evidence

- For chronic low back pain, one higher-quality trial found a firm mattress slightly inferior to a medium-firm mattress for pain-related disability and pain while in bed. There were no differences in other pain outcomes (level of evidence: fair).
- There was insufficient evidence to judge the relative effectiveness of other mattress types or in patients with acute low back pain (level of evidence: poor).

Recommendations and findings from other guidelines

- The other guidelines do not address mattress types.

Superficial heat or cold

Superficial heat or cold is the application of warm packs, heated blankets, cold packs, or ice superficially to the back. It may also be referred to generally as thermotherapy.

Results of search: systematic reviews
We identified one recent, higher-quality Cochrane review (9 trials, five rated higher-quality)[398]. We excluded one older systematic review that searched for but found no studies on superficial hot or cold[399].

Results of search: trials
The Cochrane review included nine trials (five rated higher-quality)[398]. All nine trial evaluated application of superficial heat. Two trials also evaluated application of superficial cold. The same investigator led three of the trials[400-402]. We did not search for additional trials.

Efficacy of superficial heat versus placebo

For acute or subacute low back pain, the Cochrane review[398] included two higher-quality trials[400, 402] that found heat wrap therapy moderately more effective than placebo for short-term (5 days) pain relief (WMD=1.06, 95% CI 0.68 to 1.45 on a 0 to 5 scale) and improvement in disability (WMD=-2.10, 95% CI -3.19 to -1.01 on the RDQ). Another higher-quality trial[403] found application of a heated blanket substantially decreased acute low back pain immediately following application compared to a non-heated blanket (WMD=-32.20, 95% CI -38.69 to -25.71 on a 100 point scale).

Efficacy of superficial heat versus other interventions

For acute low back pain, the Cochrane review[398] included one higher-quality trial[401] that found heat wrap therapy moderately superior to oral acetaminophen or ibuprofen for short-term pain relief (mean differences=0.68 and 0.49 points, respectively, on a 0 to 5 scale after 1 day and mean differences=0.66 and 0.93 after 3 to 4 days, $p<0.05$ for all differences) and RDQ scores (difference=2 and 2.2 points after 4 days, $p<0.05$). For subacute or acute low back pain, another higher-quality trial[404] included in the Cochrane review[398] found heat wrap therapy moderately superior to an educational booklet for early pain relief (WMD=0.60, 95% CI 0.05 to 1.15 after 2 days on a 0 to 5 scale and WMD=1.10, 95% CI 0.55 to 1.65 after 4 days) and improved function (WMD=0.40, 95% CI -1.15 to 0.95 after 2 days and WMD=0.30, 95% CI -0.41 to 1.01 after 4 days), though benefits were no longer present after a week. There were no significant differences between heat wrap therapy and McKenzie exercise.

Efficacy of superficial cold versus placebo

We identified no trials that compared superficial cold versus placebo or no treatment.

Efficacy of superficial cold versus other interventions

For chronic low back pain, the Cochrane review[398] included one lower quality trial[405] that found light ice massage and transcutaneous electrical stimulation similarly effective in reducing pain.

Efficacy of superficial heat versus superficial cold

Two lower-quality, non-randomized trials[406, 407] included in the Cochrane review[398] reported conflicting results for superficial heat versus cold in patients. One trial found no significant differences between hot packs and ice massage for back pain of mixed duration[406] and the other found ice massage superior to hot packs for chronic low back pain[407].

Harms

No serious adverse events were reported in trials of heat wrap therapy[398]. Minor adverse events mainly consisted of skin irritation or increased "pinkness."

Costs

One decision analysis compared the cost-effectiveness of heat wrap therapy relative to ibuprofen or acetaminophen in patients with acute low back pain[408]. It found heat-wrap therapy dominated over both drugs (decreased costs and superior efficacy), with conclusions insensitive to changes in parameters. This analysis relied on outcomes data from a single published trial[401].

Summary of evidence

- For acute or subacute low back pain, there is consistent evidence from three higher-quality trials that heat wrap therapy or a heated blanket is moderately superior to placebo or a non-heated blanket for short-term pain relief and back-specific functional status (level of evidence: good).
- For acute low back pain, heat wrap therapy was moderately superior to acetaminophen or ibuprofen for short-term pain relief in one higher-quality trial (level of evidence: fair).
- In patients with a mix of acute and subacute low back pain, heat wrap therapy was superior to a self-care booklet, but not exercise, in one higher-quality trial (level of evidence: fair).
- There is insufficient evidence (one lower-quality trial) to judge efficacy of superficial cold (level of evidence: poor).
- There is conflicting evidence from two lower-quality, non-randomized trials on efficacy of superficial heat versus superficial cold (level of evidence: poor).

Recommendations and findings from other guidelines

- The AHCPR guidelines found physical agents and modalities (including superficial heat or cold) of insufficiently proven benefit to justify their cost for acute low back pain (strength of evidence: C). However, they suggest that self-application of heat or cold to the back could be taught to the patient as an option.
- The VA/DoD and UK RCGP guidelines reached similar conclusions.
- The European COST guidelines make no recommendation for superficial heat or cold for acute low back pain, but note that three trials came from one research group with potential conflict of interest.

- The European COST guidelines found insufficient evidence to recommend superficial heat for chronic low back pain.

Table 22. Systematic reviews on efficacy of self-care therapies for low back pain

Author, year	Type of systematic review	Number of included trials (number rated higher-quality) *	Number of trials not included in any other relevant systematic review	Duration of treatment in included trials	Sample sizes in included trials	Interventions evaluated (number of trials)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Advice to remain active (six trials in two systematic reviews; see also Advice to rest in bed)								
Hagen, 2002[359]	Qualitative	4 (3)	0 (see Hagen 2005)	4 to 12 weeks	42 to 186	Advice to remain active (4)	Advice to remain active versus exercise (1 RCT): no differences in pain intensity; WMD=-8.6 points (95% CI -13.0 to -3.3) for ODI at 1-3 weeks (1 RCT), but no differences at 4 to 12 weeks; reduced sick leave at 1-3 weeks (WMD= -1.6 days; -3.5 to 0.3) and at 4 to 12 weeks (WMD=-2.5 days, 95% CI -5.6 to 0.6)	7
Advice to rest in bed (11 trials in one systematic review; see also Advice to remain active)								
Hagen, 2005[65]	Quantitative	11 (8)	Not applicable	9 days to 6 months (median=12 weeks)	40 to 398 (median= 186)	Advice to rest in bed (11); advice to remain active (6)	Acute low back pain without sciatica: Advice to remain active vs. advice to rest in bed: SMD= 0.22 (95% CI 0.02 to 0.41) for pain at 3-4 weeks (2 RCTs) and SMD=0.25 (95% CI 0.05 to 0.45) at 12 weeks; SMD=0.29 (95% CI 0.09 to 0.49) for function (2 RCTs) at 3-4 weeks and SMD=0.24 (95% CI 0.04 to 0.44) at 12 weeks (2 RCTs); SMDs equivalent to 5 to 7.5 mm VAS and 1.2 to 1.8 points on RDQ; bed rest also increases length of sick leave during the first 12 weeks (high quality evidence) Sciatica: Advice to remain active vs. advice to rest in bed: SMD= -0.03 (95% CI -0.24 to +0.18) for pain at 3-4 weeks (2 RCTs) and 0.10 (95% CI -0.12 to 0.31) at 12 weeks (2 RCTs);SMD=0.19 (-0.02 to +0.41) for function at 3-4 weeks and SMD=0.12 (95% CI -0.10 to +0.33) at 12 weeks	7

Table 22. Systematic reviews on efficacy of self-care therapies for low back pain

Author, year	Type of systematic review	Number of included trials (number rated higher-quality) *	Number of trials not included in any other relevant systematic review	Duration of treatment in included trials	Sample sizes in included trials	Interventions evaluated (number of trials)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Lumbar supports (six trials in one systematic review)								
Jellema, 2001[385]; Van Tulder, 2000[384]	Qualitative	6 trials of treatment (2)	Not applicable	3 to 8 weeks (median=3.5 weeks)	19 to 334 (median= 190)	Lumbar support with rigid stay (2), pneumatic lumbar support (1), other or not specified (3)	Insufficient evidence to assess efficacy of lumbar support versus no treatment (1 RCT); lumbar support superior to other interventions in 1 of 4 RCTs	7
Superficial heat (9 trials in 1 systematic review)								
French, 2006[398]	Quantitative	9 (5)	Not applicable	Single application to 7 days	36 to 371 (median= 90)	Superficial heat (9), superficial cold (2)	Heat wrap versus oral placebo or non-heated wrap for acute or subacute LBP (4 RCTs): WMD=1.06 (95% CI 0.68 to 1.45 on a 0 to 5 scale) for pain relief up to day 5 (2 RCTs); WMD=-2.10 (95% CI -3.19 to -1.01) for RDQ (2 RCTs) Insufficient evidence to assess efficacy of superficial heat versus superficial cold	7

*Trials adequately meeting at least half of the quality rating criteria or rated as good or higher-quality if the number of criteria met was not reported
CI=confidence interval, ODI=Oswestry Disability Index, LBP=low back pain, OR=odds ratio, RCT=randomized controlled trial, RDQ=Roland-Morris Disability Questionnaire, RR=relative risk, TENS=transcutaneous electrical nerve stimulation, WMD=weighted mean difference

Table 23. Summary of evidence on self-care therapies for acute low back pain

Intervention	Number of trials (number rated higher-quality by at least one systematic review)	Net benefit*	Effective vs. placebo, sham, wait list, or no treatment?	Inconsistency?†	Directness of evidence?	Overall quality of evidence	Comments
Advice to remain active	6 (5)	Small (no significant harms or burdens)	No evidence	No	Direct	Good	Advice to remain active superior to advice to rest in bed in 6 trials
Advice to rest in bed	8 (6)	Not effective	No evidence	No	Direct	Good	Advice to rest in bed inferior to advice to remain active in 6 trials
Lumbar supports	1 (0)	Unable to estimate	No evidence	Not applicable	Direct	Poor	
Self-care education book	10 (7) See comments	Small (no significant harms or burdens)	No evidence	No	Direct	Fair	Nearly all trials evaluated patients with low back pain of mixed (acute, subacute, or chronic) or unspecified duration. Self-care education book similar to usual care in 5 trials
Self-care exercise videotape	No evidence	Unable to estimate	No evidence	Not applicable	Direct	Poor	One poor-quality trial evaluated self-care exercise videotape in patients with low back pain of unspecified duration
Superficial heat	5 (5)	Moderate	Yes (2 trials)	No	Direct	Good	

* Based on evidence showing medication is more effective than placebo, and/or evidence showing medication is at least as effective as other medications or interventions thought to be effective, for one or more of the following outcomes: pain, functional status, or work status. Versus placebo, small benefit defined as 5-10 points on a 100-point Visual Analogue Scale (VAS) for pain (or equivalent), 1-2 points on the Roland Morris Disability Questionnaire (RDQ), 10-20 points on the Oswestry Disability Index (ODI), or a standardized mean difference (SMD) of 0.2-0.5. Moderate benefit defined as10-20 points on a VAS for pain, 2-5 points on the RDQ, 10-20 points on the ODI, or a SMD of 0.5-0.8. Large benefit defined as >20 points on a 100 point VAS for pain; >5 points on the RDQ, >20 points on the ODI, or a SMD of >0.8.
† Inconsistency defined as <75% of trials reaching consistent conclusions on efficacy (no effect vs. positive effect considered inconsistent)

Table 24. Summary of evidence on self-care therapies for chronic or subacute low back pain

Intervention	Number of trials (number rated higher-quality by at least one systematic review)	Net benefit*	Effective vs. placebo, sham, wait list, or no treatment?	Important Inconsistency?†	Directness of evidence?	Overall quality of evidence	Comments
Advice to remain active	2 (2)	Small	No evidence	No	Direct	Fair	Advice to remain active similar in effectiveness to exercise therapy in 2 trials
Advice to rest in bed	No evidence	No evidence	No evidence	Not applicable	Not applicable	No evidence	
Advice to restrict early morning flexion	1 (0)	Unable to estimate	Unable to estimate (1 trial)	Not applicable	Direct	Poor	
Lay-led self-care groups	2 (1)	Unable to estimate	Unable to estimate (1 trial)	Yes	Direct	Poor	Lay-led self-care group superior to usual care on some outcomes in 1 higher-quality trial, but no differences versus wait-list control in 1 lower-quality trial
Lumbar supports	2 (1)	Unclear	No evidence	Some inconsistency	Direct	Poor	
Mattresses	3 (1)	Not effective	No evidence	No	Direct	Fair	Medium-firm mattress slightly superior to firm mattress in one higher-quality trial
Self-care education book	10 (7) See comments	Small (no significant harms or burdens)	No evidence	No	Direct	Fair	Nearly all trials evaluated patients with low back pain of mixed (acute, subacute, or chronic) or unspecified duration. Self-care education book similar to usual care in 5 trials
Self-care e-mail discussion group	1 (0)	Unable to estimate	No evidence	Not applicable	Direct	Poor	
Self-care exercise videotape	No evidence	Unable to estimate	No evidence	Not applicable	Direct	Poor	One poor-quality trial evaluated self-care exercise videotape in patients with low back pain of unspecified duration

Table 24. Summary of evidence on self-care therapies for chronic or subacute low back pain

Intervention	Number of trials (number rated higher-quality by at least one systematic review)	Net benefit*	Effective vs. placebo, sham, wait list, or no treatment?	Important Inconsistency?†	Directness of evidence?	Overall quality of evidence	Comments
Self-help tools for back surgery decisions	1 (1)	Small	Yes (1 trial)	Not applicable	Direct	Fair	No effect on functional outcomes, though fewer patients using self-help tool underwent surgery
Superficial heat	3 (0)	Unable to estimate	Unclear (3 trials)	No	Direct	Poor	Three lower-quality trials

* Based on evidence showing medication is more effective than placebo, and/or evidence showing medication is at least as effective as other medications or interventions thought to be effective, for one or more of the following outcomes: pain, functional status, or work status. Versus placebo, small benefit defined as 5-10 points on a 100-point Visual Analogue Scale (VAS) for pain (or equivalent), 1-2 points on the Roland Morris Disability Questionnaire (RDQ), 10-20 points on the Oswestry Disability Index (ODI), or a standardized mean difference (SMD) of 0.2-0.5. Moderate benefit defined as10-20 points on a VAS for pain, 2-5 points on the RDQ, 10-20 points on the ODI, or a SMD of 0.5-0.8. Large benefit defined as >20 points on a 100 point VAS for pain; >5 points on the RDQ, >20 points on the ODI, or a SMD of >0.8.
† Inconsistency defined as <75% of trials reaching consistent conclusions on efficacy (no effect vs. positive effect considered inconsistent)

Table 25. Summary of evidence on self-care therapies for radiculopathy or sciatica

Intervention	Number of trials (number rated higher-quality by at least one systematic review)	Net benefit*	Effective vs. placebo, sham, or no treatment?	Important Inconsistency?†	Directness of evidence?	Overall quality of evidence	Comments
Advice to remain active	2 (2)	Small (no significant harms or burdens)	No evidence	No	Direct	Good	Advice to remain active superior to advice to rest in bed in 2 trials
Advice to rest in bed	3 (2)	Not effective	No evidence	No	Direct	Good	Advice to rest in bed inferior to advice to remain active in 2 trials
Traction	16 (4)	Not effective (continuous or intermittent traction) Small to moderate (autotraction)	No for continuous or intermittent traction (8 trials), yes for autotraction (2 trials)	Some inconsistency (for autotraction versus continuous or intermittent traction)	Direct	Fair	Other trials of traction included patients with back pain of varying duration

* Based on evidence showing medication is more effective than placebo, and/or evidence showing medication is at least as effective as other medications or interventions thought to be effective, for one or more of the following outcomes: pain, functional status, or work status. Versus placebo, small benefit defined as 5-10 points on a 100-point Visual Analogue Scale (VAS) for pain (or equivalent), 1-2 points on the Roland Morris Disability Questionnaire (RDQ), 10-20 points on the Oswestry Disability Index (ODI), or a standardized mean difference (SMD) of 0.2-0.5. Moderate benefit defined as10-20 points on a VAS for pain, 2-5 points on the RDQ, 10-20 points on the ODI, or a SMD of 0.5-0.8. Large benefit defined as >20 points on a 100 point VAS for pain; >5 points on the RDQ, >20 points on the ODI, or a SMD of >0.8.
† Inconsistency defined as <75% of trials reaching consistent conclusions on efficacy (no effect vs. positive effect considered inconsistent)

Key Question 4

How effective are different non-invasive interventions for non-radicular low back pain, radicular low back pain, or spinal stenosis, and under what circumstances?

Medications

Acetaminophen

Acetaminophen (paracetamol) is an anti-pyretic and analgesic medication without significant anti-inflammatory properties. It is believed to work in part by indirectly decreasing production of prostaglandins through inhibitory effects involving cyclo-oxygenase enzymes[409, 410].

Search results: systematic reviews
We identified one lower-quality systematic review of multiple medications for low back pain that included trials of acetaminophen[411]. In addition, a higher-quality Cochrane review of NSAIDs for low back pain included trials comparing acetaminophen to NSAIDs[412, 413]. The systematic reviews each included three to five short-term (four weeks or less in duration) trials, only one of which was rated higher-quality[414]. We excluded two relevant but outdated systematic reviews[193, 415].

Search results: trials
A total of six unique trials[353, 414, 416-419] of acetaminophen were included in two systematic reviews[411-413]. From 134 potentially relevant citations, we identified one higher-quality[401] and two lower-quality[393, 420] trials of acetaminophen for low back pain that met inclusion criteria and were not included in the systematic reviews. All three compared acetaminophen to other active interventions. Among all trials of acetaminophen, the longest was four weeks in duration.

We excluded 13 trials that either did not specifically evaluate low back pain patients[421, 422] or compared dual therapy with acetaminophen plus another drug to a different drug or drug combination[423-433]. One other trial is discussed in the section on dual therapy versus monotherapy[434].

Efficacy of acetaminophen versus placebo

For acute low back pain, one lower-quality trial included in the Cochrane review found no difference between acetaminophen (three grams/day) and no treatment[417].

Efficacy of acetaminophen versus NSAIDs

For acute low back pain, the Cochrane review included three lower-quality trials which reported conflicting results on efficacy of acetaminophen (up to four grams/day) versus NSAIDs[412, 413]. Two trials[353, 417] found no differences, but a third trial found two out of four evaluated NSAIDs superior to acetaminophen[416]. One trial not included in the systematic reviews found acetaminophen 4000 mg/day similarly effective compared to ibuprofen 1200 mg/day[401].

For chronic low back pain, one higher-quality trial (included in both systematic reviews) found acetaminophen inferior to diflunisal for the proportion of patients reporting good or excellent

efficacy after four weeks (10 of 16 vs. 4 of 12, p=0.01), though the proportion reporting no or mild low back pain was similar (13 of 16 vs. 7 of 12)[414]. Although there are no other trials of acetaminophen versus NSAID for chronic low back pain, there is consistent evidence from higher-quality systematic reviews of patients with osteoarthritis that acetaminophen is slightly inferior for pain relief[435-438].

One trial of patients with back pain of mixed acute and chronic duration found no differences between acetaminophen and flurbiprofen[418].

Efficacy of acetaminophen versus other interventions

Acetaminophen was moderately inferior to heat wrap therapy and similarly effective compared to ibuprofen in one higher-quality trial[401]. In single, lower-quality trials, acetaminophen was inferior to amitriptyline[419] and electroacupuncture[420]. Other, mostly lower-quality trials found no difference between acetaminophen, codeine, phenylbutazone, or the combination of aspirin plus oxycodone for rates of "return to work"[353] or between acetaminophen and either physical therapy, a corset, or spinal manipulation for pain or other assessed outcomes[393].

Harms

Adverse events associated with acetaminophen were poorly reported in trials of patients with low back pain. In two higher-quality systematic reviews of osteoarthritis patients, acetaminophen was superior to NSAIDs for gastrointestinal tolerability and other GI side effects[436, 438]. There exists a perceived safety advantage of acetaminophen, but evidence from clinical trials on serious side effects such as bleeding, hypertension, and myocardial infarction are sparse. Observational data suggest that acetaminophen is associated with a lower rate of GI bleeding compared to NSAIDs[439, 440], but may be associated with modest increases in blood pressure[441-443] and renal dysfunction[444]. One recent analysis from the observational, large Nurses' Health Study suggests that heavy use of acetaminophen may be associated with an increased risk of cardiovascular events similar in magnitude to heavy use of NSAIDs[445]. A recent trial found 31% to 44% of healthy patients randomized to treatments that included four grams of acetaminophen daily experienced serum alanine aminotransferase elevations greater than three times the upper limit of normal, compared to 0% with placebo, though the clinical significance of this finding is unknown[446].

Costs

We found no studies evaluating costs.

Summary of evidence

- For acute low back pain, there is conflicting evidence from four lower-quality trials regarding efficacy of acetaminophen versus NSAIDs, with three finding no difference in outcomes (level of evidence: fair).
- For chronic low back pain, one higher quality trial found acetaminophen inferior to an NSAID on an overall assessment of efficacy (level of evidence: fair).

- Multiple trials of patients with osteoarthritis consistently found acetaminophen slightly inferior to NSAIDs for pain relief (less than 10 points on a 100 point visual analogue pain scale) (level of evidence: good).
- There is insufficient evidence from single, lower quality trials that compared acetaminophen to other interventions (such as other medications, physical therapy, superficial heat, a corset, or spinal manipulation) to accurately judge relative efficacy (level of evidence: poor).
- Acetaminophen is associated with a lower risk of serious gastrointestinal adverse events compared to NSAIDs based primarily on observational data (level of evidence: fair).
- Acetaminophen is better tolerated than NSAIDs (level of evidence: good).
- Additional studies are required to evaluate whether high-dose acetaminophen is associated with increased cardiovascular risk (results available from a single observational study) (level of evidence: poor).
- Acetaminophen at 4 grams daily is associated with elevations in aminotransferase levels of 31% to 44% in healthy subjects, though the clinical significance of this finding is not known (level of evidence: fair).

Recommendations and findings from other guidelines

- The AHCPR guidelines found acetaminophen reasonably safe and acceptable for treating patients with acute low back problems (strength of evidence: C).
- The VA/DoD guideline recommendations are identical to AHCPR's.
- The UK RCGP guideline found that comparisons of effectiveness between acetaminophen and NSAIDs are inconsistent (strength of evidence: **).
- The European COST guidelines recommend acetaminophen as first choice when needed for pain relief in patients with acute low back pain.

Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)

Non-selective NSAIDs

NSAIDs are thought to reduce joint and muscle pain primarily by blocking the cyclo-oxygenase (COX)-2 enzyme[447]. However, non-selective NSAIDs—or NSAIDs that block both the COX-1 and COX-2 enzymes—also cause gastrointestinal (GI) bleeding because the COX-1 enzyme helps protect the lining of the stomach from acid.

Results of search: systematic reviews
We identified two higher-quality systematic reviews evaluating efficacy of non-selective NSAIDs for non-specific low back pain[411-413]. The more comprehensive study (51 included trials) was a Cochrane review[412, 413]. A third, higher-quality systematic review evaluated efficacy of NSAIDs in patients with sciatica[100]. We excluded four outdated systematic reviews[193, 346, 415, 448].

Results of search: trials
Fifty-seven unique trials of NSAIDs were included in three systematic reviews[411-413]. We did not search for additional trials. Almost all of the trials were short-term. Only six of the 51 trials included in the Cochrane review were longer than two weeks in duration (the longest evaluated six weeks of therapy)[412, 413].

Efficacy of non-selective NSAIDs versus placebo

The Cochrane review (51 trials, 16 higher-quality) estimated a pooled relative risk for global improvement in patients with acute low back pain of 1.24 (6 trials, 95% CI 1.10 to 1.41) after one week of NSAIDs relative to placebo and 1.29 (3 trials, 95% CI 1.05 to 1.57) for not requiring additional analgesics[412, 413]. Qualitatively, two of four higher-quality trials included in the Cochrane review reported better pain relief with NSAIDs compared to placebo and two found no differences. In a single trial of patients with chronic low back pain (rated higher-quality), an NSAID (ibuprofen) was superior to placebo[449].

The second, lower-quality systematic review was not as comprehensive (21 trials) as the Cochrane review and synthesized evidence qualitatively[411]. It also concluded that NSAIDs are effective for acute low back pain The third systematic review, which focused on a subset of three trials (two higher-quality) that evaluated patients with sciatica, found no difference between NSAIDs and placebo (OR 0.99, 95% CI 0.6 to 1.7)[100].

Efficacy of non-selective NSAIDs versus other interventions

The Cochrane review found moderate evidence that NSAIDs are not more effective than opioid analgesics or muscle relaxants (6 trials, 1 higher-quality)[412, 413]. However, small sample sizes (n=19 to 44) could have limited the power of trials to detect differences. The Cochrane review also included two trials that found NSAIDs no more effective than physiotherapy or spinal manipulation and two trials that reached discordant conclusions about efficacy of NSAIDs relative to bed rest in patients with acute low back pain.

Efficacy of one non-selective NSAID versus another NSAID

The Cochrane review found no evidence from 24 trials that any one NSAID is superior to others for pain relief[412, 413]. Most comparisons were between different oral NSAIDs. One lower-quality trial found no difference between intramuscular and oral administration of tenoxicam[450].

Harms
The Cochrane review found NSAIDs associated with similar risk of adverse events compared to placebo (RR=0.83, 95% CI 0.64 to 1.08)[412, 413]. The trials were generally short-term and not designed to evaluate risks of serious harms such as GI bleeds and CV events. In studies of NSAIDs taken for a variety of indications, NSAIDs are associated with an increased risk for serious GI complications (such as bleeding and perforation) that rises with age[451, 452].

The association between NSAIDs and cardiovascular events remains an active, ongoing area of investigation. A recent meta-analysis of over 130 randomized trials with cardiovascular safety data for NSAIDs found all non-selective NSAIDs other than naproxen associated with an

increased rate of myocardial infarction (about 1 additional myocardial infarction for every 300 patients treated for one year with an NSAID versus non-use)[453]. Due to concerns about potential cardiovascular risks, the FDA recently required labeling revisions to include additional warnings for all prescription and over-the-counter non-selective NSAIDs[454].

Costs
We found no studies evaluating costs.

Summary of evidence

- For acute low back pain, non-selective NSAIDs are associated with moderate short-term pain relief and global improvement compared to placebo (six trials) (level of evidence: good).
- For chronic low back pain, a single higher-quality trial found non-selective NSAIDs more effective than placebo (level of evidence: fair).
- Most trials evaluated mixed populations of patients with and without sciatica. Three trials (two higher-quality) that specifically evaluated patients with sciatica found no differences between non-selective NSAIDs and placebo (level of evidence: fair).
- Non-selective NSAIDs have not been shown to be more effective than other medications (opioids, skeletal muscle relaxants) or non-invasive interventions (spinal manipulation, physical therapy, bed rest) for low back pain (level of evidence: fair).
- There is no evidence that any non-selective NSAID is more effective than any other (level of evidence: good).
- Non-selective NSAIDs are associated with an increased risk of serious GI complications compared to non-use (level of evidence: good).
- The association between non-selective NSAIDs and cardiovascular events is an active area of research. In one recent meta-analysis of over 130 randomized controlled trials, non-selective NSAIDs other than naproxen were associated with a modest increase in risk of cardiovascular complications relative to non-use (about 1 additional myocardial infarction for every 300 patients treated for one year) (level of evidence: fair).

Recommendations and findings from other guidelines

- The AHCPR guidelines found NSAIDs acceptable for treating patients with acute low back problems (strength of evidence: B).
- The AHCPR guidelines found that NSAIDs have a number of potential side effects, with the most frequent gastrointestinal irritation. They recommend the decision to use these medications be guided by comorbidity, side effects, cost, and patient and provider preference (strength of evidence: C).
- The VA/DoD and UK RCGP guidelines for NSAIDs are similar to the AHCPR recommendations.
- Both the VA/DoD (strength of evidence: B) and UK RCGP (strength of evidence: ***) guidelines found various NSAIDs equally effective for low back pain.

- The UK RCGP guidelines also found NSAIDs less effective for the reduction of nerve root pain (strength of evidence: **).
- The European COST guidelines recommend NSAIDs as second choice (after paracetamol) when needed for pain relief in patients with acute low back pain. They also recommend NSAIDs for pain relief in patients with chronic low back pain, but only for exacerbations or short-term periods (up to 3 months).

COX-2 selective NSAIDs

COX-2 selective NSAIDs could theoretically cause fewer GI complications than non-selective NSAIDs because they don't block the COX-1 enzyme, which helps protect the stomach lining. However, rofecoxib and valdecoxib were both voluntarily withdrawn from the market due to concerns about increased cardiovascular risk and other adverse events[455, 456]. Celecoxib is currently the only COX-2 selective NSAID available in the U.S.

Results of search: systematic reviews
No trials of COX-2 inhibitors were included in the Cochrane review of NSAIDs[412, 413]. We identified no other systematic reviews evaluating COX-2 inhibitors in patients with low back pain.

Results of search: trials
From 85 potentially relevant citations, we identified no trials on celecoxib for low back pain. We excluded eleven trials that evaluated selective NSAIDs not available in the U.S.[457-466] and three trials[467-469] that evaluated celecoxib in post-operative settings.

Efficacy of COX-2 inhibitors

In trials of patients with osteoarthritis and rheumatoid arthritis, there was no clear difference in efficacy between celecoxib and non-selective NSAIDs for pain relief, functional outcomes, or other measures of clinical efficacy[470, 471].

Harms
In a meta-analysis of primarily short-term randomized trials, celecoxib was associated with a lower rate of discontinuations due to gastrointestinal side effects (RR=0.75, 95% CI 0.7-0.8) and clinical ulcers or bleeds (RR=0.61, 95% CI 0.46-0.81) compared to non-selective NSAIDs in patients with a variety of underlying conditions[471]. In the only long-term study designed to assess risk of ulcer complications (the CLASS trials), celecoxib was associated with fewer gastrointestinal complications after 6 months compared to diclofenac, but not compared to ibuprofen[472]. However, this benefit was no longer present after longer follow-up, in part due to high loss to follow-up[473]. No gastrointestinal safety advantage was observed with celecoxib in the subgroup of patients taking aspirin.

The most comprehensive meta-analysis (over 130 randomized trials) found an increased risk of myocardial infarction with celecoxib compared to placebo when given for a variety of indications, though most events were observed in long-term trials using higher doses of celecoxib[453]. Other

than naproxen, which was neutral with respect to cardiovascular events, the risk of myocardial infarction with selective and non-selective NSAIDs in this meta-analysis was similar, with an estimated 1 additional myocardial infarction for every 300 patient-years of treatment compared to non-use of NSAIDs.

Costs
We found no studies evaluating costs.

Summary of evidence

- Systematic reviews of COX-2-selective NSAIDs given for a variety of indications found no clear differences in efficacy (pain relief) compared to non-selective NSAIDs (level of evidence: good).
- Celecoxib is associated with a lower risk of discontinuations due to GI adverse events and serious GI complications compared to non-selective NSAIDs in trials of patients with a variety of underlying conditions, but most of the evidence comes from short-term trials (level of evidence: good).
- In the largest meta-analysis of randomized trials, celecoxib was associated with an increased risk of myocardial infarction compared to placebo (about 1 additional myocardial infarction for every 300 patients treated for one year). Most events were observed in trials of longer duration and that evaluated higher doses (level of evidence: good).

Recommendations and findings from other guidelines

- The other guidelines do not address COX-2-selective NSAIDs

Aspirin

Like the non-aspirin NSAIDs, aspirin (acetylsalicylic acid) has anti-inflammatory and analgesic effects. An important distinction between aspirin and non-aspirin NSAIDs is that aspirin also induces irreversible functional defects in platelets. Aspirin is therefore also used for primary and secondary prevention of thrombotic events, though usually in lower doses than considered most effective for pain relief.

Results of search: systematic reviews
We identified no systematic reviews evaluating efficacy of aspirin for low back pain.

Results of search: trials
From 74 potentially relevant citations, we identified one lower-quality trial that evaluated efficacy of aspirin versus multiple comparator drugs in patients with acute low back pain[416]. We excluded three trials that did not report results specifically for patients with low back pain[422, 474] or were in a foreign language[475].

Efficacy of aspirin versus other analgesics

The only trial that met inclusion criteria found aspirin at 3600 mg/day associated with a lower mean daily pain index score (1.425 vs. 1.713 on a 3 point scale, $p<0.05$) than the combination

of dextropropoxyphene plus acetaminophen, but found no differences between aspirin and indomethacin, mefenamic acid, acetaminophen alone, or phenylbutazone[416]. Aspirin also received the highest patient preference rating, though the difference was only significant compared to mefenamic acid and phenylbutazone (2.37 vs. 1.75 and 1.68, respectively, on a 3-point scale).

Harms
Most trials that evaluated gastrointestinal bleeding risk and cardioprotective effects with aspirin were conducted in patients who received aspirin for cardiovascular prophylaxis, typically at lower doses (50 mg to 1500 mg/day) than considered most effective for analgesic and anti-inflammatory effects. In a higher-quality meta-analysis of 24 such randomized trials with nearly 66,000 participants, the risk of any gastrointestinal bleeding was 2.47% with aspirin compared with 1.42% with placebo (OR=1.68, 95% CI 1.51 to 1.88), based on an average of 28 months therapy[476]. The risk of major gastrointestinal bleeding is probably substantially lower[477]. There was no association between gastrointestinal hemorrhage and dose, and modified release formulations did not attenuate risk for bleeding.

Costs
We found no studies evaluating costs.

Summary of evidence

- There is insufficient evidence to judge efficacy of aspirin for low back pain (level of evidence: poor).
- Aspirin is associated with an increased risk of gastrointestinal bleeding even at low doses (level of evidence: good).
- Unlike non-aspirin NSAIDs, aspirin does not increase risk of cardiovascular events, and it is used for primary and secondary prevention of cardiovascular events (level of evidence: good).

Recommendations and findings from other guidelines

- The AHCPR guidelines do not consider aspirin separately from other NSAIDs.

Other Medications

Antidepressants

Therapeutic effects of antidepressants on depression are thought due to their effects on different neurotransmitters. Certain antidepressants (particularly those that inhibit norepinephrine uptake) are also thought to have pain-modulating properties independent from effects on depression[478].

Results of search: systematic reviews
We identified three higher-quality systematic reviews on efficacy of antidepressants for low back pain[411, 479, 480]. Two systematic reviews included seven[480] and nine[479] placebo-controlled trials. The third systematic review (seven trials)[411] also included one head-to-head trial of

antidepressants[481] and one trial that compared an antidepressant to acetaminophen[419]. We excluded four older systematic reviews[193, 482-484] and one systematic review that evaluated antidepressants for a variety of pain conditions[485]

Results of search: trials
Ten unique trials were included in the three systematic reviews of antidepressants[411, 479, 480]. In all of the trials, the duration of therapy ranged from four to eight weeks. We did not search for additional trials.

Efficacy of antidepressants versus placebo
No trial evaluated efficacy of antidepressants versus placebo for acute low back pain.

For chronic low back pain, the overall conclusions of the three systematic reviews appeared consistent[411, 479, 480]. The first, qualitative systematic review found tricyclic or tetracyclic antidepressants slightly to moderately superior to placebo for at least one pain-related outcome measure in four of five trials (SMD=0.43[486] and SMD=0.69[487] in the two highest quality trials)[480]. Effects on functional outcomes were inconsistently reported and did not show clear benefits. The only tetracyclic antidepressant evaluated was maprotiline, a drug not available in the U.S.[486]. None of the trials evaluated norepinephrine-serotonin reuptake inhibitors such as duloxetine or venlafaxine. There were no beneficial effects associated with antidepressants without inhibitory effects on norepinephrine uptake (paroxetine and trazodone) compared to placebo in three trials. Maprotiline, the only tetracyclic antidepressant evaluated in the systematic reviews, is not available in the U.S.

A second, quantitative systematic review found all antidepressants pooled together slightly effective for improving pain severity (SMD=0.41, 95% CI 0.22 to 0.61, 9 trials), though not for improving functional status (SMD=0.25, 95% CI -0.21 to 0.69, 5 trials)[479]. Although conclusions were interpreted as insensitive to antidepressant class (test for heterogeneity or stratified results not reported), effects on pain did not appear consistent across antidepressants. The point estimates indicate that paroxetine and trazodone (three trials) are associated with the least pain improvement (no statistically significant benefit in any of the trials).

A third (qualitative) systematic review also concluded that tricyclic antidepressants are effective for chronic low back pain[411].

Efficacy of one antidepressant versus another antidepressant
For chronic low back pain, two head-to-head trials provided somewhat conflicting evidence on the relative efficacy of different antidepressant classes. One higher-quality trial[487] found maprotiline superior to paroxetine for pain relief (-45% vs. -27%, p=0.013), but one lower-quality trial[481] found similar proportions of patients randomized to amitriptyline and fluoxetine reported at least moderate pain relief (82% vs. 77%).

Efficacy of antidepressants versus other interventions

There is little evidence on efficacy of antidepressants versus other medications for low back pain. For acute low back pain, a single, small (n=39), lower-quality trial included in one of the systematic reviews[411] found amitriptyline superior to acetaminophen for pain relief (p=0.045)[419].

Harms

Though adverse events were generally not well reported, one systematic review found antidepressants associated with a higher risk for any adverse event compared to placebo (22% vs. 14%, p=0.01)[479]. Drowsiness (7%), dry mouth (9%), dizziness (7%) and constipation (4%) were the most commonly reported events. The trials were not designed to assess risk of serious adverse events such as overdose, increased suicidality, and arrhythmias.

Costs

We found no studies evaluating costs.

Summary of evidence

- For acute low back pain, there is insufficient evidence (one lower-quality trial) to judge efficacy of antidepressants (level of evidence: poor).
- For chronic low back pain, tricyclic antidepressants are slightly to moderately more effective than placebo for pain relief in higher-quality trials, but do not significantly improve functional outcomes (level of evidence: good).
- For chronic low back pain, several trials found paroxetine and trazodone not effective or marginally effective compared to placebo (level of evidence: fair).
- There is insufficient evidence from head-to-head trials (one lower-quality trial) to judge relative effectiveness of tricyclic antidepressants and selective serotonin reuptake inhibitors (level of evidence: poor).
- There are no trials on effectiveness of other antidepressants venlafaxine or duloxetine for low back pain (level of evidence: poor).
- Although serious adverse events were not observed in the trials, the selected populations evaluated in clinical trials may decrease generalizability to general practice (level of evidence: fair).

Recommendations and findings from other guidelines

- The AHCPR guidelines recommend against use of antidepressant medications for acute low back problems (strength of evidence: C).
- The VA/DoD guidelines do not address antidepressant medications, and the UK RCGP guidelines found little evidence on their effectiveness for chronic low back pain, and none for acute low back pain (strength of evidence: *).
- The European COST guidelines recommend consideration of noradrenergic or noradrenergic-serotoninergic antidepressants as co-medications for pain relief in patients with chronic low

back pain without renal disease, glaucoma, pregnancy, chronic obstructive pulmonary disease, or heart failure.

Benzodiazepines

Benzodiazepines are a class of medications that act on gaba-aminobutyric $acid_A$ ($GABA_A$) receptors and have sedative, anxiolytic, and antiepileptic effects. They are commonly used as muscle relaxants, though they are not approved by the U.S. Food and Drug Administration for this indication.

Results of search: systematic reviews
We identified one higher-quality Cochrane review of skeletal muscle relaxants for low back pain that included trials of benzodiazepines[488, 489]. We excluded two relevant but outdated systematic reviews[193, 415].

Results of search: trials
Eight trials of benzodiazepines were included in the Cochrane review[488, 489]. The trials ranged from 5 to 14 days in duration. We did not search for additional trials.

Benefits of benzodiazepines versus placebo

For acute low back pain, one higher-quality trial included in the Cochrane review[488, 489] found no differences between diazepam and placebo[490], but another, lower quality trial found diazepam superior to placebo for short-term pain relief and overall improvement[491]. For chronic low back pain, pooled results from two higher-quality trials found tetrazepam (not available in the U.S.) associated with better short-term pain relief (RR=0.71, 95% CI 0.54 to 0.93) and overall improvement (RR=0.63, 95% CI 0.42 to 0.97) compared to placebo after 10-14 days[492, 493]. A third, lower-quality placebo-controlled trial of diazepam for chronic low back pain found no benefit[494].

Efficacy of benzodiazepines versus skeletal muscle relaxants

In two head-to-head trials included in the Cochrane review[488, 489], there were no differences between diazepam and tizanidine for acute low back pain (one higher-quality trial[495]) or between diazepam and cyclobenzaprine for chronic low back pain (one lower-quality trial[494]). For acute low back pain, a third, higher-quality trial found diazepam inferior to carisoprodol for muscle spasm, global efficacy (excellent or very good 70% vs. 45%), and functional status[496]. One study which pooled data from 20 trials (n=1553) found no difference between diazepam and cyclobenzaprine for short-term (14 days) global improvement, but included trials of patients with either back or neck pain (mixed duration)[497].

Harms
Adverse events such as somnolence, fatigue, and lightheadedness were reported more frequently with benzodiazepines compared to placebo[488, 489]. No trial evaluated risks with long-term use of benzodiazepines for low back pain such as addiction, abuse, overdose, or development of tolerance.

Costs
We found no studies evaluating costs.

Summary of evidence

- For acute low back pain, evidence on efficacy of benzodiazepines versus placebo is mixed from two trials (1 higher-quality) (level of evidence: poor).
- For acute low back pain, evidence on efficacy of diazepam compared to skeletal muscle relaxants is mixed, with diazepam inferior to carisoprodol in one higher-quality trial, but no differences compared to tizanidine in another higher-quality trial (level of evidence: fair).
- For chronic low back pain, two higher-quality trials found benzodiazepines moderately effective for short-term outcomes, but a third found no benefit (level of evidence: fair).
- For chronic low back pain, there is insufficient evidence to judge efficacy of benzodiazepines relative to skeletal muscle relaxants (1 lower-quality trial) (level of evidence: poor).
- In patients with back or neck pain of mixed duration, there was no difference in short-term global improvement between diazepam and cyclobenzaprine in one analysis of 20 trials (n=1553) (level of evidence: fair).
- Benzodiazepines are associated with increased short-term central nervous system adverse events (level of evidence: good). Risks of addiction, abuse, development of tolerance, and overdose, particularly with long-term use, are unknown.

Recommendations and findings from other guidelines

- The UK RCGP guidelines note that use of benzodiazepines for more than two weeks carry a significant risk of habituation and dependency (strength of evidence: **)
- The European COST guidelines recommendations for muscle relaxants and benzodiazepines are the same.

Antiepileptic drugs

Gabapentin and pregabalin are antiepileptic drugs similar in structure to the neurotransmitter gamma-aminobutyric acid (GABA). They have been shown to be effective in patients with neuropathic pain[498-500] and are approved by the FDA for treatment of diabetic neuropathy and postherpetic neuralgia. Other antiepileptic drugs have also been used to treat neuropathic pain, though they are not FDA-approved for this indication. The efficacy of antiepileptic drugs specifically for radicular (or non-radicular) low back pain has not been well studied.

Results of search: systematic reviews
We identified no systematic reviews evaluating efficacy of antiepileptic drugs for low back pain.

Results of search: trials
From 94 potentially relevant citations, we identified two trials of gabapentin for radiculopathy that met inclusion criteria[501, 502]. One was rated higher quality[501]. We also identified two higher-quality randomized trials of topiramate for chronic radiculopathy[503] or for chronic low back pain

with or without radiculopathy[504]. The trials ranged from six to ten weeks in duration. We identified no other trials of antiepileptic drugs for low back pain.

Efficacy of gabapentin versus placebo for radiculopathy

In one higher-quality trial, neither gabapentin nor placebo was associated with an improvement in resting back pain after six weeks (Table 26)[501]. However, gabapentin (but not placebo) was associated with small improvements compared to baseline on assessments of back pain with movement and for leg pain. It was not clear if between-group differences were significant. In the other, lower-quality trial, which used higher doses of gabapentin, patients with radiculopathy had greater improvement in pain at rest with gabapentin versus placebo after eight weeks[502].

Table 26. Trials of gabapentin versus placebo in for chronic radicular low back pain

Author, year	Number of patients Duration of follow-up	Main results	Quality score
McCleane, 2001[501]	n=80 6 weeks	**Gabapentin titrated to 1200 mg/day versus placebo** Back pain at rest (mean change from baseline on 0-10 VAS): -0.51 (NS) vs. 0.1 (NS) Back pain with movement (mean change from baseline on 0-10 VAS): -0.47 ($p<0.05$) vs. +0.01 (NS) Leg pain (mean change from baseline on 0-10 VAS): -0.45 ($p<0.05$) vs. -0.24 (NS)	8/11
Yildirim, 2003[502]	n=50 8 weeks	**Gabapentin titrated to 3600 mg/day versus placebo** Back pain at rest (mean change from baseline on 0-3 scale): -1.04 vs. -0.32, $p<0.01$	3/11

Efficacy of topiramate versus placebo for chronic low back pain with or without radiculopathy

One small (n=41), higher-quality crossover trial in patients with radiculopathy found topiramate more effective than diphenhydramine (used as an active placebo) for improving back and overall pain, though mean differences were small (less than one point on a 0 to 10 scale)[503]. There was no significant difference in leg pain, ODI scores, or SF-36 scores. Topiramate was also associated with a higher proportion of patients reporting moderate to complete pain relief (54% vs. 24%, p=0.005). A second higher-quality trial (n=96) of patients with chronic low back pain with or without leg pain found topiramate moderately more effective than placebo for improving Pain Rating Index scores (about 13 points on a 0 to 100 scale)[504]. Topiramate was also slightly more effective than placebo for improving scores on all SF-36 subscales. The largest difference was on the physical function subscale (9.1 point difference, range 0.6 to 8.3 for other subscales).

Table 27. Trials of topiramate versus placebo for chronic low back pain with or without radiculopathy

Author, year Type of LBP	Number of patients Duration of follow-up	Main results	Quality score
Khoromi, 2005[503] Radiculopathy	n=41 6 weeks, followed by crossover	**Topiramate titrated to 400 mg/day (average dose 208 mg/day) vs. diphenhydramine titrated to 50 mg/day (average dose 40 mg/day)** Average leg pain (mean change from baseline on 0 to 10 scale): -0.98 vs. -0.24 (p=0.06) Average back pain: -1.36 vs. -0.49 (p=0.017) Average overall pain: -0.33 vs. +0.49 (p=0.02) Global pain relief moderate or better: 15/29 (54%) vs. 7/29 (24%) (p=0.005) Global pain relief 'lot' or 'complete': 9/29 (31%) vs. 1/29 (3.4%) ODI: -5 vs. -3 (NS) Beck Depression Inventory: No difference SF-36: No differences for any subscale after correction for multiple comparisons	7/11
Muehlbacher, 2006[504] Chronic low back pain with or without radiculopathy	n=96 10 weeks	**Topiramate titrated to 300 mg/day versus placebo** Pain Rating Index (mean change from baseline on 0 to 100 scale): -12.9 vs. -1.5 (p<0.001) SF-36 Physical functioning subscale (mean change from baseline on 0 to 100 scale): +8.7 vs. -0.4 (p<0.01, favors topiramate) SF-36, Bodily pain subscale (0 to 100): +4.1 vs. +0.9 (p<0.01, favors topiramate) SF-36, other subscales: Differences in change compared to baseline ranged from 0.6 (Role-emotional) to 8.3 (Role-physical) points, favoring topiramate for all comparisons at p<0.05	7/11

Harms
Withdrawal due to adverse events occurred in 2 of 25 patients randomized to gabapentin versus none of 25 randomized to placebo in one trial[502]. No withdrawals due to adverse events occurred in the other trial[501]. However, drowsiness (6%), loss of energy (6%), and dizziness (6%) were reported with gabapentin[501].

A higher proportion of patients randomized to topiramate compared to diphenhydramine withdrew due to adverse events in one trial (33% vs. 15%)[503], but there was no difference in rates of withdrawal due to adverse events in the other (4% vs. 4%)[504]. Topiramate was also associated with higher rates of withdrawal due to adverse events (33% vs. 15%), sedation (34% vs. 3%) and diarrhea (30% vs. 10%) compared to diphenhydramine in one trial[503].

Costs
We found no studies evaluating costs.

Summary of evidence

- In patients with radiculopathy, two small (n=50 and n=80) trials (one higher-quality) found gabapentin slightly superior for short-term pain relief compared to placebo (level of evidence: fair).

- No trials evaluated efficacy of gabapentin in patients with non-radicular low back pain.
- In patients with radiculopathy, one small (n=42), higher-quality trial found topiramate slightly superior to diphenhydramine (used as an active placebo) for short-term pain relief, but not functional status. Topiramate was associated with more withdrawals due to adverse events, sedation and diarrhea than diphenhydramine (level of evidence: poor).
- For chronic low back pain with or without radiculopathy, one small (n=96), higher-quality trial found topiramate moderately superior to placebo for short-term pain relief and slightly superior for functional status (level of evidence: poor).

Recommendations and findings from other guidelines

- The European COST guidelines found insufficient evidence to recommend gabapentin in patients with chronic nonspecific low back pain, but does not address use of gabapentin for radiculopathy.

Skeletal muscle relaxants

The term “skeletal muscle relaxants” is commonly used to refer to a heterogeneous group of pharmacologically unrelated medications that are FDA-approved to treat two distinct underlying conditions: spasticity from upper motor neuron syndromes and pain or spasms from musculoskeletal conditions such as non-specific low back pain[505]. The muscle relaxants carisoprodol, chlorzoxazone, cyclobenzaprine, metaxalone, methocarbamol, and orphenadrine carry FDA-approved indications for treatment of musculoskeletal conditions. Although the other drugs in this class (baclofen, dantrolene, and tizanidine) are approved only for the treatment of spasticity, there is some overlap in clinical usage. In particular, tizanidine has also been studied in patients with musculoskeletal conditions such as low back pain. Benzodiazepines are commonly used as muscle relaxants, though they are not FDA-approved for this indication (see section on benzodiazepines).

Results of search: systematic reviews
We identified four higher-quality systematic reviews on efficacy and safety of muscle relaxants for low back pain[100, 411, 488, 489, 506]. Of these, a recent higher-quality Cochrane review was the most comprehensive (26 trials of skeletal muscle relaxants)[488, 489]. We excluded two outdated systematic reviews[193, 415].

Results of search: trials
Thirty-six unique trials of skeletal muscle relaxants were included in the four systematic reviews[100, 411, 488, 489, 506]. The duration of therapy in all trials was two weeks or less, with the exception of one three-week trial. We did not search for additional trials.

Efficacy of skeletal muscle relaxants versus placebo

For acute low back pain, the Cochrane review included eight trials that found skeletal muscle relaxants superior to placebo for short-term (2 to 4 days) pain relief (at least a two-point or 30% improvement on an 11 point pain rating scale) and global efficacy[488, 489]. The relative risk for pain relief was 1.25 (95% CI 1.12 to 1.41) after 2 to 4 days and 1.72 (95% CI 1.32 to 2.22) after

5 to 7 days, based on three higher-quality trials and one lower-quality trial that could be pooled. Skeletal muscle relaxants were also superior to placebo for short-term improvement in global efficacy (RR=2.04, 95% CI 1.05 to 4.00 after 2 to 4 days), though differences were no longer significant after 5 to 7 days (RR=1.47, 95% CI 0.88 to 2.44).

The Cochrane review also included three trials of skeletal muscle relaxants for chronic low back pain. Only one—a lower-quality trial of cyclobenzaprine that did not report pain intensity or global efficacy outcomes—evaluated a skeletal muscle relaxant available in the U.S.[494].

Two other systematic reviews were less comprehensive than the Cochrane review, but reached consistent conclusions[411, 506]. One systematic review of cyclobenzaprine included trials of patients with back or neck pain. [506]. It found cyclobenzaprine slightly to moderately superior to placebo (SMD=0.38 to 0.58) for pain, muscle spasm, tenderness to palpation, range of motion, and activities of daily living, with the greatest benefit seen within the first few days of treatment. It included two lower-quality trials of cyclobenzaprine for chronic or subacute low back or neck pain that reported mixed results versus placebo and were excluded from the Cochrane review[488, 489]. A systematic review[100] on various treatments for sciatica included one higher-quality trial[507] that found no difference between tizanidine and placebo.

Efficacy of one skeletal muscle relaxant versus another skeletal muscle relaxant

The Cochrane review found insufficient evidence to conclude that any muscle relaxant is more beneficial or less harmful compared to any other[488, 489]. A systematic review of muscle relaxants for various musculoskeletal conditions reached similar conclusions[505]. Cyclobenzaprine is the most-studied skeletal muscle relaxant in published trials[506]. There is sparse evidence (two trials) on effectiveness of the antispasticity drugs dantrolene and baclofen for either chronic or acute low back pain[488, 489]. Tizanidine (the other antispasticity skeletal muscle relaxant) was effective for low back pain in eight trials.

Harms

The Cochrane review found skeletal muscle relaxants associated with more total adverse events (RR=1.50, 95% CI 1.14 to 1.98) and central nervous system (primarily sedation) adverse events (RR=2.04, 95% CI 1.23 to 3.37) than placebo, though most events were self-limited, and serious complications appeared rare[488, 489]. Certain skeletal muscle relaxants are associated with other specific safety issues. For example, carisoprodol is a controlled substance in some states because of its metabolism in part to meprobamate, a drug associated with abuse and overdose. Dantrolene carries a black box warning on its label about potentially fatal hepatotoxicity. Chlorzoxazone and tizanidine are associated with usually self-limited and mild hepatotoxicity[505].

Costs

We found no studies evaluating costs.

Summary of evidence

- For acute low back pain, multiple trials found skeletal muscle relaxants moderately more effective than placebo for short-term (less than one week) pain relief and global response (level of evidence: good).
- For chronic low back pain or sciatica, there is insufficient evidence (one lower-quality trial) to judge efficacy of skeletal muscle relaxants (level of evidence: poor).
- Although there is no evidence showing one skeletal muscle relaxant is superior to others (level of evidence: fair), the number of available trials varies considerably for different drugs, with cyclobenzaprine the most-studied drug in published trials. Only two trials evaluated the efficacy of the antispasticity drugs baclofen and dantrolene (level of evidence: poor).
- Skeletal muscle relaxants are associated with an increased rate of adverse events (mostly sedation) compared to placebo, though they are usually mild and self-limited (level of evidence: fair).
- Specific safety issues are associated with carisoprodol (metabolism to meprobamate), dantrolene (potentially fatal hepatotoxicity), chlorzoxazone and tizanidine (usually reversible and mild hepatotoxicity).

Recommendations and findings from other guidelines

- The AHCPR guidelines recommend muscle relaxants as an option in the treatment of low back pain problems. While they found muscle relaxants probably more effective than placebo, they also found muscle relaxants had not been shown to be more effective than NSAIDs (strength of evidence: C).
- The AHCPR guidelines recommend balancing potential side effects (particularly drowsiness) associated with muscle relaxants against a patient's intolerance for other agents when considering the optional use of muscle relaxants (strength of evidence: C).
- The VA/DoD guidelines are identical to the AHCPR guidelines.
- The UK RCGP guidelines are similar to the AHCPR recommendations, but rated evidence on the effectiveness of muscle relaxants for acute back pain more highly (strength of evidence: ***).
- The European COST guidelines recommend the addition of a short course of muscle relaxants on its own or added to NSAIDs in patients with acute low back pain, if acetaminophen or NSAIDs failed to reduce pain.
- The European COST guidelines recommend consideration of muscle relaxants for short-term pain relief in chronic low back pain, but suggests caution because of side effects and to use medications with fewer side effects first.

Opioid analgesics

Opioid analgesics are derivatives of morphine that bind to opioid receptors. Some are available in immediate-release and sustained-release formulations, and opioids can be administered via a variety of routes (most commonly oral or transdermal). Opioids are the most potent medications

available for treatment of most types of severe pain. However, they are also associated with significant adverse events, including nausea, somnolence, respiratory depression (including risk of overdose), abuse, and addiction.

Results of search: systematic reviews
We identified no systematic reviews of opioids for low back pain. We excluded four reviews that did not clearly use systematic methods[508, 509] or were not specific for low back pain[510, 511].

Results of search: trials
From 600 potentially relevant citations, we identified nine trials (one higher-quality[512]) of opioids that met inclusion criteria[353, 426, 512-518]. Two trials were placebo-controlled[512, 514], two compared opioids to either NSAIDs or acetaminophen[353, 517], and the remainder compared different opioid drugs or formulations (sustained-release versus immediate-release). All of the trials were less than 3 weeks in duration except for two (one 16 weeks[517], the other 13 months[513]). We excluded twelve trials[416, 423, 425, 428-431, 433, 519-521] that evaluated dual therapy with an opioid plus another medication versus a different medication (or medication combination), one trial[522] that evaluated single-dose therapy, two trials[523, 524] that did not report efficacy of opioids specifically for low back pain, and two trials[525, 526] that did not evaluate any included outcome.

Efficacy of opioids versus placebo
For chronic low back pain, a single higher-quality trial found either sustained-release oxymorphone or sustained-release oxycodone superior to placebo for pain relief after 18 days (average difference in pain relief 18 points on a 100 point scale, Table 28)[512]. The active treatments were also superior to placebo for measures of interference with pain on activities. A problem with interpreting these results is that all patients were titrated to stable pain control on opioids prior to allocation to continued opioids or placebo, so poorer outcomes in the placebo group could have been due in part to cessation of opioids and withdrawal. In addition, although patients were initially randomized to sustained-release oxycodone or sustained-release oxymorphone, it was not clear if patients were randomly re-allocated to continued opioids or placebo.

A second, lower-quality placebo-controlled trial found the less potent opioid propoxyphene no better than placebo for improvement in pain scores or assessments of global improvement in patients with acute or chronic low back pain[514]. Propoxyphene was superior to placebo on only one of three sleep parameters (difficulty falling asleep).

Table 28. Trials of an opioid versus placebo in patients with low back pain

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Baratta, 1976[514]	n=61 14 days	**Propoxyphene versus placebo** Pain on active improvement (mean improvement from baseline): 0.8 vs. 0.4, NS Global improvement at least 'satisfactory': 22% vs. 14% (NS)	5/11
Hale, 2005[512]	n=235 18 days	**Sustained-release morphine versus sustained-release oxycodone versus placebo** Pain intensity (100 point VAS), mean differences versus placebo: -18.21 vs. -18.55 (p=0.0001 for each comparison) Global assessment at least 'good': 59% vs. 63% vs. 27%	7/11

Two systematic reviews of fifteen[511] and thirty[510] placebo-controlled trials of opioids for various non-cancer pain conditions (most commonly osteoarthritis and neuropathic pain) found opioids moderately effective. They estimated a mean decrease in pain intensity with opioids in most trials of at least 30%[511] or an SMD for pain relief of -0.60 (95% CI -0.69 to -0.50)[510]. In one of the reviews, opioids were also slightly superior to placebo for functional outcomes (SMD=-0.31, 95% CI -0.41 to -0.22)[510]. Estimates of benefit were similar for neuropathic and non-neuropathic pain.

Efficacy of opioids versus NSAIDs or acetaminophen

For low back pain, opioids have only been directly compared to NSAIDs in two lower-quality trials (Table 29). One small, lower-quality trial of patients with chronic low back pain found adding an opioid to naproxen alone associated with superior outcomes for average pain, current pain, and anxiety or depression scores after 16 weeks[517]. Differences in pain relief were small, ranging between 5 and 10 points on a 100-point scale. In addition, results are difficult to interpret because doses of naproxen weren't clearly reported. Another trial (n=50) found similar mean number of days before return to work in patients with acute low back pain randomized to codeine or acetaminophen (10.7 vs. 13.0 days)[353].

Table 29. Trials of an opioid versus an NSAID or acetaminophen

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Jamison, 1998[517]	n=36 16 weeks	**Sustained-release morphine + immediate-release oxycodone (titrated dose) + naproxen versus immediate-release oxycodone (set dose) + naproxen versus naproxen alone (mean scores over 16 weeks, all outcomes on 0 to 100 scales)** Average pain: 54.9 vs. 59.8 vs. 65.5 Anxiety: 11.2 vs. 15.0 vs. 31.6 Depression: 10.8 vs. 16.4 vs. 26.9 Level of activity: 49.3 vs. 49.3 vs. 51.5 Hours of sleep (means): 5.9 vs. 5.9 vs. 6.1	3/11
Wiesel, 1980[353]	n=50 14 days	**Codeine versus acetaminophen** Mean number of days before return to work: 10.7 vs. 13.0 (NS)	3/11

One systematic review that included trials of opioids for a variety of chronic pain conditions (8 trials, only one of low back pain patients) found no difference between all opioids and other drugs (NSAIDs, tricyclic antidepressants, or acetaminophen) for pain relief (SMD=-0.05, 95% CVI -0.32 to 0.21), though more potent opioids (oxycodone and morphine) were slightly superior to other drugs (SMD=-0.34, 95% CI -0.67 to -0.01) in stratified analyses[510]. There were no differences in functional outcomes.

Efficacy of different opioids and opioid formulations

There was no evidence from five lower-quality trials that sustained-release opioid formulations are superior to immediate-release formulations for pain, functional status, or other measured outcomes in patients with low back pain (Table 30)[426, 515-518].

Table 30. Trials of a sustained-release opioid versus an immediate-release opioid

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Gostick, 1989[515]	n=61 2 weeks followed by crossover	**Sustained- versus immediate-release dihydrocodeine** No differences for pain intensity, rescue drug use, global efficacy, patient preference	5/11
Hale, 1997[426]	n=104 5 days	**Sustained-release codeine plus acetaminophen versus immediate-release codeine plus acetaminophen** Long-acting codeine superior for pain intensity, but non-equivalent codeine use (200 mg vs. 71 mg)	5/11
Hale, 1999[516]	n=57 4-7 days followed by crossover	**Sustained- versus immediate-release oxycodone** No differences for overall pain intensity, mean pain intensity, or rescue drug use	5/11
Jamison, 1998[517]	n=36 16 weeks	**Sustained-release morphine + immediate-release oxycodone (titrated dose) + naproxen versus immediate-release oxycodone (set dose) + naproxen versus naproxen alone (mean scores over 16 weeks, all outcomes on 0 to 100 scales)** Average pain: 54.9 vs. 59.8 vs. 65.5 Anxiety: 11.2 vs. 15.0 vs. 31.6 Depression: 10.8 vs. 16.4 vs. 26.9 Level of activity: 49.3 vs. 49.3 vs. 51.5 Hours of sleep (means): 5.9 vs. 5.9 vs. 6.1	3/11
Salzman, 1999[518]	n=57 10 days	**Sustained- versus immediate-release oxycodone** No differences for pain intensity, time to stable pain control, mean number of dose adjustments	2/11

In two head-to-head trials of opioids for chronic low back pain (Table 31), there were no differences in efficacy between sustained-release oxymorphone and sustained-release oxycodone[512] or between transdermal fentanyl and sustained-release morphine[513]. The latter study is the longest (13 months) and largest (n=683) trial of opioids for low back pain available.

Table 31. Head-to-head trials of sustained-release opioids

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Allan, 2005[513]	n=683 13 months	**Transdermal fentanyl versus sustained-release oral morphine** No differences for pain scores, rescue medication use, quality of life, loss of working days	4/11
Hale, 2005[512]	n=235 18 days	**Sustained-release morphine versus sustained-release oxycodone** No differences for pain intensity, pain relief, pain interference with activities, global assessment	7/11

A systematic review of opioids for various non-cancer pain conditions also found no clear differences between sustained- and immediate-release opioids or different sustained-release opioids[527].

Harms
In the single higher-quality trial, a large proportion of patients on opioids had adverse events (85%), with constipation and sedation the most commonly reported symptoms[512]. Few "serious" adverse events were reported, and withdrawal due to adverse events was low in all groups, probably due at least in part to the use of a run-in period prior to randomization. In trials that compared opioids to other analgesics (NSAIDs or acetaminophen), constipation, dry mouth, somnolence, and nausea were all more common in the opioid arms[353, 517]. One lower-quality trial reported a higher rate of constipation with oral sustained-release morphine compared to transdermal fentanyl (65% vs. 52%)[513]. However, sustained-release morphine was also associated with a non-significant trend towards a lower rate of withdrawal due to any adverse event (31% vs. 37%).

In systematic reviews of opioids for various non-cancer pain conditions, 50% to 80% of patients experienced at least one adverse event. Constipation (41%), nausea (32%), and somnolence (29%) were the most common adverse events[510, 511, 528]. Relative to placebo, the rate of constipation was 10% to 16% higher with opioids, nausea 15% higher, dizziness or vertigo 8% to 9% higher, somnolence or drowsiness 9% to 10% higher, vomiting 5% to 8% higher, and dry skin, itching or pruritus 4% to 11% higher[510, 528]. About 22% to 24% of patients randomized to opioids withdrew due to adverse events, a rate about two-to-threefold higher than in patients randomized to placebo[510, 528]. Abuse and addiction were rarely reported in the trials, but because of short follow-up, enrollment of selected populations, and use of insensitive or poorly defined methods for detecting abuse and addiction, reliable conclusions about risks for these outcomes were not possible even when such data (few or no cases) were reported[510, 511]. In trials with longer-term (longer than seven months) open-label follow-up, less than half of patients remained on opioids[511].

Costs
We found no studies evaluating costs.

Summary of evidence

- For either acute or chronic low back pain, evidence that demonstrates efficacy of opioids versus placebo is sparse (one higher-quality trial showing moderate effects on pain) (level of evidence: fair).
- Multiple trials of patients with various non-cancer pain conditions consistently found opioids moderately superior to placebo for pain relief in primarily short-term trials (level of evidence: good), though effects on functional outcomes appear small and evidence on long-term effects is sparse.
- There is insufficient evidence from single, lower-quality trials to judge efficacy of opioids versus acetaminophen or in addition to NSAIDs (level of evidence: poor).
- For chronic low back pain, consistent evidence from lower-quality trials found no differences between sustained- and immediate-release opioids on a variety of outcomes (level of evidence: fair).

- There were no clear differences in efficacy or safety between different sustained-release opioids in two head-to-head trials (one higher-quality) (level of evidence: fair).
- Although adverse events are common with opioids, few serious adverse events were reported in published trials (level of evidence: fair). However, reliable estimates of long-term harms, rates of abuse or addiction, overdose, or other serious adverse events are not available (level of evidence: poor).

Recommendations and findings from other guidelines

- The AHCPR guidelines recommend opioids as an option for a time-limited course in patients with acute low back problems, with the decision guided by consideration of potential complications (which can lead to discontinuation in as many of 35% of patients) relative to other options (strength of evidence: C).
- The AHCPR guidelines found opioids no more effective in relieving low back symptoms than safer analgesics such as acetaminophen, aspirin, or other NSAIDs (strength of evidence: C).
- The AHCPR guidelines recommend warning patients about potential physical dependence and the danger associated with the use of opioids while operating heavy equipment or driving (strength of evidence: C).
- The VA/DoD and UK RCGP guideline recommendations are essentially identical to the AHCPR recommendations.
- The UK RCGP guidelines also suggest that pain of such severity that it requires opioids for longer than two weeks requires further investigation and assistance with management (strength of evidence: *).
- The UK RCGP guidelines suggest combinations of paracetamol plus a weak opioid as an alternative when paracetamol or NSAIDs alone do not give adequate pain control, though adverse effects include constipation and drowsiness (strength of evidence: **).
- The European COST guidelines recommend weak opioids in patients with nonspecific chronic low back pain who do not respond to other treatment modalities. Due to the risk of addiction, they recommend slow-release over immediate-release formulations and scheduled rather than as-needed dosing.

Tramadol

Tramadol is a synthetic centrally-active analgesic that has weak affinity for opioid μ-receptors. It also appears to have effects on the noradrenergic and serotoninergic systems.

Results of search: systematic reviews
We identified one higher-quality systematic review of various medications for low back pain[411] that included three short-term trials of tramadol[519, 529, 530] for low back pain. Two of the trials were rated higher-quality[529, 530].

Results of search: trials
Three trials[519, 529, 530] of tramadol were included in the systematic review[411]. From 147 potentially relevant citations, we identified two additional trials of tramadol for low back pain that met inclusion criteria. Both compared sustained-release to immediate-release tramadol[531, 532]. All trials ranged between one and four weeks in duration. We excluded three trials that evaluated dual therapy with tramadol plus another medication versus another medication or medication combination[432, 520, 533], one trial because it is only available as a conference abstract[534], and one small (n=40) trial cited in an electronic database that we could not locate[535]

Efficacy of tramadol versus placebo
The systematic review[411] included one higher-quality trial[530] that found tramadol moderately more effective than placebo for chronic low back pain on mean pain scores at 4 weeks (3.5 vs. 5.1 on 10 point scale, p≤0.001) as well as the McGill Pain Questionnaire (p=0.0007) and the RDQ (p=0.0001).

Efficacy of tramadol versus other interventions
No trial compared tramadol to opioid analgesics for low back pain. The systematic review included two trials comparing tramadol to other drugs[411]. For acute low back pain, one higher-quality trial found tramadol inferior to the NSAID dextroprofen-trometamol for pain relief (p=0.044) and need for rescue medication (p=0.011)[529]. For chronic low back pain, one lower-quality trial found tramadol associated with similar outcomes compared to the combination of paracetamol plus codeine[519].

Efficacy of sustained-release versus immediate-release tramadol
Two short-term (three weeks), lower-quality trials found no differences in efficacy between sustained-release and immediate-release tramadol for chronic low back pain (Table 32)[531, 532].

Table 32. Trials of sustained-release tramadol vs. immediate-release tramadol

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Raber, 1999[531]	n=248 9 days	**Tramadol sustained-release versus tramadol immediate-release** Pain relief, improvement in VAS (0 to 100): -25 vs. -25 for per-protocol analysis; ITT results stated as similar but data not reported Functional assessment 'without pain' or 'slight pain possible': >80% in both intervention groups for putting on jacket, putting on shoes, and climbing/descending stairs No awakenings due to low back pain: 41% vs. 47% Global assessment 'good' or 'moderately good': 80% (84/105) vs. 81% (80/99) Global assessment 'good': 47% (49/105) vs. 46% (45/99)	4/11
Sorge, 1997[532]	n=205 3 weeks	**Tramadol sustained-release versus tramadol immediate-release** Pain relief 'complete', 'good', or 'satisfactory': 88% (52/59) vs. 86% (49/57; results only reported for persons who completed three-week course Pain relief 'complete': 8.5% (5/59) vs. 5.3% (3/57); results only reported for persons who completed three-week course	5/11

Harms
In two trials included in the systematic review[411], tramadol was associated with similar rates of withdrawal due to adverse events compared to placebo[530] or the combination of paracetamol plus codeine[529]. There were also no differences in adverse events between sustained-release and immediate-release tramadol[531, 532].

Costs
We found no studies evaluating costs.

Summary of evidence

- No trial evaluated efficacy of tramadol versus placebo for acute low back pain.
- For acute low back pain, tramadol was inferior to the NSAID dextroprofen-trometamol (not available in the U.S.) for pain relief and need for rescue medications in one higher-quality trial (level of evidence: fair).
- For chronic low back pain, tramadol was moderately more effective than placebo for short-term pain relief and improvement in functional status in one higher-quality trial (level of evidence: fair).
- For chronic low back pain, tramadol was no better than the combination of paracetamol plus codeine in one lower-quality trial (level of evidence: poor).
- There is insufficient evidence to judge efficacy of tramadol compared to acetaminophen, opioid analgesics, or NSAIDs available in the U.S. (no trials).
- There was no difference in benefits or harms between sustained- and immediate-release tramadol in two lower-quality trials (level of evidence: fair).

- In single trials, tramadol was associated with similar rates of withdrawal due to adverse events (a marker for intolerable or severe adverse events) compared to placebo or the combination of paracetamol plus codeine (level of evidence: fair).

Recommendations and findings from other guidelines

- The European COST guidelines recommend weak opioids (including tramadol) in patients with nonspecific chronic low back pain who do not respond to other treatment modalities. Due to the risk of addiction, they recommend slow-release over immediate-release formulations and scheduled rather than as needed dosing.

Systemic corticosteroids

Results of search: systematic reviews
We identified no systematic reviews on efficacy of systemic corticosteroids for low back pain.

Results of search: trials
From 418 potentially relevant citations, we identified three small (n=33 to 65), higher-quality trials of systemic corticosteroids for radiculopathy of acute or unspecified duration[536-538]. One other higher-quality trial evaluated efficacy of systemic corticosteroids for acute low back pain without radiculopathy[539]. We excluded three trials[540-542] of systemic corticosteroids in operative or post-operative settings and one German-language trial[543].

Efficacy of systemic corticosteroids versus placebo

For acute sciatica, one higher-quality trial found a single large (500 mg) bolus of intravenous methylprednisolone associated with small (average 6 mm on a 100 mm scale) early improvement in short-term leg pain compared to placebo, but the benefit was no longer observed after the first 3 days (Table 33)[536]. There were no differences in degree of pain relief, functional disability, the proportion requiring spine surgery within the first month, or medication use. In two other higher-quality trials, seven day tapering courses of either oral[537] or intramuscular[538] dexamethasone (initial dose 64 mg/day) were not associated with differences in any outcomes including overall effect (either early or after up to 4 years of follow-up), hospitalization length, or subsequent surgery.

For acute low back pain with a negative straight leg raise test, one higher-quality trial found no differences between a single intramuscular injection of 160 mg of methylprednisolone versus a placebo injection for pain relief or function[539]. The excluded German-language trial also reported no significant difference between a 10-day course of intramuscular steroids and placebo in patients with sciatica in likelihood of a successful outcome (OR=2.0, 95% CI 0.8 to 4.9)[543].

Table 33. Trials of systemic corticosteroids versus placebo

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Finckh, 2006[536]	n=65 (acute sciatica) 30 days	**Methylprednisolone 500 mg IV bolus versus placebo** Leg pain, difference between interventions in VAS pain scores (0 to 100 scale): 5.7 (favors methylprednisolone) at day 3, (p=0.04), not significant after 3 days (p=0.22) Proportion with >20 mm improvement in VAS pain score after 1 day: 48% vs. 28% (p=0.097)	10/11
Friedman, 2006[539]	n=88 (acute low back pain with negative straight leg raise) 1 month	**Methylprednisolone 160 mg IM bolus vs. placebo** Pain, mean change from baseline (0 to 10 scale): -4.1 vs. -4.8 (NS) after 1 week, -5.1 vs. -5.8 (NS) after 1 month RDQ-18, mean score (0 to 18): 2.6 vs. 3.4 after 1 week, 2.6 vs. 3.1 after 1 month	11/11
Haimovic, 1986[537]	n=33 (sciatica, duration of symptoms unclear) 1 to 4 years	**Dexamethasone 64 mg followed by 1 week oral taper versus placebo** Early improvement: 33% (7/21) vs. 33% (4/12) Sustained improvement (1 to 4 years): 50% (8/16) vs. 64% (7/11)	6/11
Porsman, 1979[538]	n=52 (sciatica, duration of symptoms unclear) 9 days or longer	**Dexamethasone 64 mg followed by 1 week intramuscular taper versus placebo** 'Positive effect': 52% (13/25) vs. 58% (14/24) Subsequent surgery: 32% (8/25) vs. 25% (6/24)	6/11

Harms

In one trial, a large (500 mg) intravenous methylprednisolone bolus was associated with two cases of transient hyperglycemia and one case of facial flushing[536]. In another trial, a smaller (160 mg) intramuscular methylprednisolone injection was associated with no cases of hyperglycemia requiring medical attention, infection, or gastrointestinal bleeding[539]. Although there was a higher rate of adverse events (primarily gastrointestinal) in the placebo group in this trial, these findings are difficult to interpret because both groups also were given naproxen and oxycodone and use of those medications was not reported. Adverse events were poorly reported in the other trials.

Costs

We found no studies evaluating costs.

Summary of evidence

- For acute sciatica, systemic corticosteroids were consistently associated with no clinically significant benefit when given as a single large parenteral bolus or as a short oral or intramuscular taper (three higher-quality trials) (level of evidence: good).
- For acute non-radicular low back pain, one higher-quality trial found no benefit from a single intramuscular injection of methylprednisolone (160 mg) (level of evidence: fair).
- Serious adverse events after single large boluses of corticosteroids were not reported in two trials (level of evidence: fair). However, systemic corticosteroids are associated with

hyperglycemia, systemic infections, bleeding, osteoporosis, avascular necrosis, and psychosis, particularly with higher doses and longer courses of treatment.

Recommendations and findings from other guidelines

- The AHCPR guidelines recommend against systemic steroids for acute low back problems (strength of evidence: C).
- The AHCPR guidelines found a potential for severe side effects with extended use of oral steroids or short-term use of high-dose steroids (strength of evidence: D).
- The UK RCGP guidelines on systemic steroids are similar.

Topical lidocaine

Results of search: systematic review
We found no systematic reviews of topical lidocaine for low back pain.

Results of search: trials
From 278 potentially relevant citations, we identified one open-label, randomized trial, but it did not meet inclusion criteria because results are only available as a conference abstract[544]. It found no differences between lidocaine 5% patch and celecoxib 200 mg for low back pain (with or without radiation) after four weeks on the Brief Pain Index, ODI, or proportion of patients with >30% reduction in pain. The trial was terminated early because of concerns about potential cardiovascular risks associated with celecoxib, and results were only reported for 76 of the 97 patients randomized.

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- There is insufficient evidence to evaluate efficacy of topical lidocaine for low back pain (one open-label trial, terminated early, only available as an abstract) (level of evidence: poor).

Recommendations and findings from other guidelines

- The other guidelines do not address topical lidocaine.

Herbal therapies

Results of search: systematic reviews
We identified one higher-quality Cochrane review on efficacy of devil's claw, white willow bark, or topical cayenne for low back pain herbal therapies for low back pain[545, 546]. We excluded an earlier version of this systematic review[547].

Results of search: trials
Ten trials were included in the systematic review[545]. Five of the ten trials were rated higher-quality (met more than half of the 12 quality criteria), but all assessed short-term (<6 weeks) outcomes and more than half either had authors with potential conflicts of interest or did not report potential conflicts. In addition, the same investigator led half of the trials. We did not search for additional trials.

Efficacy of harpagoside (devil's claw) versus placebo
For acute episodes of chronic non-specific low back pain, the Cochrane review[545, 546] included two higher-quality trials[548, 549] that found devil's claw (harpagoside) superior to placebo for the proportion pain-free (9% and 17% with devil's claw versus 2% and 5% with placebo). However, significant differences were not seen for Arhus Index scores (a measure of physical impairment, disability, and pain) or concomitant analgesic (tramadol) use.

Efficacy of salix alba (white willow bark) versus placebo
For chronic low back pain, the Cochrane review[545, 546] included one higher-quality trial that found white willow bark superior to placebo for the likelihood of becoming pain-free, with a significant dose trend (5.7% with placebo, 21% with low dose willow bark, 39% with high dose), as well as for improvements in Arhus Index scores[550].

Efficacy of capsicum frutescens (cayenne) versus placebo
Capsaicin is the main active ingredient in cayenne. For acute low back pain, one lower-quality trial included in the Cochrane review[545, 546] found topical cayenne (in combination with topical salicylate) superior to placebo cream (mean improvement 3.79 cm on a 10 cm VAS after 14 days in the cayenne group)[551]. For chronic low back pain, two lower-quality trials found cayenne associated with a higher likelihood of at least 50% improvement in pain compared to placebo (35% versus 17% in one trial[552] and 45% versus 24% in the other[553]). Arhus Index scores also decreased more in the cayenne groups (33% vs. 22% in one trial[552] and 42% vs. 31% in the other[553]). However, a fourth, lower-quality trial of cayenne versus homeopathic treatment (Spiroflor SLR homeopathic gel) for back pain of mixed duration found no differences in pain relief, proportion using acetaminophen, proportion unable to work, or assessments of overall efficacy[554].

Efficacy of herbal therapies versus other interventions
Two trials included in the Cochrane review[545, 546] compared either devil's claw (higher-quality[459]) or willow bark (lower-quality[458]) to low-dose (12.5 mg) rofecoxib, a COX-2 selective NSAID no longer on the market. Both found no statistically or clinically significant differences between herbal therapies and rofecoxib for pain, Arhus Index scores, or other outcomes.

Harms
Devil's claw was not consistently associated with a higher rate of adverse events compared to placebo in the Cochrane review[545, 546]. Serious adverse events were rare in published trials, though a severe allergic reaction was reported in one study of willow bark[550]. Because of its

mechanism of action, cayenne is associated with burning or itching upon initial administration that decreases after repeated applications.

Costs
We found no studies evaluating costs.

Summary of evidence

- For acute exacerbations of chronic low back pain, two higher-quality trials found devil's claw slightly superior to placebo for short-term pain relief and one higher-quality trial found devil's claw equivalent to low-dose rofecoxib. Because all of the trials were led by the same investigator, reproducibility of findings has not been established (level of evidence: fair).
- For acute exacerbations of chronic low back pain, one higher-quality trial found white willow bark superior to placebo and one lower-quality trial found white willow bark equivalent to low-dose rofecoxib (level of evidence: fair).
- For acute low back pain or acute exacerbations of chronic low back pain, one lower-quality trial found cayenne moderately superior to placebo for pain relief and other outcomes, but one other lower-quality trial found no benefit compared to a homeopathic gel (level of evidence: poor).
- For chronic low back pain, one higher-quality trial found willow back moderately superior to placebo for short-term pain relief (level of evidence: fair).
- For chronic low back pain, two lower-quality trials found cayenne moderately superior to placebo (level of evidence: fair).
- Serious adverse reactions with herbal therapies appear uncommon (level of evidence: fair).
- No trials evaluated long-term outcomes.

Recommendations and findings from other guidelines

- The European COST guidelines make no recommendation for herbal therapies for acute low back pain, but note that most of the available trials came from the same research group and primarily involved patients with acute exacerbations of chronic low back pain.
- The European COST guidelines recommend consideration of capsicum pain plasters for short-term symptomatic pain relief in chronic low back pain.

Table 34. Systematic reviews on efficacy of medications and herbal therapies for low back pain

Drug	Author, year	Type of systematic review	Number of included trials (number rated higher-quality) *	Number of trials not included in any other relevant systematic review	Duration of treatment in included trials	Sample sizes in included trials	Interventions evaluated (number of trials)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Acetaminophen **(6 unique trials in two systematic reviews)**	Schnitzer, 2004[411]	Qualitative (efficacy of multiple medications)	3 (1)	1	7 days to 5 weeks (median=4 weeks)	30 to 60 (median=39)	Acetaminophen 4 grams/day (2), 2 grams/day (1)	Does not draw specific conclusions regarding acetaminophen	4
	Van Tulder, 2000[412]	Qualitative	5 (1)	3	7 days to 4 weeks (median=2 weeks)	30 to 70 (median=50)	Acetaminophen 4 grams/day (3), 2 grams/day (1), dose not specified (1)	Acetaminophen vs. NSAIDs for acute LBP (3 lower-quality RCTs): No differences in 2 trials; in 3rd trial 2 of 4 evaluated NSAIDs superior to acetaminophen Acetaminophen vs. diflunisal for chronic LBP (1 RCT): Diflunisal superior for proportion reporting no or mild low back pain after 2-4 weeks and for global assessment of efficacy	7
Antidepressants **(10 unique trials in three systematic reviews)**	Salerno, 2002[479]	Quantitative	9 (5)	2	4 to 8 weeks (median=6 weeks)	16 to 103 (median=50)	Nortriptyline (1), imipramine (2), amitriptyline (1), desipramine (1), doxepine (2), maprotiline (1), paroxetine (2), trazodone (1)	Antidepressant vs. placebo for chronic low back pain (9 RCTs): SMD=0.41 (95% CI 0.22 to 0.61) for pain (9 RCTs); SMD=0.24 (95% CI -0.21 to 0.69) for activities of daily living (5 RCTs)	6
	Schnitzer, 2004[411]	Qualitative (efficacy of multiple medications)	7 (4)	1	4 to 8 weeks (median=8 weeks)	16 to 103 (median=50)	Nortriptyline (1), imipramine (1), amitriptyline (2), maprotiline (1), paroxetine (2), fluoxetine (1) trazodone (1)	Antidepressants vs. placebo for chronic low back pain (7 RCTs): Antidepressants superior to placebo in 5 of 7 trials	5

Table 34. Systematic reviews on efficacy of medications and herbal therapies for low back pain

Drug	Author, year	Type of systematic review	Number of included trials (number rated higher-quality) *	Number of trials not included in any other relevant systematic review	Duration of treatment in included trials	Sample sizes in included trials	Interventions evaluated (number of trials)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Antidepressants **(10 unique trials in three systematic reviews)**	Staiger, 2003[480]	Qualitative	7 (6)	0	4 to 8 weeks (median=8 weeks)	16 to 103 (median=50)	Nortriptyline (1), imipramine (2), amitriptyline (1), maprotiline (1), paroxetine (2), trazodone (1)	Tricyclic and tetracyclic antidepressant vs. placebo for chronic low back pain (5 RCTs): 3 of 5 trials, including the two highest quality trials, found mild to moderate, significant benefits for pain; insufficient evidence on functional status Paroxetine or trazodone vs. placebo for chronic low back pain (3 RCTs): No consistent benefits on pain (SMD ranged from -0.13 to +0.32 in 3 RCTs)	7
Benzodiazepines **(8 unique trials in one systematic review)**	Van Tulder, 2003[488]	Qualitative and quantitative	8 (5)	8	6 to 14 days (median=8 days)	50 to 152 (median=73)	Diazepam (6), tetrazepam (2)	Diazepam vs. placebo for acute LBP (1 RCT): Diazepam superior for short-term pain and overall improvement Tetrazepam vs. placebo for chronic LBP (3 RCTs): RR=1.41 (95% CI 1.08 to 1.85, 2 RCTs) for pain relief of >20% or >16 on a 100 point VAS after 8 to 14 days and RR=1.59 (95% CI 1.03 to 2.38) for global improvement after 8-14 days (2 RCTs) Benzodiazepine vs. skeletal muscle relaxants (3 RCTs): No differences in higher-quality trials	7

Table 34. Systematic reviews on efficacy of medications and herbal therapies for low back pain

Drug	Author, year	Type of systematic review	Number of included trials (number rated higher-quality) *	Number of trials not included in any other relevant systematic review	Duration of treatment in included trials	Sample sizes in included trials	Interventions evaluated (number of trials)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Herbal therapies **(10 unique trials in one systematic review)**	Gagnier, 2006[545]	Qualitative	10 (5)	10	1 to 6 weeks (median=4 weeks)	40 to 320 (median=158)	Devil's claw (3), white willow bark (3), cayenne (4)	Devil's claw more effective than placebo for short-term improvement in pain in 2 RCTs, white willow bark more effective than placebo for short-term improvement in pain in 2 RCTs, topical cayenne more effective than placebo in 3 trials but no more effective than homeopathic gel in one trial	7
Non-steroidal anti-inflammatory drugs **(57 unique trials in three systematic reviews)**	Schnitzer, 2004[411]	Qualitative (efficacy of multiple medications)	21 (10)	5	7 days to 8 weeks (median=14 days)	30 to 282 (median=73)	Naproxen (4), ibuprofen (1), indomethacin (4), diclofenac (3), piroxicam (6), diflunisal (6), others (9)	NSAIDs for acute LBP (14 RCTs): NSAIDs superior to placebo in 2 of 3 RCTs; 9 of 11 RCTs of NSAID vs. active control found significant improvements from baseline in NSAID group NSAID for chronic LBP (4 RCTs): NSAIDs superior to placebo in 1 RCT. In 3 of 3 RCTs of NSAID vs. active control found significant improvements from baseline in NSAID group	5
Non-steroidal anti-inflammatory drugs **(57 unique trials in three systematic reviews)**	Van Tulder, 2000[413]	Qualitative and quantitative	51 (15)	34	1-2 days to 6 weeks (median=12 days)	20 to 459 (median=72)	Naproxen (4), ibuprofen (6), indomethacin (10), diclofenac (15), piroxicam (7), diflunisal (8), others (18)	NSAID vs. placebo for acute LBP (9 RCTs): RR=1.24 (95% CI 1.10 to 1.41) for global improvement after 1 week (6 RCTs) and RR=1.29 (95% CI 1.05 to 1.57) for not requiring additional analgesics after 1 week (3 RCTs)	7

Table 34. Systematic reviews on efficacy of medications and herbal therapies for low back pain

Drug	Author, year	Type of systematic review	Number of included trials (number rated higher-quality) *	Number of trials not included in any other relevant systematic review	Duration of treatment in included trials	Sample sizes in included trials	Interventions evaluated (number of trials)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Non-steroidal anti-inflammatory drugs (57 unique trials in three systematic reviews)	Vroomen, 2000[100]	Quantitative	4 (2)	1	2-4 days to 17 days (median=10 days)	40 to 214 (median=54)	Indomethacin (1), piroxicam (1), others (2)	NSAID vs. placebo for sciatica (3 RCTs): OR=0.99 (95% CI 0.6-1.7)	5
Skeletal muscle relaxants (38 unique trials in four systematic reviews)	Browning, 2001[506]	Quantitative (efficacy of cyclobenza-prine for back or neck pain)	14 (5)	11	5 to 21 days (median=14 days)	48 to 1153 (median= 100)	Cycloben-zaprine (14)	Cyclobenzaprine vs. placebo for acute or chronic LBP or neck pain: OR=4.7 for global improvement (10 RCTs, 95% CI 2.7-8.1), SMD=0.41 (95% CI 0.29 to 0.53) for local pain at 1 to 4 days (7 RCTs), SMD=0.54 (95% CI 0.34 to 0.74) for function at 1-4 days (6 RCTs); results similar at >9 days	7
	Schnitzer, 2004[411]	Qualitative (efficacy of multiple medications)	5 (4)	1	5 to 10 days (median=7 days)	49 to 361 (median=112)	Tizanidine (3), baclofen (1), other (1)	SMR vs. placebo for acute LBP (5 RCTs): SMR superior in 4 of 5 RCTs (no benefit in 1 of 3 RCTs of tizanidine); benefit mostly short-term and early (<7 days)	5

Table 34. Systematic reviews on efficacy of medications and herbal therapies for low back pain

Drug	Author, year	Type of systematic review	Number of included trials (number rated higher-quality) *	Number of trials not included in any other relevant systematic review	Duration of treatment in included trials	Sample sizes in included trials	Interventions evaluated (number of trials)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Skeletal muscle relaxants (38 unique trials in four systematic reviews)	Van Tulder, 2003[488, 489]	Qualitative and quantitative	26 (20)	19	Single dose to 21 days (median=7 days)	20 to 361 (median=80)	Cyclobenzaprine (5), carisoprodol (3), chlorzoxazone (1), orphenadrine (4) methocarbamol, tizanidine (8), dantrolene (1), baclofen (1), others (5)	Skeletal muscle relaxant (SMR) vs. placebo for acute low back pain (8 RCTs): RR=1.25 (95% CI 1.12 to 1.41) for pain relief of >20% or >16 on a 100 point VAS after 2-4 days (3 RCTs), RR=1.72 (95% CI 1.32 to 2.22) for pain relief after 5-7 days (2 RCTs), RR=2.05 (95% CI 1.05 to 4.00) for global improvement after 2-4 days (4 RCTs) and RR=1.47 (95% CI 0.88 to 2.44) for global improvement after 5-7 days (4 RCTs)	7
	Vroomen, 2000[100]	Qualitative (efficacy of medications for sciatica)	1 (1)	0	7 days	112	Tizanidine (1)	Tizanidine vs. placebo for sciatica (1 higher-quality RCT): No difference	5

*Trials adequately meeting at least half of the quality rating criteria or rated as good or higher-quality if the number of criteria met was not reported
CI=confidence interval, NSAID=non-steroidal anti-inflammatory drug, RCT=randomized controlled trial, RR=relative risk, OR=odds ratio, SMD=standardized mean difference, VAS=visual analogue scale

Table 35. Summary of evidence on medications and herbal therapies for acute low back pain

Drug	Number of trials (number rated higher-quality by at least one systematic review)	Net benefit*	Effective versus placebo?	Inconsistency?†	Directness of evidence?	Overall quality of evidence	Comments
Acetaminophen	3 (0)	Moderate	Unable to determine (1 lower-quality trial showing no difference)	Some inconsistency (versus NSAIDs)	Direct	Good	Little data on serious adverse events
Antidepressants	0	No evidence	No evidence	Not applicable	Not applicable	Not applicable	
Antiepileptic drugs	0	No evidence	No evidence	Not applicable	Not applicable	Not applicable	Only evaluated in patients with radicular low back pain
Benzodiazepines	5 (3)	Moderate	Unable to determine (2 trials with inconsistent results)	Some inconsistency (versus placebo and versus skeletal muscle relaxants)	Direct, with supporting indirect evidence from mixed populations with back and neck pain	Fair	No reliable data on risks of abuse or addiction No differences between diazepam and cyclobenzaprine for short-term global efficacy (both superior to placebo) in one large, short-term trial of patients with back or neck pain (mixed duration)
Herbal therapies	7 (5)	Moderate	Yes for devil's claw (2 trials) and white willow bark (1 trial), unable to determine for cayenne (1 lower-quality trial)	Some inconsistency for cayenne (effective versus placebo but not versus homeopathic gel)	Direct	Fair for devil's claw and white willow bark, poor for cayenne	Most trials evaluated patients with acute exacerbations of chronic low back pain
Non-steroidal anti-inflammatory drugs	31 (10)	Moderate	Yes (7 trials)	No	Direct	Good	May cause serious gastrointestinal and cardiovascular adverse events. Insufficient evidence to judge benefits and harms of aspirin or celecoxib for low back pain
Opioids	1 (1)	Moderate	No evidence	Not applicable	Data available from trials of opioids for other acute pain conditions	Fair	No reliable data on risks of abuse or addiction

Table 35. Summary of evidence on medications and herbal therapies for acute low back pain

Drug	Number of trials (number rated higher-quality by at least one systematic review)	Net benefit*	Effective versus placebo?	Inconsistency?†	Directness of evidence?	Overall quality of evidence	Comments
Skeletal muscle relaxants	31 (21)	Moderate	Yes (19 trials)	No	Direct	Good	Little evidence on efficacy of antispasticity skeletal muscle relaxants baclofen and dantrolene for low back pain
Systemic corticosteroids	1 (1)	Not effective	No (1 trial)	No	Direct	Fair	Mostly evaluated in patients with radicular low back pain
Topical lidocaine	0	No evidence	No evidence	Not applicable	Not applicable	Not applicable	
Tramadol	1 (1)	Unable to estimate	No evidence	Not applicable	Direct	Poor	The only trial compared tramadol to a non-steroidal anti-inflammatory drug not available in the U.S.

* Based on evidence showing medication is more effective than placebo, and/or evidence showing medication is at least as effective as other medications or interventions thought to be effective, for one or more of the following outcomes: pain, functional status, or work status. Versus placebo, small benefit defined as 5-10 points on a 100-point Visual Analogue Scale (VAS) for pain (or equivalent), 1-2 points on the Roland Morris Disability Questionnaire (RDQ), 10-20 points on the Oswestry Disability Index (ODI), or a standardized mean difference (SMD) of 0.2-0.5. Moderate benefit defined as10-20 points on a VAS for pain, 2-5 points on the RDQ, 10-20 points on the ODI, or a SMD of 0.5-0.8. Large benefit defined as >20 points on a 100 point VAS for pain; >5 points on the RDQ, >20 points on the ODI, or a SMD of >0.8.
† Inconsistency defined as >25% of trials reaching discordant conclusions on efficacy (no effect vs. positive effect considered discordant)

Table 36. Summary of evidence on medications and herbal therapies for chronic or subacute low back pain

Drug	Number of trials (number rated higher-quality by at least one systematic review)	Net benefit*	Effective versus placebo?	Inconsistency?†	Directness of evidence?	Overall quality of evidence	Comments
Acetaminophen	2 (1)	Moderate	No trials in patients with low back pain	No	Data available from trials of acetaminophen for osteoarthritis	Good	Asymptomatic elevations of liver function tests at therapeutic doses.
Antidepressants	10 (5)	Small to moderate	Yes (9 trials)	No	Direct	Good	Only tricyclic antidepressants have been shown effective for low back pain No evidence on duloxetine or venlafaxine
Antiepileptic drugs	1 (1)	Small to moderate	Yes (1 trial of topiramate)	Not applicable	Direct	Poor	One small trial evaluated topiramate for back pain with or without radiculopathy
Benzodiazepines	3 (2)	Moderate	Mixed results (3 trials)	Some inconsistency (versus placebo)	Direct	Fair	No reliable data on risks of abuse or addiction
Herbal therapies	3 (0)	Moderate	Yes for willow bark (1 trial) and cayenne (2 trials), no evidence for devil's claw	No	Direct	Fair	
Non-steroidal anti-inflammatory drugs	6 (3)	Moderate	Yes (1 trial)	No	Direct	Good	May cause serious gastrointestinal and cardiovascular adverse events. Insufficient evidence to judge benefits and harms of aspirin or celecoxib for low back pain
Opioids	7 (1)	Moderate	Yes (1 trial)	No	Most trials compare different opioids or opioid formulations	Fair	No reliable data on risks of abuse or addiction

Table 36. Summary of evidence on medications and herbal therapies for chronic or subacute low back pain

Drug	Number of trials (number rated higher-quality by at least one systematic review)	Net benefit*	Effective versus placebo?	Inconsistency?†	Directness of evidence?	Overall quality of evidence	Comments
Skeletal muscle relaxants	6 (2)	Unable to estimate	Unable to determine (5 trials)	Not applicable	Most trials evaluated skeletal muscle relaxants not available in the U.S. or mixed populations of patients with back and neck pain	Poor	The two higher-quality trials evaluated skeletal muscle relaxants not available in the U.S.
Systemic corticosteroids	0	No evidence	No evidence	Not applicable	Not applicable	Not applicable	Mostly evaluated in patients with radicular low back pain
Topical lidocaine	0	No evidence	No evidence	Not applicable	Not applicable	Not applicable	
Tramadol	4 (1)	Moderate	Yes (1 trial)	No	Direct	Fair	

* Based on evidence showing medication is more effective than placebo, and/or evidence showing medication is at least as effective as other medications or interventions thought to be effective, for one or more of the following outcomes: pain, functional status, or work status. Versus placebo, small benefit defined as 5-10 points on a 100-point Visual Analogue Scale (VAS) for pain (or equivalent), 1-2 points on the Roland Morris Disability Questionnaire (RDQ), 10-20 points on the Oswestry Disability Index (ODI), or a standardized mean difference (SMD) of 0.2-0.5. Moderate benefit defined as10-20 points on a VAS for pain, 2-5 points on the RDQ, 10-20 points on the ODI, or a SMD of 0.5-0.8. Large benefit defined as >20 points on a 100 point VAS for pain; >5 points on the RDQ, >20 points on the ODI, or a SMD of >0.8.
† Inconsistency defined as >25% of trials reaching discordant conclusions on efficacy (no effect vs. positive effect considered discordant)

Table 37. Summary of evidence on medications for sciatica or radicular low back pain

Drug	Number of trials (number rated higher-quality by at least one systematic review)	Net benefit*	Effective versus placebo?	Inconsistency?†	Directness of evidence?	Overall quality of evidence	Comments
Antiepileptic drugs	3 (2)	Small	Yes (2 trials of gabapentin and 1 trial of topiramate)	No	Direct	Fair	No trials of antiepileptic drugs other than gabapentin or topiramate
Non-selective non-steroidal anti-inflammatory drugs	4 (2)	Not effective	No (3 trials)	No	Direct	Fair	NSAIDs more effective than placebo in mixed populations of patients with low back pain with or without sciatica
Systemic corticosteroids	3 (3)	Not effective	No (3 trials)	No	Direct	Good	

* Based on evidence showing medication is more effective than placebo, and/or evidence showing medication is at least as effective as other medications or interventions thought to be effective, for one or more of the following outcomes: pain, functional status, or work status. Versus placebo, small benefit defined as 5-10 points on a 100-point Visual Analogue Scale (VAS) for pain (or equivalent), 1-2 points on the Roland Morris Disability Questionnaire (RDQ), 10-20 points on the Oswestry Disability Index (ODI), or a standardized mean difference (SMD) of 0.2-0.5. Moderate benefit defined as10-20 points on a VAS for pain, 2-5 points on the RDQ, 10-20 points on the ODI, or a SMD of 0.5-0.8. Large benefit defined as >20 points on a 100 point VAS for pain; >5 points on the RDQ, >20 points on the ODI, or a SMD of >0.8.
† Inconsistency defined as >25% of trials reaching discordant conclusions on efficacy (no effect vs. positive effect considered discordant)

Acupuncture and related interventions

Acupuncture and dry needling

Acupuncture involves the insertion of needles at specific acupuncture points in order to treat or prevent symptoms and conditions. Dry needling also involves the insertion of needles, but targets painful trigger points rather than acupuncture points. Neither technique involves injection of medications through the needle.

Results of search: systematic reviews
We identified two higher-quality systematic reviews (33 and 35 trials) on efficacy of acupuncture (including electroacupuncture) for primarily chronic low back pain[68-70]. One review[69, 70] also evaluated efficacy of dry needling. We also identified two lower-quality systematic reviews[555, 556], one of which focused on safety of acupuncture[556]. We excluded an outdated Cochrane review[557], four other outdated systematic reviews[558-561], and three systematic reviews that did not specifically assess efficacy of acupuncture for low back pain[562-564].

Results of search: trials
Fifty-one unique trials on efficacy of acupuncture were included in three systematic reviews[68-70, 555]. Both higher-quality systematic reviews identified significant methodological shortcomings in trials of acupuncture (10 of 33 and 14 of 35 studies rated as higher-quality)[68-70]. In addition, about one-third of the trials were conducted in Asian settings, which could limit generalizability of findings to the U.S., due to different patient expectations for benefit[565] or other factors. Treatment duration varied from one to 20 session of acupuncture.

We also identified three recent, large (n=241, 298 and 2,841), higher-quality trials[566-568] of acupuncture for low back pain not included in the systematic reviews.

Efficacy of acupuncture versus placebo or sham treatment

Results of the three systematic reviews on efficacy of acupuncture were generally consistent[68-70, 555]. For acute low back pain, the two higher-quality systematic reviews found sparse evidence (two trials, one higher-quality) on efficacy of acupuncture versus sham acupuncture[68-70]. Results are inconclusive because of small sample sizes and inconsistent results. One lower-quality trial[569] found acupuncture superior to sham acupuncture, but one higher-quality trial[570] found no differences. The higher-quality trial only evaluated a single session of single point acupuncture.

For chronic low back pain, both higher-quality systematic reviews found acupuncture moderately more effective than no treatment (8 trials, SMD=-0.69, 95% CI -0.98 to -0.40[68] and 2 trials, SMD=-0.73, 95% CI -1.19 to -0.28[69, 70]). Both systematic reviews also found acupuncture moderately more effective than sham treatments (acupuncture or TENS) (7 trials, SMD=-0.54, 95% CI -0.73 to -0.35[68] and 2 trials, WMD=-17.8, 95% CI -25.5 to -10.1[69, 70]) for short-term (defined as <6 weeks or <3 months) pain relief. Versus sham acupuncture alone, one of the systematic reviews estimated an SMD=-0.58 (4 trials, SMD=-0.80 to -0.36), equivalent to a WMD=-14.5 on a 100 point VAS[68]. However, these results may overestimate benefits of

acupuncture because they are based on a re-calculation of effect sizes from one trial (resulting in a larger estimate of effect) and also included data from a trial in which most patients randomized to sham acupuncture were excluded from analysis because they crossed over to receive true acupuncture[571, 572]. A re-analysis based on published effect sizes that excluded the trial with high crossover estimated an SMD for short-term pain intensity of -0.425 (95% CI -0.66 to -0.19) for acupuncture versus sham acupuncture, equivalent to a WMD=-10.6 on a 100 point VAS[571]. Both systematic reviews found acupuncture associated with moderate short-term improvements in functional status compared to no treatment (SMD=-0.62, 95% CI -0.95 to -0.30[68] and SMD=-0.63, 95% CI -1.08 to -0.19[69, 70]), but not compared to sham therapies. For short- and long-term assessments of "overall" improvement, acupuncture was superior to either sham treatments or no treatment.

A recent, higher-quality trial (n=298) not included in the systematic reviews found acupuncture substantially superior to wait list control for short-term pain relief (mean difference 21.7 points on a 100 point scale), but was inconsistent with the systematic reviews because it found no differences between acupuncture and sham acupuncture (superficial needling at nonacupuncture points) on any outcome at either 8 weeks or with longer follow-up on (through 52 weeks) (Table 38)[566]. In general, evidence on longer-term (more than 6 weeks after treatment) benefits of acupuncture is sparser and more inconsistent than evidence on short-term benefits. In one systematic review acupuncture was associated with moderately superior long-term pain relief compared to sham TENS in two trials (SMD=-0.62, 95% CI -1.22 to -0.03) and to no additional treatment in five trials (SMD=-0.74, 95% CI -1.47 to -0.02), but was no better than sham acupuncture in two trials (SMD=-0.59, 95% CI -1.29 to +0.10)[68]. One higher-quality trial included in the systematic reviews that evaluated outcomes one year after treatment found no differences between acupuncture and a self-education book for pain (SMD=-0.35, 95% CI -0.09 to +0.51), and acupuncture slightly inferior to massage (SMD=+0.40, 95% CI +0.09 to +0.71)[369]. A large, higher-quality trial not included in the systematic reviews found substantial differences between acupuncture and no acupuncture in back function (20 points on a 100 point scale) and back pain (27 points on a 100 point scale) at 3 months, but clinically insignificant differences (less than 5 points) at 6 months (Table 38)[568]. On the other hand, another higher-quality trial not included in the systematic reviews found that some beneficial effects of acupuncture may extend beyond a year[567]. In this trial, acupuncture was associated with small sustained improvements in SF-36 pain scores compared to usual general practitioner care 24 months after a short course of treatment (mean adjusted difference -8.0 on a 100 point scale, p=0.032) and decreased use of low back pain medications in the last 4 weeks (60% vs. 41%, p=0.03). There were no differences in ODI scores, McGill Present Pain Intensity scores, or other SF-36 dimension scores.

Table 38. Recent trials of acupuncture not included in systematic reviews

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Brinkhaus, 2006[566]	n=298 8 weeks (versus wait list control) to 52 weeks (versus sham acupuncture)	**Acupuncture vs. sham acupuncture vs. wait list control at 8 weeks; acupuncture vs. sham acupuncture at 52 weeks** Pain intensity (difference from baseline, 0 to 100 scale): -28.7 vs. -23.6 vs. -6.9 at 8 weeks (p=0.26 for acupuncture vs. sham; p<0.001 for acupuncture vs. wait list control); 39.2 vs. 44.9 at 52 weeks (p=0.20) Back function (mean, 0 to 100 scale): 66.8 vs. 62.9 vs. 57.7 at 8 weeks, 66.0 vs. 63.1 at 52 weeks (NS) Pain Disability Index (mean, 0 to 100 scale): 18.8 vs. 21.5 vs. 27.1 at 8 weeks, 19.0 vs. 23.0 at 52 weeks (NS) SF-36 physical health scale (mean): 40.5 vs. 36.2 vs. 33.9 at 8 weeks (p=0.004 for acupuncture vs. sham and p<0.001 for acupuncture vs. wait list control); 38.9 vs. 36.1 at 52 weeks (p=0.07) SF-36 mental health scale: No differences at 8 weeks, 50.5 vs. 47.2 at 52 weeks (p=0.04) SF-36 pain scale (mean): 58.8 vs. 50.7 vs. 39.9 at 8 weeks (p=0.01 for acupuncture vs. sham), 52.4 vs. 44.0 at 52 weeks Depression: No significant differences	8/10
Thomas, 2006[567]	n=241 24 months	**Acupuncture versus usual care** SF-36 Pain score, mean adjusted difference between interventions: -5.6 (95% CI -11.4 to +0.2) at 12 months, -8.0 (95% CI -13.2 to -2.8) at 24 months (favors acupuncture) McGill Present Pain Intensity: No difference at 12 or 24 months ODI Score: No difference at 12 or 24 months Pain-free in last 12 months: 18% vs. 8% (p=0.06) Use of low back pain medication in last 4 weeks: 60% vs. 41% (p=0.03)	7/10
Witt, 2006[568]	n=2,841 6 months	**Acupuncture vs. no acupuncture (difference in change from baseline, positive values favor acupuncture)** Back function loss (Hannover Functional Assessment Questionnaire, 0 to 100 scale): 22.0 (95% CI 19.3 to 24.7) at 3 months, 3.7 (95% CI 0.7 to 6.7) at 6 months Low Back Pain Rating Scale (0 to 100): 27.2 (95% CI 20.9 to 24.5) at 3 months, 2.7 (95% CI -0.3 t0 5.7) at 6 months SF-36 Physical Component score: 4.7 (95% CI 4.0 to 5.4) at 3 months, 0.6 (95% CI -0.2 to 1.3) at 6 months SF-36 Mental Component score: 2.1 (95% CI 1.4 to 2.8) at 3 months, 0.2 (95% CI -0.6 to 1.0) at 6 months	8/10

*Excludes criteria involving blinding of care providers, for maximum score of 10

Efficacy of acupuncture versus other interventions

For acute low back pain, both systematic reviews included one higher-quality trial that found no differences between acupuncture and NSAIDs for pain relief[68-70]. In mixed populations of patients with acute or longer duration low back pain, there was no significant difference between acupuncture and moxibustion (one lower-quality trial), but electroacupuncture was superior to TENS for pain relief (one higher-quality trial).

For chronic low back pain, both systematic reviews found acupuncture inferior to spinal manipulation for short-term pain relief, though the number and quality of trials was limited[68-70]. One of the systematic reviews calculated an SMD=+1.32 (95% CI +0.77 to +1.87) from two lower-quality trials[68]. Neither found any differences between acupuncture and other active therapies (massage, analgesic medication, or TENS, each comparison evaluated in one to four trials).

Efficacy of one acupuncture technique versus another acupuncture technique

The Cochrane review compared benefits of different acupuncture techniques (8 trials, 2 higher-quality)[69, 70]. In one higher-quality trial, deep stimulation was superior to superficial stimulation at short-term follow-up[573]. In the other higher-quality trial, there was no difference between manual acupuncture and electroacupuncture[574]. There was insufficient evidence (single comparisons from lower-quality trials) to judge comparative efficacy of other acupuncture techniques.

Efficacy of dry needling

For acute low back pain, the Cochrane review[69, 70] included one lower-quality trial that found no differences between one session of dry needling versus trigger point injection with lidocaine and steroid, trigger point injection with lidocaine only, or cooling spray over the trigger point area followed by acupuncture[575]. For chronic low back pain, one higher-quality trial found superficial needling of trigger points superior to sham TENS for immediate pain relief[140] and one lower-quality trial found dry needling added to a regimen of physiotherapy, occupational therapy, and industrial assessments superior to the regimen without dry needling[576] for short- and intermediate-term functional status.

Harms

The Cochrane review found only 14 of 35 trials reported any complications or side effects[69, 70]. Minor complications occurred in 5% (13/245) patients receiving acupuncture, 0% (0 of 156) receiving sham, and 10% (21/205) receiving other interventions. None of the complications were fatal or required hospitalization.

Another systematic review of prospective (randomized and non-randomized) studies of over 250,000 acupuncture treatments for various conditions found wide variation in rates of adverse events, ranging from 1% to 45% for needle pain, and 0.03% to 38% for bleeding[556]. The wide ranges are probably related to multiple factors, including differences in populations, interventions, and methods for defining, identifying, and reporting adverse events. Feelings of faintness and syncope were uncommon, with an incidence of 0% to 0.3%. Serious adverse events were rare. Pneumothorax was reported in two patients, and there were no cases of infections.

Costs

Three trials estimated cost-effectiveness for acupuncture. One found routine offering of acupuncture associated with an incremental cost-effectiveness ratio of $8,185/QALY (95% CI $369 to $54,090) relative to usual care (converted from British pounds to U.S. dollars at January

2007 exchange rate of 1 British pound = 1.93 U.S. dollars)[577], and another estimated cost-effectiveness of €10,526/QALY (about $13,684 U.S./QALY in January 2007) for acupuncture versus no acupuncture[568]. The third trial found no significant differences in back pain-related HMO costs between patients randomized to acupuncture, massage, and self-care (massage was the most effective therapy for patient outcomes)[369].

Summary of evidence

- For acute low back pain, there is insufficient evidence (two trials, one higher-quality) to judge efficacy of acupuncture compared to sham acupuncture, as results are inconsistent and the acupuncture intervention was suboptimal in the higher-quality trial (level of evidence: poor).
- For acute low back pain, one higher-quality trial found no difference between acupuncture and NSAIDs (level of evidence: poor).
- For mixed populations of patients with acute and longer duration low back pain, one lower-quality trial found no difference between acupuncture and moxibustion and one higher-quality trial found electroacupuncture superior to TENS (level of evidence: poor to fair).
- For chronic low back pain, there is consistent evidence from multiple trials that acupuncture is moderately effective for short-term pain relief compared to no treatment and sham TENS in patients with chronic low back pain, and superior to no treatment for short-term functional outcomes (level of evidence: good).
- For chronic low back pain, evidence on efficacy of acupuncture versus sham acupuncture is inconsistent. Although four trials (three higher-quality) found acupuncture moderately more effective than sham acupuncture for short-term pain relief, a recent, large (n=298), higher-quality trial found no significant differences (level of evidence: fair).
- For chronic low back pain, evidence on longer-term (>6 weeks) outcomes is sparse but suggests acupuncture is more effective than sham TENs or no treatment, though benefits may become attenuated with longer follow-up. One recent, higher-quality trial found small beneficial effects on pain persist for up to 24 months (level of evidence: fair).
- Acupuncture was substantially inferior to spinal manipulation in two lower-quality trials (level of evidence: fair)
- There is no clear evidence of significant differences between acupuncture and TENS (4 trials), medications (3 trials), or massage (1 trial) (level of evidence: fair).
- Dry needling alone was not effective compared to trigger point injections or acupuncture for acute low back pain in one lower-quality trial (level of evidence: poor), but was more effective than placebo or when added to other interventions for chronic low back pain in two trials (one higher-quality) (level of evidence: fair).
- Serious adverse events with acupuncture appear rare, though rates of minor events vary widely and were often poorly reported (level of evidence: fair).

Recommendations and findings from other guidelines

- The AHCPR guidelines recommend against invasive needle acupuncture and other dry needling techniques for patients with acute low back problems (strength of evidence: D).
- The VA/DoD and UK RCGP guidelines on acupuncture for acute low back pain are similar.
- The European COST guidelines make no recommendations on acupuncture for acute low back pain, and found insufficient evidence to recommend acupuncture for chronic low back pain.

Acupressure

Acupressure is a non-invasive method that involves manipulation of the skin and soft tissues with the fingers or other blunt devices instead of needles on acupuncture points. It is less well-studied than acupuncture.

Results of search: systematic reviews
We found no systematic review evaluating efficacy of acupressure.

Results of search: trials
From nine potentially relevant citations, we identified two higher-quality, open-label trials of acupressure for chronic low back pain[578, 579]. Both were conducted in Taiwan by the same group of investigators. Duration of follow-up in both trials was six months.

Efficacy of acupressure versus physical therapy

For chronic low back pain, one higher- and one lower-quality trial found acupressure more effective than unstandardized physical therapy that consisted of multiple techniques at the discretion of the physical therapist (Table 39)[578, 579]. In the one trial that reported functional outcomes, acupressure was associated with moderate effects on the RDQ (mean difference -5.36, 95% CI -7.21 to -3.52) but only small effects on the ODI (-7.99, 95% CI -10.8 to -5.17) that persisted through six months[579]. Days off from work or school also improved more in the acupressure group (mean difference compared to baseline -2.79 days, $p<0.0001$). In both trials, acupressure was moderately to substantially superior to physical therapy for pain relief, with mean differences between treatments -27.2 on a 100 point VAS ($p<0.0001$) and -4.46 on the 0 to 45 point Short-Form Pain Questionnaire ($p=0.0001$) after 6 months. In one trial, effects on pain relief were about twice as high as seen with most other conventional interventions or acupuncture[579].

Table 39. Trials of acupressure versus physical therapy

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Hsieh, 2004[578]	n=146 6 months	**Acupressure versus physical therapy** Short-form Pain questionnaire, mean change from baseline: -8.69 vs. -4.23 (p=0.0001)	6/10
Hsieh, 2006[579]	n=158 6 months	**Acupressure versus physical therapy** RDQ score, difference in mean change from baseline: -5.36, 95% CI -7.21 to -3.52 (p<0.0001) Modified ODI score, difference in mean change from baseline: -7.99, 95% CI -10.8 to -5.17 (p<0.0001) Pain (VAS, 0 to 100), difference in mean change from baseline between interventions: -27.12 (p<0.0001)	5/10

*Excludes criteria involving blinding of care providers, for maximum score of 10

Harms
One of the trials reported no adverse events in the acupressure group[578]. The other trial did not report adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- There is no evidence on acupressure for acute low back pain.
- For chronic low back pain one higher and one lower-quality trial found acupressure moderately to substantially more effective than physical therapy for pain and functional outcomes. However, it is not clear if these results can be generalized to other settings because both trials were conducted in Taiwan by the same investigators and the physical therapy interventions were not standardized (level of evidence: fair)
- Acupressure does not appear associated with serious adverse events, but harms were only reported by one trial (level of evidence: fair).

Recommendations and findings from other guidelines

- The other guidelines do not address acupressure.

Neuroreflexotherapy

Neuroreflexotherapy is a technique characterized by the temporary implantation of staples superficially into the skin over trigger points in the back and referred tender points in the ear. Like acupuncture, it involves the use of puncture devices in the skin. However, neuroreflexotherapy is believed to stimulate different zones of the skin.

Results of search: systematic reviews
We identified one recent, higher-quality Cochrane review (three trials, two rated higher-quality[580, 581]) on effectiveness of neuroreflexotherapy for chronic low back pain[582].

Results of search: trials
The Cochrane review included three trials (two rated higher-quality) on neuroreflexotherapy for chronic low back pain[580, 581]. The same principal investigator conducted all three trials in Spain (total number of patients: 273). We did not search for additional trials.

Efficacy of neuroreflexotherapy versus sham neuroreflexotherapy

The two higher-quality trials[580, 581] both found neuroreflexotherapy substantially superior to sham therapy for short-term (up to 45 days) pain relief. In one trial, the proportion of patients with pain relief was 96% with neuroreflexotherapy versus 2.3% with sham ($p<0.0001$)[580]. In the other trial, neuroreflexotherapy was associated with an average improvement in spontaneous pain of 3.09 (on a 10 point scale) compared to 0.34 with sham treatment that was statistically significant ($p<0.001$), but not clinically significant[581]. One[580] of the two trials found neuroreflexotherapy superior to sham therapy on a variety of functional and work-related outcomes, but the other[581] found no significant differences.

Efficacy of neuroreflexotherapy versus usual care

The third, lower-quality trial compared neuroreflexotherapy to usual care[583]. It found neuroreflexotherapy moderately superior for short-term (60 days) pain relief (average improvement 5.50 on a 10 point scale versus 1.92, $p<0.0005$) and substantially superior for functional status (average improvement 8.67 on RDQ scale versus 2.05, $p=0.007$). Number of days on sick leave and duration of sick leave (average 3.2 vs. 105.2 days, $p=0.001$) and use of health care services were also lower in the neuroreflexotherapy group after one year. There were no differences in quality of life.

Harms
One trial found a higher incidence of adverse effects in the sham therapy group (65% vs. 9%), primarily due to gastric discomfort probably associated with increased NSAID use[580]. Skin tightness was associated with implantation of staples, but did not require early extraction in any patient. Scarring was not specifically reported in any trial, but is not believed to be an important problem because of the superficial nature of the staple implantations.

Costs
One trial included a cost-effectiveness analysis that found neuroreflexotherapy dominated usual care (total costs lower and clinical outcomes superior)[583]. Neuroreflexotherapy was associated with median costs of $800 compared to $3,800 with usual care, and superior by an average of 5.5 points on the RDQ Scale (0 to 24).

Summary of evidence

- There is no evidence on efficacy of neuroreflexotherapy for acute low back pain.
- For chronic low back pain, three trials (two higher-quality) found neuroreflexotherapy substantially superior to sham therapy or usual care for short-term pain relief. All of the trials were conducted in Spain by the same principal investigator at a specialized center, potentially limiting applicability of results to other settings (level of evidence: fair).

- Evidence on beneficial effects of neuroreflexotherapy relative to sham treatment on functional outcomes is mixed (level of evidence: fair).
- The single lower-quality trial assessing one-year outcomes found lower self-reported sick leave and consumption of health care resources following neuroreflexotherapy compared to usual care (level of evidence: poor).

Recommendations and findings from other guidelines

- The European COST guidelines recommend consideration of neuroreflexotherapy for patients with moderate or severe (>3/10 on VAS) chronic low back pain.

Educational interventions

Back schools

The original Swedish back school was introduced in 1969[584, 585]. The basic elements of back schools consist of an educational and skills program, including exercises, in which all lessons are given to groups of patients and supervised by a therapist or medical specialist. However, the content and intensity of back schools meeting this basic definition can vary widely.

Results of search: systematic reviews
We identified one recent, higher-quality Cochrane review of 19 trials (6 rated higher-quality) on back schools for acute or chronic low back pain[586, 587]. We also included two other recent, lower-quality systematic reviews[588, 589]. Another recent, higher-quality systematic review evaluated factors that could predict better outcomes from back schools and multidisciplinary rehabilitation (results not clearly separated for the two interventions)[590]. We excluded an outdated Cochrane review[591] and ten other outdated systematic reviews[193, 345, 346, 386, 592-597].

Results of search: trials
Thirty-one unique trials were included in three systematic reviews of back schools[586-589]. We did not search for additional trials.

Efficacy of back schools versus placebo or wait list control

For acute or subacute low back pain, the Cochrane review included one lower-quality trial[598] that found back school superior to sham treatment (shortwave therapy at the lowest intensity) for short-term recovery and return to work, but not for short-term pain or long-term recurrences[586, 587]. For chronic low back pain, the Cochrane review found conflicting evidence from eight trials (2 higher-quality[599, 600]) on effectiveness of back schools versus placebo or wait list controls. For short-term outcomes, seven RCTs found no benefit from back schools. For long-term outcomes, one higher-quality trial[600] found beneficial effects on functional status and return to work, though two lower-quality trials[601, 602] found no long-term benefits. Results of back schools were generally more promising in trials conducted in an occupational setting (moderate evidence for improved short- and intermediate-term pain and return to work) and for more intensive (three to five-week stays in specialized centers) programs consisting of modifications of the original Swedish back school. In general, however, any benefits associated with back schools were small.

Conclusions of two other (lower-quality) systematic reviews were generally consistent with the Cochrane review[588, 589]. The three systematic reviews included a total of 13 trials of back schools versus placebo or wait list controls for chronic or subacute low back pain[586-589]. No trial evaluated efficacy of back school versus placebo or wait list control in patients with exclusively acute (<4 weeks) low back pain).

Efficacy of back schools versus other interventions

For acute or subacute low back pain, the Cochrane review[586, 587] included four trials (two higher quality[603-605]) on effectiveness of back school versus other treatments (physical therapy, usual care, or advice). Although one higher-quality trial found back school associated with decreased sick leave compared to usual care after 200 days (30% vs. 60%) and 5 years (19% vs. 34%)[603, 604], the other three trials reported no significant differences between back school and other treatments[598, 605, 606]. Only one of these trials (rated lower-quality) evaluated patients with exclusively acute (<4 weeks) low back pain[606]. It found no differences between back school and advice.

For chronic low back pain, the Cochrane review included six trials (one higher-quality, four in occupational settings) that found back schools slightly superior to other treatments (exercises, spinal manipulation, myofascial therapy, or some kind of advice) for short and intermediate-term pain relief and improvement in functional status, but not for long-term outcomes[586, 587].

Altogether, the three systematic reviews included a total of 13 unique trials of back schools versus other interventions for chronic or subacute low back pain[586-589]. None of the systematic reviews found sufficient evidence to conclude that back schools are clearly effective. The systematic review on factors associated with better outcomes after back school or multidisciplinary rehabilitation found consistent evidence that higher baseline pain is associated with worse outcomes.[590] It also found several work-related parameters (such as high satisfaction) and low levels of active coping skills at baseline associated with better outcomes. Many predictors were evaluated in only one study or lacked consistent predictive value, in part due to flaws in the studies.

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- For acute low back pain, back schools were no better than advice in a single lower-quality trial (level of evidence: poor).
- For acute or subacute low back pain, back schools were superior to placebo in a single lower-quality trial for short-term recovery and return to work, but not for pain or long-term recurrences (level of evidence: poor).

- For acute or subacute low back pain, evidence on efficacy of back schools versus physical therapy, usual care, or advice was inconsistent, though most studies found no differences (four trials, two higher-quality) (level of evidence: fair).
- For chronic low back pain, evidence on effects of back schools versus placebo or wait list controls is inconsistent, though most trials found no beneficial effects (level of evidence: fair).
- For chronic low back pain, back schools are slightly superior to exercises, spinal manipulation, myofascial therapy, or advice for short-term pain and functional status, but not for long-term outcomes (level of evidence: fair).
- More intensive back school programs based on the original Swedish program and back school programs in occupational settings appear to be the most effective (level of evidence: fair).

Recommendations and findings from other guidelines

- The AHCPR guidelines found back schools in the workplace that include worksite-specific education may be effective adjuncts to individual education efforts by the clinician for the treatment of patients with acute low back problems (strength of evidence: C).
- The AHCPR guidelines found that efficacy of back schools in nonoccupational settings had not been proven (strength of evidence: C).
- The European COST guidelines recommend considering back schools where information given is consistent with evidence-based recommendations for short-term (<6 weeks) pain relief and improvements in functional status. They do not recommend back schools as a treatment for chronic low back pain when aiming at long-term effects (>12 months).

Brief educational interventions

We defined brief interventions as a detailed clinical examination by a physician and/or physiotherapist followed by individualized back education and advice. As we defined them, brief educational interventions typically require several hours and are usually completed in one or two sessions. Brief interventions differ from back schools because they don't involve group education and exercises. They also are distinct from multidisciplinary rehabilitation, which generally includes a coordinated cognitive-behavioral or other psychological therapy component as well as a supervised rehabilitation program.

Results of search: systematic reviews
We found no systematic reviews of brief educational interventions.

Results of search: trials
We identified three trials (all in workers with low back pain for less than three months) that evaluated brief educational interventions in workers with subacute low back pain (Table 40)[603, 604, 607-610]. Two were rated higher-quality[603, 604, 609, 610]. A fourth, higher-quality trial evaluated a brief educational intervention for chronic low back pain[611, 612].

Efficacy of brief educational interventions versus usual care

For workers on sick leave for 8 to 12 weeks due to low back pain, one lower-quality trial found a brief educational intervention (a single visit to a spine clinic with a detailed examination by a physiatrist and physical therapist and advice to remain active) associated with no differences compared to usual care in the proportion who continued to report low back pain at 6 months or 1 year or the proportion off sick leave at 3 years, though patients randomized to the intervention were more likely to be off sick leave at 1 year (OR=1.60, 95% CI 1.08 to 2.39)[607, 608]. In workers with bothersome low back pain for up to 3 months, a higher-quality trial found a brief intervention associated with fewer sick days after 1 year (19 versus 41 days, p=0.02)[609] and 2 years (30 versus 62 days, p=0.03) compared to usual care [610]. There were no differences in pain or ODI scores at any follow-up period. A smaller proportion of patients reported severe symptoms at 3 months, but not with longer duration of follow-up. In workers with back pain for four to twelve weeks, another higher-quality trial found a brief educational intervention (detailed examination plus three hours of advice for light duty) associated with a lower likelihood for sick leave (19% versus 34%, p<0.001) or permanent disability (49% vs. 69%, p<0.03) after five years compared to usual care[603, 604].

Table 40. Trials of brief educational interventions versus usual care

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Indahl, 1995 and 1998[603, 604]	n=489 5 years	**Brief educational intervention versus usual care** On sick leave: 30% vs. 60% at 200 days, 19% vs. 34% at 5 years (p<0.001) Long term or permanent disability status after 5 years: 19% vs. 34% (p<0.001) Sick listed > 2 x: 49% vs. 69% (p<0.03)	7/9
Karjalainen, 2003 and 2004[609, 610]	n=170 2 years	**Brief educational intervention versus mini intervention plus work site visit versus usual care** Pain intensity: 3.5 vs. 3.2 vs. 3.4 at 24 months (NS) Very or extremely bothersome symptoms during the past week: 29% vs. 35% vs. 48% at 3 months, 23% vs. 20% vs. 29% at 24 months (p=0.048 for A vs. C at 3 months, NS for B vs. C) ODI: 19 vs. 18 vs. 18 at 24 months (NS) Days on sick leave: 30 vs. 45 vs. 62 (p=0.030 for A vs. C, NS for B vs. C)	7/9
Molde Hagen, 2000 and 2003[607, 608]	n=510 3 years	**Brief educational intervention versus usual care** LBP still present at 1 year: 47% vs. 52% (NS) Off sick leave at 1 year: 69% vs. 57% (p<0.05) Off sick leave at 3 years: 64% vs. 62% (NS) New episodes of sick leave due to LBP (through 3 years): 62% (147/237) vs. 61% (135/220) (NS)	4/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Efficacy of brief educational interventions versus brief educational interventions plus manipulation and exercise

For chronic low back pain, one higher-quality trial found a brief intervention (consisting of a physician consultation and individualized reassurance, education, and back advice with a repeat visit at 5 months) slightly inferior to the brief intervention plus manipulation (using a muscle energy technique involving contraction of muscles against an applied counterforce) and

exercise for pain relief at 12 and 24 months (difference of about 6 points on a 100 point pain scale at 12 months and about 3 points at 24 months) (Table 41)[611, 612]. Effects on disability, health-related quality of life and number of days of sick leave through 1 year (20 vs. 14 days) were similar.

Table 41. Trial of brief educational intervention versus brief educational intervention plus exercise and manipulation

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Niemisto, 2003 and 2005[611, 612]	n=204 2 years	**Brief educational intervention versus brief intervention plus manipulation (using a 'muscle energy technique') plus exercise** Pain (0 to 100): 32.2 vs. 25.7 at 12 months (p=0.01), 33.1 vs. 30.7 at 24 months ODI: 16.5 vs. 13.7 at 12 months (p=0.20), 14.0 vs. 12.0 at 24 months Health-related Quality of Life (15D): No differences Number of days of work absence through 1 year: 20 vs. 14	8/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Harms
No trial reported adverse events.

Costs
Cost-benefit analyses of two trials of workers with subacute low back pain found the brief educational intervention superior to usual care by an average of $3,497[608] and €4,839 (about $6,290 U.S.)[610], largely due to decreased sick leave in the first year after the intervention. For chronic low back pain, a third trial estimated an incremental cost-effectiveness of $512 per additional point of improvement on a 100-point pain scale for combined manipulation and exercise plus a brief intervention, versus the brief intervention alone[612].

Summary of evidence

- In workers with subacute low back pain, three trials (two higher-quality) found a brief educational intervention associated with beneficial effects on sick leave compared to usual care, with most benefits observed in the first year after the intervention. There were no clear effects on pain or functional status (level of evidence: good).
- For chronic low back pain, a brief intervention was only slightly inferior to the brief intervention plus exercise and manipulation (one higher-quality trial) (level of evidence: fair).

Recommendations and findings from other guidelines

- The European COST guidelines recommend brief educational interventions that encourage a return to normal activity to reduce sickness absence and disability associated with chronic low back pain.

Exercise and related interventions

Exercise

We defined exercise therapy as either a supervised exercise program or formal home exercise regimen. Exercise therapy can range from programs aimed at general physical fitness or aerobic exercise to programs more specifically aimed at muscle strengthening, flexibility, or stretching, or different combinations of these elements.

Results of search: systematic reviews
We identified a recent, higher-quality Cochrane review (61 trials) on efficacy of exercise therapy for nonspecific low back pain[613, 614]. A separate article based on the Cochrane review reported results of meta-regression and modeling to identify features of more effective exercise regimens[615]. We included five other recent systematic reviews of exercise therapy, all with a less comprehensive scope than the Cochrane review[616-620]. Two were rated higher-quality[617, 619]. We excluded an outdated Cochrane review[621], one systematic review that only evaluated trials included in the outdated Cochrane review[622]; nine other outdated systematic reviews[193, 344-346, 386, 623-626], one review that didn't use systematic methods[627], and one systematic review focusing on rehabilitation following lumbar disc surgery[628].

Results of search: trials
Seventy-nine unique trials of exercise therapy were included in six systematic reviews[613, 614, 616-620]. Most of the trials evaluated patients with chronic low back pain and had methodological shortcomings. For example, 43 of 61 trials in the Cochrane review evaluated patients with chronic low back pain[613, 614]. Only eight of the 61 trials met all four quality rating criteria used by this review. We also identified a recent, large (n=1334), lower-quality trial not included in the systematic reviews that compared manipulation, exercise, or both to usual care[629]. Another recent trial that compared different physical therapy regimens for spinal stenosis (consisting of different types of exercise plus manipulation/mobilization) is reviewed in Key Question 10 (combination therapies)[630].

Efficacy of exercise therapy versus placebo or usual care

For acute low back pain, the Cochrane review[613, 614] found exercise therapy superior to usual care or no treatment in only two (one higher quality[349]) of nine trials. Among trials with data that could be pooled, there was no difference between exercise therapy usual care for pain relief (3 trials) or functional outcomes (3 trials) at any time period. The Cochrane review also included five trials that compared exercise to usual care or no treatment in patients with subacute low back pain. Although two trials[631, 632] (one higher-quality[632]) found a graded-activity intervention in the workplace associated with reduced absenteeism compared to usual care and one lower-quality trial[633] found an exercise program combined with behavioral therapy associated with improved functioning compared to usual care, pooled results showed no significant differences in pain scores (5 trials, WMD=1.89 on a 100 point scale, 95% CI -1.13 to 4.91) or functional outcomes (4 trials, WMD=1.07, 95% CI -3.18 to 5.32).

For chronic low back pain, the Cochrane review found exercise slightly to moderately superior to no treatment for pain relief at the earliest follow-up period (19 trials, WMD=10 points on a 0 to 100 scale, 95% CI 1.31 to 19.09), though not for functional outcomes (17 trials, WMD=3.00 on a 0 to 100 scale, 95% CI -0.53 to 6.48)[613, 614]. Results were similar at later follow-up. The differences were somewhat greater in health care settings (WMD=13.3 points for pain, 95% CI 5.5 to 21.1 and WMD=6.9 for function, 95% CI 2.2 to 11.77) than in occupational or general population settings.

Three other systematic reviews were less comprehensive than the Cochrane review, but reached consistent conclusions[617, 618, 620]. A higher-quality systematic review that focused on work outcomes (14 trials) found exercise (including exercise as part of a multidisciplinary intervention) slightly reduced sick leave during the first year (SMD=-0.24, 95% CI -0.36 to -0.11) and improved the proportion returned to work (RR=1.37 at 1 year, 95% CI 1.05 to 1.78), though no benefit was observed in the severely disabled subgroup (>90 days sick leave under usual care) or in patients receiving disability payments[617].

One lower-quality, qualitative systematic review found "positive results" on at least one outcome (pain or back specific function) for all six included trials that compared exercise therapy to wait list, advice, or TENS[618]. Another lower-quality systematic review[620] that focused on exercise for spondylolysis and spondylolisthesis included only two trials (one higher-quality[634]), both of which found exercise superior to usual care[634] or sham exercise[635].

The recently published, large (n=1334) UK BEAM Trial also reported results consistent with the Cochrane review (Table 42)[629]. In patients with low back pain for at least 28 days, exercise was only marginally superior to usual care for pain and disability.

Table 42. Results of the UK BEAM trial

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
UK BEAM Trial, 2004[629]	n=1334 12 months	**Manipulation + exercise versus manipulation alone versus exercise alone (all results are absolute net benefit relative to usual care at 12 months)** RDQ Questionnaire (0 to 24 scale): 1.30 (95% CI 0.54 to 2.07) vs. 1.01 (95% CI 0.22 to 1.81) vs. 0.39 (95% CI -0.41 to 1.19) Modified Von Korff pain score (0 to 100 scale): 6.71 (95% CI 2.47 to 10.95) vs. 5.87 (95% CI 1.58 to 10.17) vs. 4.90 (95% CI 0.30 to 9.50) Modified Von Korff disability score (0 to 100 scale): 6.71 (95% CI 2.62 to 10.80) vs. 5.65 (95% CI 1.57 to 9.72) vs. 4.56 (95% CI 0.34 to 8.78)	2/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Efficacy of exercise therapy versus other interventions

For acute low back pain, the Cochrane review included seven trials that found no difference between exercise therapy and other non-invasive treatments for pain (WMD=0.31 point, 95% CI

-0.10 to 0.72) and function[613, 614]. For chronic low back pain, exercise was associated with statistically significant but only small benefits compared to other non-invasive treatments for pain (WMD=5.93 points, 95% CI 2.21 to 9.65) and function (WMD=2.37 points, 95% CI 0.74 to 4.0).

One higher-quality[619] and one lower-quality trial[616] focused on efficacy of the McKenzie method. The McKenzie method is an exercise-based intervention which places patients in one of three broad categories (derangement, dysfunction, and postural syndrome) to guide therapy. Patients are taught to perform exercises that centralize their symptoms and to avoid movements that peripheralize them, using techniques that primarily rely on patient-generated forces and emphasizing self-care. The higher-quality systematic review (11 trials) found conflicting evidence on effectiveness of McKenzie therapy versus other interventions[619]. For acute low back pain (9 trials), the McKenzie method was slightly superior (mean differences <5 points on 100 point pain and disability scales) to passive therapies (educational booklets, bed rest, ice packs, and massage), but slightly inferior to advice to stay active, with inconsistent results compared to spinal manipulation. For back pain of mixed duration, a lower-quality and less comprehensive (5 trials) systematic review found the McKenzie method associated with small short-term improvements in short-term pain and disability compared to other non-invasive interventions (WMD=-8.6, 95% CI -13.7 to -3.5 for pain and WMD=-5.4, 95% CI -8.4 to -2.4 for function), but no better for intermediate term disability or work absence[616].

The recent UK BEAM Trial[629] found no clear differences between exercise therapy and manipulation (see Table 42 above).

Efficacy of one type of exercise therapy versus another

A lower-quality, qualitative systematic review found no clear differences between different exercise regimens, including no differences between supervised exercise and home exercise programs in three trials[618]. A more detailed meta-regression that analyzed potential predictors of greater effectiveness was conducted by the authors of the Cochrane review[615]. Compared to home exercises only, it found improved pain scores with individually designed programs (5.4 point improvement in pain scores, 95% credible interval 1.3 to 9.5), supervised home exercise (6.1 points, credible interval -0.2 to 12.4), group exercise (4.8 points, 95% credible interval 0.2 to 9.4 points), and individually supervised programs (5.9 points, 95% credible interval 2.1 to 9.8 points). High-dose exercise programs (20 or more hours of intervention time) were not superior to low-dose programs. Interventions that included additional non-invasive therapy were superior (5.1 points, 95% credible interval 1.8 to 8.4 points) to those without additional non-invasive therapy. The exercise regimens that were most effective used stretching and strengthening, though there was some overlap with other types of exercise (aerobic, mobilizing, or other specific exercise methods). The meta-regression suggested that an intervention incorporating all of the features of an effective exercise regimen would improve pain scores by 18.1 points (95% credible interval 11.1 to 25.0 points) compared to no treatment and by 13.0 points (95% credible interval 6.0 to 19.9 points) compared to other non-invasive treatment. Function would improve by 5.5 points (95% credible interval 0.5 to 10.5) compared to no treatment and by 2.7

points (95% credible interval -1.7 to 7.1) compared to other non-invasive treatment. No trials of such an intervention are available to confirm these estimates.

For acute low back pain, a higher-quality systematic review included one higher-quality trial that found marginal differences between the McKenzie method and flexion exercises (mean differences=2 points on a 0 to 100 scale) for acute pain, though a second, lower-quality trial found the McKenzie method associated with large benefits on short-term (5 days) disability (mean difference=-22 points on a 0 to 100 scale, 95% CI -26 to -18)[619]. For chronic low back pain, there were no clear differences between the McKenzie method and either flexion exercise or strengthening exercises (one trial for each comparison).

Harms
One systematic review attempted to evaluate adverse events associated with exercise therapy, but found insufficient evidence to generate reliable estimates[618]. It found 29 of 51 trials did not report adverse events at all and nine others gave insufficient information on adverse events. Reported adverse events include two myocardial infarctions (neither thought related to exercise) and increased pain.

Costs
Two trials calculated cost-effectiveness ratios for exercise therapies. The UK BEAM trial found the addition of exercise associated with an incremental cost-effectiveness of £8300/QALY (about $16019/QALY) relative to best care, though exercise was dominated by the combination of exercise and manipulation (more costly and less effective)[629]. Another British trial estimated an incremental cost-effectiveness of £3,010/QALY (about $5,809 U.S./QALY) for physiotherapy relative to physiotherapy advice alone, but a high likelihood of no significant differences between interventions[636].

Two trials compared costs between exercise programs and usual care. One found no significant cost differences related to health services, equipment, and days off work between a progressive exercise program and usual primary care[633]. A cost-minimization analysis from another trial found no differences in total costs (direct and indirect) between both standard or intensive physical therapy (including exercise) and usual care[637].

Three other trials included cost-benefit analyses of exercise therapy versus other interventions. For acute low back pain, one trial found no significant cost difference between exercise and either bed rest or usual activities (usual activities associated with more rapid recovery in this trial)[349]. Another trial found exercise associated with greater costs compared to providing a self-care education book ($437 versus $153), and only marginally better outcomes[367].

Studies that compared costs between exercise therapy and spinal manipulation are discussed in the spinal manipulation section.

Summary of evidence

- For acute low back pain, evidence on efficacy of exercise relative to placebo or no treatment is somewhat inconsistent, though most trials found no benefit (level of evidence: fair).
- For chronic low back pain, numerous trials found exercise moderately superior to placebo for pain relief and work-related outcomes, though exercise was not associated with beneficial effects on functional outcomes (level of evidence: good).
- For either acute or chronic low back pain, numerous trials found no consistent, clinically significant differences between exercise therapy and other non-invasive interventions (level of evidence: good).
- Exercise regimens incorporating features such as individual tailoring, supervision, stretching, and strengthening were associated with the best outcomes in a meta-regression analysis (level of evidence: fair).
- There are no clear differences in four trials (two higher-quality) between the McKenzie method and flexion or strengthening exercises, with only one lower-quality trial finding the McKenzie method superior (level of evidence: fair).

Recommendations and findings from other guidelines

- The AHCPR guidelines found that low-stress aerobic exercise can prevent debilitation due to inactivity during the first month of symptoms and help patients with acute low back problems return to usual functioning (strength of evidence: C).
- The AHCPR guidelines suggest that low-stress aerobic exercise programs can be started during the first 2 weeks for most patients with acute low back problems (strength of evidence: D).
- The AHCPR guidelines suggest that conditioning exercises for trunk muscles are helpful for patients with acute low back problems, particularly if symptoms persist, but may aggravate symptoms more than aerobic exercise in the first 2 weeks (strength of evidence: C).
- The AHCPR guidelines found no evidence that back-specific exercise machines provide benefit over traditional exercise (strength of evidence: D).
- The AHCPR guidelines found no evidence to support stretching of the back muscles for acute low back problems (strength of evidence: D).
- The AHCPR guidelines suggest that gradually increasing exercise quotas result in better outcomes than telling patients to stop exercising if pain occurs (strength of evidence: C).
- The VA/DoD guideline recommendations for exercise are similar to the AHCPR recommendations.
- The UK RCGP guidelines concluded that it is doubtful that specific back exercises produce significant improvement in acute low back pain, or that it is possible to select which patients will respond to which exercises (strength of evidence: ***).

- The UK RCGP guidelines found some evidence that exercise programs and physical reconditioning can improve pain and function in patients with chronic low back pain (strength of evidence: **).
- The UK RCGP guidelines found theoretical arguments for starting exercise programs at around 6 weeks after start of symptoms (strength of evidence: *).
- The European COST guidelines recommend against advising specific exercises for acute low back pain.
- The European COST guidelines recommend supervised exercise as a first-line treatment for chronic low back pain. They suggest exercise programs that don't require expensive training machines, the use of a cognitive-behavioral approach with graded exercises, and quotas. Group exercises are suggested as a low-cost option. The guidelines provide no recommendations on specific types of exercise, and suggest the patient and therapist could best determine that.

Hydrotherapy

For this review, we defined hydrotherapy as exercises performed in a pool or other water-based setting. In contrast to spa therapy and balneotherapy, which involve immersion in thermal mineral water, hydrotherapy generally employs normal (or chlorinated) tap water.

Results of search: systematic reviews
We found no systematic reviews evaluating efficacy of hydrotherapy for low back pain.

Results of search: trials
From 88 potentially relevant citations, we identified three lower-quality trials of hydrotherapy for chronic low back pain[638-640].

Efficacy of hydrotherapy versus delayed hydrotherapy

For chronic low back pain, one lower-quality trial (n=109) found hydrotherapy superior to delayed hydrotherapy for back-specific functional status, but not for pain (Table 43)[638]. Incomplete and inconsistent reporting of results data makes this trial difficult to interpret.

Table 43. Trial of hydrotherapy versus delayed hydrotherapy

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
McIlveen, 1998[638]	n=109 4 weeks	**Hydrotherapy versus delayed hydrotherapy** ODI, percent improved: 27% vs. 8% (p=0.05) Pain rating index of McGill Pain Questionnaire, percent improved >10 points: 11% vs. 8% (NS) Present pain intensity of McGill Pain Questionnaire, percent improved by >1 point: 33% vs. 22% (NS)	3/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Efficacy of hydrotherapy versus land-based therapy

For chronic low back pain, two lower-quality trials (n=60 and n=30) each found no differences between hydrotherapy and land-based therapy for short-term pain or functional status (Table 44)[639, 640].

Table 44. Trials of hydrotherapy versus land-based therapy

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Sjogren, 1997[639]	n=60 4 weeks	**Hydrotherapy vs. land-based therapy** Pain, mean improvement in VAS (0-10 scale): 1.35 vs. 0.79 (NS) ODI, mean improvement: 3.25 vs. 2.40 (NS)	3/9
Yozbatiran, 2004[640]	n=30 4 weeks	**Hydrotherapy vs. land-based therapy** Pain, mean improvement in VAS (0-10 scale): 3.53 vs. 2.53 (NS) ODI, mean improvement: 19.34 vs. 17.34 (NS)	2/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Harms
No trial reported adverse events.

Costs
We found no studies on costs.

Summary of evidence

- There is no evidence on effects of hydrotherapy for acute low back pain.
- For chronic low back pain, there is insufficient evidence (one lower-quality trial) to judge efficacy of hydrotherapy versus delayed hydrotherapy (level of evidence: poor).
- For chronic low back pain, there is consistent evidence from two lower-quality trials that hydrotherapy and land-based therapy are associated with similar outcomes (level of evidence: fair).

Recommendations and findings from other guidelines

- The other guidelines do not address hydrotherapy.

Yoga

Yoga can typically be distinguished from traditional exercise by its emphasis on achieving specific body positions and movement, breathing techniques, and emphasis on mental focus. One challenge in evaluation of yoga is that many styles are practiced, each associated with different postures and techniques as well as different degrees of physical difficulty and intensity.

Results of search: systematic reviews
We identified no systematic reviews evaluating efficacy of yoga for low back pain.

Results of search: trials
From 27 potentially relevant trials, we identified three trials (two higher-quality[371, 641]) on efficacy of yoga for chronic low back pain (Table 45)[371, 641, 642].

Efficacy of yoga versus other interventions

For chronic low back pain, one higher-quality trial (n=101) found six weeks of viniyoga (a therapeutically oriented style) slightly superior to both conventional exercise and a self-care education book on the RDQ at twelve weeks (mean difference versus exercise=-1.8, 95% CI -3.5 to -0.1 and mean difference versus self-care education book=-3.4, 95% CI -5.1 to -1.6), but only superior to the self-care book at 26 weeks (mean difference=-3.6, 95% CI -5.4 to -1.8)[371]. Effects on symptom bothersomeness scores were similar at 12 weeks for all three interventions, though yoga was superior to the self-care book at 26 weeks (mean difference=-2.2, 95% CI -3.2 to -1.2). Yoga was also associated with decreased medication use at week 26 (21% vs. 50% vs. exercise and 21% vs. 59% vs. self-care book, $p<0.05$ for both comparisons), though there was no significant difference in the proportion of patients that visited health care providers for low back pain.

Two smaller (n=60 and 22), trials evaluated Iyengar yoga, a commonly practiced style of Hatha yoga that makes frequent use of props. The larger trial (higher-quality) found yoga slightly more effective than exercise instruction (from a weekly newsletter) for reducing disability[641]. Benefits were present 3 months after the end of a 16-week course of treatment (-10.4 vs. -8.5 improvement on a 70 point disability scale, $p=0.009$). Differences in pain outcomes were small and only significant when adjusted for baseline differences in the intervention groups. In addition, interpretation of results is difficult because of differences in baseline disability scores (14.3 vs. 21.2) and because nearly a third of the patients did not complete the study or were lost to follow-up. The other trial (lower-quality) found no significant differences between Iyengar yoga and usual activities on measures of back-specific function or depression[642]. Pain outcomes were not assessed.

Table 45. Trials of yoga versus exercise

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Galantino, 2004[642]	n=22 6 weeks	**Iyengar yoga versus usual activities** Oswestry Disability Index (change from baseline): 3.83 vs. 2.18 Proportion with lower scores on Oswestry: 46% vs. 40%	2/9
Sherman, 2005[371]	n=101 26 weeks	**Viniyoga versus exercise** RDQ Score (0 to 24 scale), mean difference between groups relative to baseline: -1.8 (95% CI -3.5 to -0.1) at 12 weeks (p=0.034) and -1.5 (95% CI -3.2 to 0.2) at 26 weeks (p=0.092) **Viniyoga versus self-care book** RDQ Score, mean difference between groups relative to baseline: -3.4 (95% CI -5.1 to -1.6) at 12 weeks (p=0.0002) and -.6 (95% CI -5.4 to -1.8) at 26 weeks (p<0.001)	8/9
Williams, 2005[641]	n=60 7 months	**Iyengar yoga versus exercise education** Present Pain Index, mean change at 7 months (0 to 5 scale): -0.5 vs. -0.9, p=0.140 Pain Disability Index, mean change at 7 months (7 to 70 scale): -8.5 vs. -10.4, p=0.009 Pain, VAS, mean change at 7 months (0 to 10 scale): 1.2 vs. -1.6, p=0.398	5/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- There is no evidence on efficacy of yoga for acute low back pain.
- For chronic low back pain, viniyoga was slightly superior to traditional exercises and moderately superior to a self-care education book for back-specific functional status and use of medications in one higher-quality trial (level of evidence: fair).
- There is insufficient evidence to judge effectiveness of other types of yoga (two smaller trials of Hatha yoga, one rated higher-quality, but both with significant methodological shortcomings) (level of evidence: poor).

Recommendations and findings from other guidelines

- The other guidelines do not address yoga.

Interdisciplinary interventions

Interdisciplinary rehabilitation (multidisciplinary rehabilitation)

Interdisciplinary or multidisciplinary rehabilitation combines and coordinates physical, vocational, or psychological components and is provided by at least two health care professionals with different clinical backgrounds. The intensity and content of interdisciplinary

therapy varies widely, but most involve an exercise program and some type of psychological therapy.

Results of search: systematic reviews
We identified two higher-quality Cochrane reviews of interdisciplinary rehabilitation. One included trials of patients with chronic (>3 months) low back pain (ten trials, three higher-quality)[643, 644] and the other included trials of subacute (defined as >4 weeks and <3 months in duration) low back pain (two lower-quality trials)[299, 300]. No systematic review evaluated effectiveness of interdisciplinary rehabilitation for acute low back pain. We included one other systematic review on effects of multiple interventions that included five trials of interdisciplinary rehabilitation[645]. We excluded one outdated systematic review[593].

Results of search: trials
Twenty unique trials of interdisciplinary rehabilitation were included in the three systematic reviews[299, 300, 643-645]. We also identified one recent, higher-quality trial of intensive interdisciplinary rehabilitation for high-risk patients with low back pain of less than eight weeks' duration that wasn't included in the systematic reviews[306]. This trial is also discussed in Key Question 1c (identification and treatment of yellow flags and subsequent outcomes).

Efficacy of interdisciplinary rehabilitation versus usual care or non-interdisciplinary rehabilitation

For subacute low back pain, one of the Cochrane reviews found interdisciplinary rehabilitation (defined by the review as an intervention consisting of a physician's consultation plus a psychological, social, or vocational intervention, or a combination of these) with a workplace visit more effective than usual care, but only included two lower-quality trials (n=103 and 104)[299, 300]. In one of the trials, return to work averaged 10 weeks (SD=12.7) with interdisciplinary rehabilitation (which consisted of measurement of functional capacity, a work-place visit, back school, and graded exercise with an operant-conditioning approach) versus 15 weeks (SD=15.6) with traditional care (p=0.03 for difference), and there was less sick leave in the interdisciplinary rehabilitation group in the following year (mean difference=-7.5 days, 95% CI=-15.06 to 0.06)[632]. Subjective disability was also slightly superior in the intervention group. In the second trial, the duration of absence from work was lower with a combined occupational (occupational physician consultation and work place visit) and clinical intervention (back school, visit to back specialist, and multidisciplinary work rehabilitation including functional rehabilitation if needed) compared to the occupational or clinical interventions alone or to usual care (median days off work=60 vs. 67 vs. 131 vs. 120 days, $p<0.05$)[646]. Return to work was 2.4 times faster (95% CI 1.19 to 4.89) in the combined intervention group compared to the usual care group and 1.91 times faster (95% CI 1.18 to 3.1) with any occupational intervention compared to the two groups without the occupational intervention. The combined intervention group also was associated with greater improvements in ODI scores after one year compared to usual care (mean difference=10.7, p=0.02).

For chronic low back pain, the other Cochrane review (10 trials) included three trials[647-649] (one higher-quality[648]) that found intensive (>100 hours), daily interdisciplinary rehabilitation (defined

as an intervention with a physical component plus a psychological and/or social/occupational component meeting pre-defined criteria) with functional restoration moderately superior to non-interdisciplinary rehabilitation or usual care for improving short- and long-term functional status (SMD=-0.40 to -0.90 at 3-4 months and SMD=-0.56 to -1.07 at 60 months)[643, 644]. Two trials[647, 648] (one higher-quality[648]) found interdisciplinary rehabilitation moderately superior for pain outcomes at 3-4 months (SMD=-0.56 and SMD=-0.74), though long-term effects were inconsistent (SMD=-0.51 and SMD=0.00 at 60 months)[643, 644]. There was also inconsistent evidence regarding vocational outcomes, with one higher-quality trial[648] showing improvements in "work-readiness" but two other trials[649, 650] (one higher-quality[650] found no effects on sick leave. In contrast to the intensive interventions, less intensive interdisciplinary rehabilitation was not associated with improvements in pain, function, or vocational outcomes compared to non-interdisciplinary outpatient rehabilitation or usual care (five trials, two higher-quality). A smaller (five trials) systematic review reported results consistent with the Cochrane review[645].

For patients with low back pain for less than 8 weeks identified as being at higher risk for development of chronic disabling symptoms, one recent, small (n=70), higher-quality trial found an intensive interdisciplinary intervention (including 3 physician evaluations and up to 45 physical therapy, biofeedback/pain management, group didactic, and case manager/occupational therapy sessions) associated with improved pain, decreased disability, and decreased costs (mainly related to lost wages) compared to usual care (Table 46)[306].

Table 46. Trial of intensive interdisciplinary rehabilitation in patients with low back pain for <8 weeks

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Gatchel, 2003[306]	n=70 12 months	**Intensive interdisciplinary functional restoration vs. usual care** Return to work at 12 months: 91% vs. 69% (p=0.027) Average number of disability days due to back pain: 38 vs. 102, p=0.001 Average self-rated pain over last 3 months: 27 vs. 43, p=0.001 Taking opioid analgesics: 27% vs. 44%, p=0.020	6/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Harms
No trial reported adverse events.

Costs
In one trial of workers disabled due to low back pain, interdisciplinary rehabilitation with physical conditioning was associated with an average cost-benefit of $18,585 after 6.4 years of follow-up, though the difference was not statistically significant, in part because of highly skewed distributions[651]. In workers with chronic low back pain, another trial found a light interdisciplinary intervention associated with an average cost-benefit of about $15,000 after 2 years relative to usual care[652]. For patients with acute or subacute low back pain identified as being at higher risk for developing chronic disabling symptoms, a cost-benefit analysis of a trial that compared

an intensive, early interdisciplinary intervention to usual care estimated a net gain of $9,122, mostly related to fewer lost wages in the interdisciplinary intervention group[306].

Summary of evidence

- For subacute low back pain, interdisciplinary rehabilitation (particularly with a work site visit) was associated with quicker return to work, reduced sick leave, and moderately improved disability relative to usual care in two lower-quality trials (level of evidence: fair).
- In higher-risk patients with acute or subacute low back pain, one higher-quality trial found interdisciplinary rehabilitation moderately more effective than usual care for pain relief, use of analgesic medications, and return to work (level of evidence: poor).
- For chronic low back pain, intensive interdisciplinary rehabilitation with functional restoration is moderately more effective than usual care or non-interdisciplinary rehabilitation for reducing pain and improving function, though effects on work-related outcomes are inconsistent (four trials, two higher-quality) (level of evidence good).
- Less intensive (<100 hours) interdisciplinary rehabilitation was not more effective than usual care or non-interdisciplinary rehabilitation (five trials) (level of evidence: good).

Recommendations and findings from other guidelines

- The European COST guidelines recommend consideration of interdisciplinary treatment programs in occupational settings for workers on sick leave for more than 4-8 weeks and interdisciplinary intervention with functional restoration in patients with chronic low back pain who have failed monodisciplinary treatment options.

Functional restoration (physical conditioning, work conditioning, or work hardening)

Functional restoration programs (variously referred to as physical conditioning, work conditioning, or work hardening programs) involve simulated or actual work tasks in a supervised environment in order to enhance job performance skills and improve strength, endurance, flexibility, and cardiovascular fitness in injured workers[653]. The goal of such programs is to improve functional and work outcomes. A challenge in assessing the efficacy of functional restoration is the wide variation in the content (such as the use of behavioral therapy or the type of exercise) and intensity of treatment programs.

Results of search: systematic reviews
We identified one higher-quality Cochrane review on efficacy of functional restoration programs for acute or chronic low back pain[302, 303]. Several trials evaluated in this Cochrane review were also included in Cochrane reviews of interdisciplinary rehabilitation for subacute (2 of 2 trials)[299, 300] and chronic (3 of 10 trials)[643, 644] low back pain.

Results of search: trials
Eighteen trials of functional restoration (9 rated higher-quality) were included in the Cochrane review[302, 303]. We identified one additional higher-quality trial of an intensive interdisciplinary

functional restoration intervention in patients with low back pain for less than eight weeks (see discussion in interdisciplinary rehabilitation section)[306].

Efficacy of functional restoration versus usual care

For acute low back pain, the Cochrane review[302, 303] included four trials, three of which found functional restoration no better than usual care, normal activities, or standard exercise therapy[349, 654, 655] (two trials rated higher-quality[349, 654]). In the only trial that found a beneficial effect (rated higher-quality[656]), functional restoration was compared to an intervention consisting of lying prone and using ice packs. A recent trial not included in the Cochrane review found intensive, interdisciplinary functional restoration superior to usual care for several outcomes in high-risk patients with low back pain for less than eight weeks (see section on interdisciplinary rehabilitation)[306].

For chronic low back pain (14 trials), functional restoration programs with a cognitive-behavioral approach generally appeared effective for reducing time off work. In two relatively homogeneous trials[632, 646] (one higher-quality[646]) of functional restoration versus usual care, the decrease in number of sick days after 12 months follow-up averaged 45 days (95% CI 3 to 88). There was little evidence for or against effectiveness of functional restoration not accompanied by a cognitive behavioral approach.

Efficacy of functional restoration versus other interventions

For chronic low back pain, the Cochrane review[302, 303] included two higher-quality trials that found functional restoration associated with an average of 112 and 243 fewer lost work days compared to traditional physical therapy (about two-thirds of patients received physical modalities and one-third manipulation)[657] or traditional exercise therapy plus behavioral therapy[658].

Harms
No trial reported adverse events.

Costs
See section on interdisciplinary rehabilitation.

Summary of evidence

- For acute low back pain, evidence from six heterogeneous trials on efficacy of functional restoration is inconsistent, with the majority of studies showing no benefit (level of evidence: fair).
- For chronic low back pain, functional restoration with a cognitive-behavioral approach was moderately effective for reducing time off work (14 trials) (one higher quality) (level of evidence: fair).
- For chronic low back pain, functional restoration was more effective than traditional physical therapy (including physical modalities or manipulation) and traditional exercise therapy plus

behavioral therapy for reducing days lost from work (two higher-quality trials) (level of evidence: good).

- There is insufficient evidence to evaluate benefits of functional restoration without a cognitive-behavioral approach.

Recommendations and findings from other guidelines

- The European COST guidelines recommend consideration of interdisciplinary treatment programs in occupational settings for workers on sick leave for more than 4-8 weeks and interdisciplinary intervention with functional restoration in patients with chronic low back pain who have failed monodisciplinary treatment options.

Physical modalities

Interferential therapy

Interferential therapy involves the application of a medium frequency alternating current modulated to produce low frequencies up to 150 Hz. It is thought to provide pain relief in part by increasing blood flow to tissues, and is considered more comfortable for patients than transcutaneous electrical nerve stimulation.

Results of search: systematic reviews
We found no systematic reviews of interferential therapy.

Results of search: trials
From eight potentially relevant citations, we identified three trials (one higher-quality[659]) of interferential therapy[659-661]. Two trials evaluated patients with subacute (>4 weeks) back pain and the other evaluated patients with back pain of mixed duration (mainly chronic). Interferential therapy was compared to spinal manipulation, traction, and a back self-care book in one trial each.

Efficacy of interferential therapy versus spinal manipulation or traction

For subacute (>4 weeks) low back pain, one higher-quality trial (n=240) found no difference between an 8-week course of interferential therapy and spinal manipulation on pain, functional disability, quality of life, work status, or other outcomes after 6 to 12 months (Table 47)[659]. For back pain of unspecified duration (primarily >5 years), a lower-quality trial (n=152) also found no differences between interferential therapy and traction on pain or the ODI after 3 months[660].

Table 47. Trials of interferential therapy versus other interventions

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Hurley, 2004[659]	n=240 12 months	**Interferential therapy versus manipulative therapy versus combination** (mean improvement at 12 months) Pain (0 to 100 VAS): -26.5 vs. -18.2 vs. -25.7 (NS) McGill Pain Questionnaire Pain Rating Index (0 to 78): -8.3 vs. -6.4 vs. -9.2 (NS) RDQ score (0 to 24): -4.9 vs. -4.7 vs. -6.5 (NS) SF-36: No differences Recurrent low back pain: 69% vs. 77% vs. 64% (NS) Absent from work >30 days: 8% vs. 12% vs. 12%	7/10
Werners, 1999[660]	n=152 3 months	**Interferential therapy versus traction** (mean difference from baseline to 3 months) Pain (0 to 100): -9.8 vs. -14.6 (NS) Oswestry (0 to 100): -7.7 vs. -7.4 (NS)	4/10

*Excludes criterion involving blinding of care providers, for maximum score of 10

Efficacy of interferential therapy plus a back self-care book versus a back self-care book alone

For subacute low back pain (>4 weeks), one small (n=60), higher-quality trial found interferential therapy applied to the paraspinal area (near the target spinal nerve) plus a back self-care book superior to the back self-care book alone on the RDQ after 3 months, but not on the Pain Rating Index or EQ-5D (Table 48)[661]. Interpretation of effects on functional status are difficult because baseline RDQ scores were higher in the interferential therapy group (median 9.0 vs. 5.0), and median RDQ scores were identical at 3 months in the two groups (1.0 vs. 1.0). This trial also found no differences between interferential therapy applied to the painful area plus a self-care book versus the self-care book alone.

Table 48. Trial of interferential therapy + self-care book versus a self-care book alone

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Hurley, 2001[661]	n=60 3 months	**Interferential therapy applied to painful area + self-care book versus interferential therapy applied to area of spinal nerve + self-care book versus self-care book alone** (difference in median scores from baseline to 3 months) McGill Pain Questionnaire Pain Rating Index (0 to 78): +2.2 vs. -2.5 vs. -9.7 RDQ Score (0 to 24): -3.5 vs. -8.0 vs. -4.0 EQ-5D: No difference RDQ Score, median score at 3 months: 2.0 vs. 1.0 vs. 1.0	5/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Harms

One trial reported no adverse events with interferential therapy or manipulation[659]. The other two trials reported no information on adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- For subacute low back pain, one higher-quality trial found no difference between interferential therapy and spinal manipulation (level of evidence: fair).
- For subacute low back pain, one higher-quality trial found interferential therapy plus a self-care book superior to the self-care book alone, but differences could be due to baseline differences between groups (level of evidence: fair).
- For primarily chronic low back pain, one lower-quality trial found no differences between interferential therapy and traction (level of evidence: poor).

Recommendations and findings from other guidelines

- The AHCPR guidelines found physical agents and modalities (including electrical stimulation) of insufficiently proven benefit to justify their cost in patients with acute low back pain (strength of evidence: C).
- The VA/DoD and UK RCGP guidelines reached similar conclusions.
- The European COST guideline made no recommendation for interferential therapy in acute low back pain, and found insufficient evidence to recommend interferential therapy for chronic low back pain.

Low-level laser therapy

Low-level laser therapy involves application of laser at wavelengths varying from 632 to 904 nm to the skin in order to apply electromagnetic energy to soft tissues. Optimal treatment parameters (wavelength, dosage, dose-intensity, type of laser) are uncertain.

Results of search: systematic reviews
We identified no systematic reviews on efficacy of low-level laser therapy specifically for low back pain. We excluded five systematic reviews on low-level laser therapy for various musculoskeletal conditions[623, 662-665].

Results of search: trials
We identified seven trials (four higher-quality[666-669]) of low-level laser therapy for low back pain[666-672]. Four trials evaluated patients with chronic low back pain, one evaluated patients with acute low back pain, and two did not specify duration of back pain symptoms. Although low-level laser therapy is frequently used in Russia and Asia, we found no non-English language trials. However, studies in Russian and Asian languages are frequently not indexed in English-language electronic databases.

Efficacy of low-level laser therapy versus sham therapy or placebo

For chronic low back pain or low back pain of unspecified duration, results of six trials of low-level laser therapy are difficult to interpret because they evaluated heterogeneous outcome

measures and different types of lasers at varying doses. Two[666, 668] of the three[667] higher-quality trials found laser therapy slightly superior to placebo or sham laser at the end of treatment for back-specific function (about 4 point difference on the ODI score)[666] and moderately superior for the proportion of patients with >60% pain relief (71% vs. 36%, p<0.007)[668] (Table 49). In one trial, benefits persisted for one month following treatment[666], and in the other, relapse of back pain was less likely 6 months following the end of treatment[668]. One other higher-quality trial found laser more 'effective' than sham, but used a poorly described and unvalidated outcome measure[669]. One lower-quality trial of patients with back pain of unspecified duration reported similar findings, with decreased relapse through one year following treatment[671]. In the one higher quality trial that found no difference between laser and sham laser, each group also received a standardized home exercise regimen[667].

Table 49. Trials of low-level laser therapy versus sham laser

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Basford, 1999[666]	n=61 1 month after end of treatment	**Nd:YAG laser versus sham** (mean change from baseline) ODI score: -6.3 vs. -2.1 Maximal pain in the last 24 hours (0 to 100 VAS): -16.1 vs. -2.3	8/11
Klein, 1990[667]	n=20 1 month after treatment	**GaAS laser + exercise versus sham laser + exercise** (mean change from baseline) Pain (0 to 7.5 VAS): -1.3 vs. -1.2 RDQ Disability score: -1.8 vs. -3.0	6/11
Longo, 1988[671]	n=120 1 year after treatment	**904 nm laser vs. 10600 nm laser vs. sham** Complete disappearance of pain 1 month after treatment: 95% vs. 82.5% vs. 2.5% Relapse 1 year after treatment: 65% vs. 70% vs. 95%	5/11
Soriano, 1998[668]	n=85 6 months after end of treatment	**GaAS laser versus sham** Proportion with >60% pain relief at end of treatment: 71% (27/38) vs. 36% (12/33), p<0.007	6/11
Toya, 1994[669]	n=41 1 day after treatment	**GaAS laser versus sham** Treatment 'effective': 94% (15/16) vs. 48% (12/25)	10/11

One systematic review found low level laser effective for a variety of musculoskeletal conditions when the subgroup of trials that evaluated higher laser doses were analyzed[663]. The criteria for adequate doses were defined for various locations in an *a priori* matter. There were too few trials (four) to assess effects of dose in patients specifically with low back pain.

Efficacy of low-level laser therapy versus other interventions

For acute low back pain, one trial of low-level laser therapy was uninterruptable because of poor methodologic quality, unclear reporting of outcomes, and comparison to mesotherapy (an unproven technique involving injections of various substances into fat) (Table 50)[672]. For chronic low back pain, another lower-quality trial found no differences between laser, exercise, and the combination of laser plus exercise for pain and back-specific functional status[670].

Table 50. Trials of low-level laser therapy versus other interventions

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Gur, 2003[670]	n=75 1 month after treatment	**Laser versus exercise versus laser + exercise (mean change from baseline)** Pain (0 to 10 VAS): -4.2 vs. -3.6 vs. -4.4 (p>0.05) RDQ Score: -9.7 vs. -9.6 vs. -11.5 (p>0.05) Modified ODI: -16.4 vs. -16.9 vs. -17.6 (p>0.05)	3/11
Monticone, 2004[672]	n=22 Up to 12 months after treatment	**Laser versus stabilization (exercise, lumbar therapy, and mesotherapy)** Pain at rest (VAS 0 to 10), mean change from baseline and 12 months following end of treatment: 0 vs. -5; -1 vs. -6 Pain with movement (VAS 0 to 10), mean change from baseline and 12 months following end of treatment: -4 vs. -7, -2 vs. -8	1/11

Harms
In a systematic review of low-level laser therapy for various musculoskeletal conditions, six of the 11 trials evaluating higher dose regimens reported no adverse events[663]. One other trial reported one transient adverse event in both laser and sham groups[666].

Costs
We found no studies evaluating costs.

Summary of evidence

- For acute low back pain, there is no reliable evidence (one lower-quality trial) on efficacy of low-level laser therapy (level of evidence: poor).
- For chronic low back pain, there is conflicting evidence from five trials (four higher-quality) on efficacy of low-level laser compared to placebo or sham laser. Four trials (three higher-quality) found laser therapy superior to sham for pain or functional status up to one year following treatment (estimates of effects ranged from small to large), but one higher-quality trial found no difference between laser and sham in patients also receiving exercise. In addition, interpretation of results is compromised by the use of heterogeneous and non-standardized outcome measures in some studies (level of evidence: fair).
- For chronic low back pain, there was no difference between low-level laser therapy, exercise, or the combination of laser plus exercise in one lower-quality trial (level of evidence: poor).
- Additional research is needed on optimal doses of low-level laser therapy, number of sessions, and type of laser.
- Publication bias from non-English language studies could affect these conclusions.

Recommendations and findings from other guidelines

- The AHCPR guidelines found physical agents and modalities (including low-level laser) of insufficiently proven benefit to justify their cost for acute low back pain (strength of evidence: C).

- The VA/DoD guidelines reached similar conclusions.
- The UK RCGP guidelines don't address low-level laser therapy.
- The European COST guidelines found insufficient evidence to recommend low-level laser for chronic low back pain.

Shortwave diathermy

Shortwave diathermy involves application of shortwave electromagnetic radiation with a frequency range from 10 to 100 MHz in order to elevate the temperature of deep tissues.

Results of search: systematic reviews
We identified no systematic review of shortwave diathermy.

Results of search: trials
From 14 potentially relevant citations, we identified three lower-quality trials of shortwave diathermy[673-675].

Efficacy of shortwave diathermy versus sham diathermy

For low back pain of at least two months' duration, one lower-quality trial found no significant differences between two weeks of short-wave diathermy and sham diathermy in median pain scores and the proportion of patients free of pain through 12 weeks, following a two-week course of therapy[673]. For back pain present for longer than one week (widely varying durations), another lower-quality trial found no differences in global response (other outcomes not reported) between short-wave diathermy and sham diathermy after 2 weeks (Table 51)[675].

Table 51. Trials of shortwave diathermy for low back pain

Author, year Duration of low back pain	Number of patients Duration of follow-up	Main results	Quality score
Gibson, 1985[673] Low back pain >2 months	n=109 12 weeks	**Shortwave diathermy vs. osteopathic manipulation vs. detuned (sham) diathermy** Median daytime pain score (0 to 100) at 2 weeks: 35 vs. 25 vs. 28 Median daytime pain score (0 to 100) at 12 weeks: 25 vs. 13 vs. 6 Proportion free of pain at 2 weeks: 35% vs. 25% vs. 28% Proportion free of pain at 12 weeks: 37% vs. 42% vs. 44% Proportion needing analgesics at 2 weeks: 22% vs. 18% vs. 32% Proportion needing analgesics at 12 weeks: 7% vs. 18% vs. 22% Proportion unable to work or with modified activities at 2 weeks: 31% vs. 13% vs. 38% Proportion unable to work or with modified activities at 12 weeks: 7% vs. 5% vs. 19%	4/11
Rasmussen, 1979[674] Low back pain <3 weeks	n=24 2 weeks	**Shortwave diathermy vs. spinal manipulation** Proportion 'fully restored" by 14 days: 25% (3/12) vs. 92% (11/12)	3/11
Sweetman, 1993[675] Low back pain >1 week	n=400 2 weeks	**Shortwave diathermy versus extension exercises versus traction versus sham diathermy** Global effect "better" at 2 weeks: 39% (39/100) vs. 45% (45/100) vs. 49% (49/100) vs. 37% (37/100) (NS)	5/11

Efficacy of shortwave diathermy versus other interventions

For low back pain present for at least two months, one lower-quality trial found no significant differences between shortwave diathermy and spinal manipulation on median pain scores, proportion free of pain, or requirement for analgesics through 12 weeks, following a two-week course of treatment[673]. For acute low back pain, a second lower-quality trial found a lower rate of symptom resolution two weeks following a course of shortwave diathermy (3 of 12) compared to a course of spinal manipulation (11 of 12)[674]. However, no details about the shortwave diathermy intervention were provided. For low back pain present longer than one week, a lower-quality trial found no difference between shortwave diathermy and either extension exercises or traction after two weeks[675].

Harms

No trial reported adverse events.

Cost

We found no studies evaluating costs.

Summary of evidence

- For acute low back pain, one small, lower-quality trial found shortwave diathermy inferior to spinal manipulation for the proportion of patients reporting resolution of symptoms after 2 weeks (level of evidence: poor).

- For subacute or chronic low back pain, one lower-quality trial found no difference between shortwave diathermy and sham diathermy in pain relief through 12 weeks (level of evidence: poor).
- For subacute or chronic low back pain, one lower-quality trial found no difference between shortwave diathermy and osteopathic spinal manipulation in pain relief through 12 weeks (level of evidence: poor).
- For back pain of varying duration, one lower-quality trial found no difference between shortwave diathermy, sham diathermy, exercise, or traction using an unvalidated measure of global effect after 2 weeks (level of evidence: poor).

Recommendations and findings from other guidelines

- The AHCPR guidelines found physical agents and modalities (including shortwave diathermy) of insufficiently proven benefit to justify their cost in patients with acute low back pain (strength of evidence: C).
- The VA/DoD and UK RCGP guidelines reached similar conclusions.
- The European COST guidelines found insufficient evidence to recommend shortwave diathermy for chronic low back pain.

Traction

Traction involves drawing or pulling of the body in order to stretch the lumbar spine. A variety of methods are used and usually involve a harness around the lower rib cage and around the iliac crest, with the pulling motion performed using free weights and a pulley, motorized equipment, inversion techniques, or an overhead harness.

Results of search: systematic reviews
We identified a higher-quality Cochrane review (23 RCTs, 5 rated high-quality) of traction for low back pain[676, 677]. All included trials enrolled patients with low back pain and sciatica, though seven also included patients without sciatica. We included three other higher-quality systematic reviews that each included between 8 and 14 trials of traction[100, 399, 678]. We excluded three older systematic reviews[193, 623, 679].

Results of search: trials
Twenty-four unique trials of traction were included in four systematic reviews[100, 399, 676-678]. Sixteen trials only included patients with sciatica. The remaining trials evaluated mixed populations of patients with and without sciatica. We did not search for additional trials.

Efficacy of traction versus placebo, sham, or no treatment

For low back pain of varying duration (with or without sciatica), the Cochrane review[676, 677] included two higher-quality trials[680-682] that found traction no more effective than placebo, sham, or no treatment for pain, functional status, overall improvement, or work absenteeism.

For low back pain specifically with sciatica (varying duration), the Cochrane review[676, 677] included two lower-quality trials[683, 684] that found autotraction more effective than placebo, sham, or no treatment for pain, global improvement, or work absenteeism, but other forms of traction (continuous or intermittent traction) were not associated with beneficial effects in eight other trials (one higher-quality[685]).

Three other systematic reviews did not include any trials not in the Cochrane review and found either no evidence that traction is effective for low back pain with or without sciatica[100, 399], or insufficient evidence to draw reliable conclusions[678].

Efficacy of traction versus other interventions

For sciatica of varying duration, six RCTs (five rated lower-quality) included in the Cochrane review compared various types of traction to other non-invasive interventions. In the lone higher-quality trial, autotraction was superior to abdominal and pelvic floor muscle isometric exercises at the end of treatment[686]. However, benefits were no longer present after one month. In a lower-quality trial, intermittent traction was superior to physiotherapy for global well-being after three to five weeks, though no better than superficial application of hot packs[687]. In the other four lower-quality trials, no statistically significant differences were seen between traction and spinal manipulation and a corset[389], an infra-red lamp[151, 688], exercise and shortwave diathermy[675], or strengthening and range of motion exercises[689]. For chronic low back pain with sciatica, traction was no more effective than isometric exercise in two trials[689, 690], and superior to TENS in the third[691] (none rated higher- quality).

For low back pain of varying duration without sciatica, one higher-quality trial found no differences between intermittent traction and interferential treatment in pain or function three months after treatment[660].

Efficacy of one type of traction versus another

For chronic low back pain with or without sciatica, one small (n=44) trial found autotraction more effective than mechanical traction for global improvement (but not pain or function)[692]. In two other small trials, there were no differences between static and intermittent traction[693] or between autotraction and manual traction[694]. One trial found no differences between intermittent or continuous traction using different levels of force[695].

Harms

Adverse events were generally reported inconsistently and poorly in the 23 trials included in the Cochrane review[676, 677]. Two trials reported no adverse events[685, 696]. Six other trials reported adverse events including increased pain, increased rate of subsequent surgery, aggravation of neurological signs, aggravation of symptoms[676, 677]. The other sixteen trials did not mention adverse events.

Costs

We found no studies evaluating costs.

Summary of evidence

- For low back pain of varying duration (with or without sciatica), there is consistent evidence from two higher-quality trials that continuous traction is not associated with superior outcomes compared to placebo, sham, or other treatments (level of evidence: good).
- For low back pain of varying duration with sciatica, eight trials (one higher-quality) consistently found no differences between continuous or intermittent traction and placebo, sham, or other treatments (level of evidence: good).
- For low back pain of varying duration with sciatica, two lower-quality trials found autotraction superior to placebo or sham therapies and one lower-quality trial found autotraction superior to mechanical traction (level of evidence: fair).
- For chronic low back pain with sciatica, traction was no better than isometric exercises in two lower-quality trials and inferior to TENS in a third lower-quality trial (level of evidence: poor).
- Adverse events associated with traction may include aggravation of signs and symptoms or subsequent surgery, but were inconsistently and poorly reported in the trials (level of evidence: poor).

Recommendations and findings from other guidelines

- The AHCPR guidelines recommend against traction for treatment of patients with acute low back problems (strength of evidence: B).
- The VA/DoD and UK RCGP also recommend against traction, but rate the strength of evidence differently (strength of evidence: C and ***, respectively).
- The European COST guidelines recommend against traction for acute low back pain and found insufficient evidence to recommend traction for chronic low back pain.

Transcutaneous electrical nerve stimulation (TENS)

Transcutaneous electrical nerve stimulation involves the use of a small battery-operated device to provide continuous electrical impulses via surface electrodes, with a goal of providing symptomatic relief by modifying pain perception.

Result of search: systematic reviews
We identified one recent, higher-quality Cochrane review on efficacy of TENS versus sham TENS (two trials, one rated higher-quality[697]) for low back pain[698, 699]. In addition, higher-quality systematic reviews of acupuncture[68], massage[700, 701], spinal manipulation[66, 67]; traction[676, 677], and superficial heat or cold[398] each included one to four trials comparing the target intervention to TENS. We excluded three outdated Cochrane reviews[702-704] and three other outdated systematic reviews[193, 623, 705].

Results of search: trials
Eleven unique trials of TENS were included in the systematic reviews[68, 398, 676, 698, 699, 701, 706]. We did not search for additional trials.

Efficacy of TENS versus sham TENS

For chronic low back pain, the Cochrane review included one higher-quality trial (n=145)[697] that found no differences between TENS and sham TENS for any measured outcome (including pain and functional status) after 4 weeks[698, 699]. A smaller (n=30), lower-quality trial found active TENS associated with greater reduction in pain over the 60-minute treatment session compared to sham TENS (WMD=-33.62, 95% CI -52.27 to -13.97)[707]. Longer-term results and adverse events were not reported.

Efficacy of TENS versus other interventions

For chronic low back pain, a systematic review of acupuncture included five trials (none higher-quality) that found no differences between acupuncture and TENS for short- (four trials pooled, SMD=0.15, 95% CI -0.33 to 0.63) or long-term pain (two trials, SMD=0.32, 95% CI -0.33 to 0.96)[68]. Results of studies that compared TENS to other interventions for chronic low back pain are mixed: one lower-quality trial found TENS inferior to traction[691], one higher-quality trial found TENS superior to minimal massage[708], and one lower-quality trial found no differences between TENS and gentle ice massage[405].

For acute low back pain, a systematic review of acupuncture included one lower-quality trial[709] that found TENS inferior to acupuncture for pain relief[68]. For subacute low back pain, a systematic review of spinal manipulation[66, 67] included one higher-quality trial[390, 391] that found TENS moderately inferior to spinal manipulation for pain (SMD 0.5, 95% CI 0.1 to 1.0) and substantially inferior for disability (SMD 1.3, 95% CI 0.5 to 2.0), though there were no differences between TENS and gentle massage.

Harms

In trials of TENS, one third of patients with either active or sham TENS had minor skin irritation, with one patient (sham) discontinuing due to severe dermatitis[698, 699]. The proportion of patients with skin irritation was similar in patients who received active or sham TENS.

Costs

We found no studies evaluating costs.

Summary of evidence

- For acute low back pain, TENS was inferior to acupuncture in one lower-quality trial (level of evidence: poor)
- For subacute low back pain, TENS was inferior to spinal manipulation in one higher-quality trial (level of evidence: fair).
- For chronic low back pain, the only higher-quality trial found no differences between TENS and sham TENS (level of evidence: fair).
- For chronic low back pain, five lower-quality trials found consistent evidence of no differences between TENS and acupuncture (level of evidence: fair).

- For chronic low back pain, evidence on efficacy of TENS compared to other interventions is limited to single trials of traction (traction superior), minimal massage (TENS superior), and gentle ice massage (no differences) (level of evidence for each comparison: poor).
- TENS is associated with skin irritation that is usually minor (level of evidence: fair).

Recommendations and findings from other guidelines

- The AHCPR guidelines recommend against TENS in patients with acute low back problems (strength of evidence: C).
- The VA/DoD guidelines are identical.
- The UK RCGP found inconclusive evidence on the efficacy of TENS in patients with acute low back problems (strength of evidence: **).
- The European COST guidelines recommend against TENS for chronic low back pain.

Percutaneous electrical nerve stimulation (PENS)

Percutaneous electrical nerve stimulation (PENS) involves the insertion of acupuncture-like needles and applying low-level electrical stimulation. It differs from electroacupuncture in that the insertion points target dermatomal levels for local pathology, rather than acupuncture points. However, there is some uncertainty over whether PENS should be considered a novel therapy or a form of electroacupuncture[710].

Results of search: systematic review
We identified no systematic reviews of PENS.

Results of search: trials
We identified three trials of PENS for chronic low back pain[711-713] and one trial of PENS for sciatica[714]. All were rated lower quality.

Efficacy of PENS versus sham PENS

For chronic low back pain, two trials compared PENS to sham PENS (Table 52)[712, 713]. Both found PENS moderately superior to sham PENS for pain outcomes, either at the end of treatment[712] or three months after a course of treatment[713]. One trial also found moderate to substantial improvements in functional outcomes and quality of sleep at the end of treatment[712]. The other trial found no benefits on measures of depression or functional status three months after treatment[713]. In both trials, success of blinding was not assessed.

For sciatica of at least six weeks' duration, a third trial found PENS moderately to substantially superior to sham PENS immediately after a two-week course of treatment for pain, functional status, and measures of sleep quality[714].

Table 52. Trials of PENS versus sham PENS

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Ghoname, 1999[712] (non-sciatic low back pain)	n=60 At end of 2-week course of treatment	**PENS vs. sham PENS** (mean improvement from baseline) Pain (VAS 0 to 10): -2.9 vs. -0.2 (p<0.02 for PENS) Level of activity (0 to 10): -2.3 vs. -0.2 (p<0.02 for PENS) Quality of sleep (0 to 10): -2.4 vs. 0 (p<0.02 for PENS)	2/11
Ghoname, 1999[714] (sciatica)	n=64 At end of 2-week course of treatment	**PENS vs. sham PENS** Pain (VAS 0 to 10): -3.1 vs. -0.5 (p<0.01) Level of activity (0 to 10): -2.4 vs. -0.5 (p<0.01) Quality of sleep (0 to 10): -2.4 vs. -0.3 (p<0.01)	1/11
Weiner, 2003[713] (non-sciatic low back pain)	n=34 3 months after treatment	**PENS + physical therapy versus sham PENS + physical therapy** (mean scores 3 months after treatment) McGill Pain Questionnaire: 6.19 vs. 11.82 (p=0.04) Multidimensional Pain Inventory Pain Inventory score: 2.16 vs. 3.10 (p=0.003) RDQ scale: 9.25 vs. 12.18 (p=0.26)	4/11

Efficacy of PENS versus other interventions

For chronic low back pain, two trials compared PENS to TENS[711, 712] (Table 53). Both found PENS moderately superior to TENS at the end of treatment for measures of pain and functional status, but the only trial that followed patients after the end of treatment found that benefits were no longer present after 1 to 2 months[711].

One of these trials also compared PENS to a minimal exercise intervention (seated flexion and extension)[712]. PENS was substantially superior to exercise on measures of pain and functional status at the end of a two-week course of treatment.

For patients with sciatica, one lower-quality trial found PENS slightly superior to TENS on measures of pain and moderately superior for functional status at the end of a two-week course of treatment[714].

Table 53. Trials of PENS versus other interventions

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Ghoname, 1999[712] (non-sciatic low back pain)	n=60 At end of 2-week course of treatment	**PENS vs. TENS vs. exercise**, mean improvement from baseline Pain (VAS 0 to 10): -2.9 vs. -0.6 vs. -0.1 (p<0.02 for PENS vs. other interventions) Level of activity (0 to 10): -2.3 vs. -0.8 vs. 0 (p<0.02 for PENS vs. other interventions) Quality of sleep (0 to 10): -2.4 vs. -0.3 vs. -0.3 (p<0.02 for PENS vs. other interventions)	2/11
Ghoname, 1999[714] (sciatica)	n=64 At end of 2-week course of treatment	**PENS vs. TENS**, mean improvement from baseline Pain (VAS 0 to 10): -3.1 vs. -2.6 (p<0.01) Level of activity (0 to 10): -2.4 vs. -1.3 (p<0.01) Quality of sleep (0 to 10): -2.4 vs. -1.0 (p<0.01)	1/11
Yokoyama, 2004[711] (low back pain, presence or absence of sciatica not specified)	n=60 2 months after treatment	**PENS vs. TENS** Pain (VAS pain scores): 32 vs. 48 at end of treatment (p<0.01), no differences 2 months after treatment Physical impairment (0 to 4 scale): difference between PENS and TENS significant at end of treatment but not 1 month after treatment (data not reported)	3/11

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- There is no evidence on efficacy of PENS for acute low back pain.
- For chronic low back pain, PENS was moderately superior to sham PENS for short-term pain outcomes in two lower-quality trials. In the only trial that assessed longer-term (not immediately after a course of treatment) outcomes, benefits on pain were present through two months, but there was no effect on functional outcomes (level of evidence: fair).
- For chronic low back pain, PENS was moderately superior to TENS and a minimal exercise intervention for pain and functional outcomes in one lower-quality trial immediately after a course of treatment, but in the only trial that evaluated longer-term outcomes, no benefits were present after two months (level of evidence: poor).
- For sciatica, PENS was moderately to substantially superior to sham PENS and slightly to moderately superior to TENS for pain and functional outcomes in one lower-quality trial, but outcomes were only assessed immediately after a two-week course of treatment (level of evidence: poor).
- There is insufficient evidence to accurately judge safety of PENS.

Recommendations and findings from other guidelines

- The European COST guidelines recommend considering PENS for patients with chronic nonspecific low back pain.

Ultrasound

Ultrasound involves the therapeutic application of high-frequency sound waves up to 3 MHz to the body surface.

Results of search: systematic reviews
We identified four systematic reviews of ultrasound therapy for patients with a variety of musculoskeletal conditions, but none specifically evaluated efficacy of ultrasound for low back pain[623, 715-717].

Results of search: trials
From 265 potentially relevant citations, we identified three small (n=15 to 73) lower-quality trials of therapeutic ultrasound for low back pain[718-720].

Efficacy of ultrasound versus sham or placebo

For acute low back pain with prolapsed lumbar intervertebral disc and sciatica, one non-randomized trial found ultrasound superior to sham ultrasound or analgesics for the proportion of pain-free patients (41% vs. 12% vs. 6.8%)[719]. Patients in all groups were also prescribed bed rest.

For chronic low back pain, one small (n=15) trial found ultrasound moderately superior to sham ultrasound for functional status after ten treatment sessions, but had a number of methodological shortcomings, including high loss to follow-up (one-third of enrollees) and lack of intention-to-treat analysis[718]. For low back pain of unspecified duration, a second small (n=36) randomized trial found no difference between ultrasound and sham ultrasound in pain improvement after one month of therapy[720]. Functional status and other outcomes were not reported.

Three systematic reviews found little evidence of beneficial effects with ultrasound relative to placebo for other musculoskeletal conditions, with the possible exceptions of single trials of lateral epicondylitis, carpal tunnel syndrome, and calcific tendonitis of the shoulder[623, 715, 717]

Harms
Adverse events were not reported in the two studies. None of the systematic reviews of therapeutic ultrasound for various musculoskeletal conditions assessed adverse events. There is one report of two patients with a herniated disc who had transiently increased radicular pain after application of therapeutic ultrasound[721].

Costs
We found no studies evaluating costs.

Summary of evidence

- There is insufficient evidence (one non-randomized trial) to judge benefits or harms of ultrasound for low back pain with sciatica (level of evidence: poor).
- There is insufficient evidence (two lower-quality, small randomized trials with inconsistent results) to judge benefits or harms of ultrasound for chronic low back pain or back pain of unspecified duration (level of evidence: poor).

Recommendations and findings from other guidelines

- The AHCPR guidelines found physical agents and modalities (including ultrasound) of insufficiently proven benefit to justify their cost in acute low back pain (strength of evidence: C).
- The VA/DoD and UK RCGP guidelines reached similar conclusions.
- The European COST guidelines found insufficient evidence to recommend ultrasound therapy for chronic low back pain.

Other non-invasive interventions

Psychological therapies

Psychological therapies include standard cognitive-behavioral or operant therapy as well as other interventions such as biofeedback (use of auditory and visual signals reflecting muscle tension or activity to train patients to inhibit or reduce the muscle activity), progressive relaxation (deliberate tensing and relaxation of muscles to facilitate recognition and release of muscle tension) and self-regulatory therapy (biofeedback, relaxation training or hypnosis).

Results of search: systematic reviews
We identified two higher-quality systematic reviews on efficacy of psychological therapies for chronic low back pain[301, 722]. One was a Cochrane review (21 trials, 7 higher-quality) that only included trials evaluating psychological therapies as a separate treatment[301]. The other systematic review (22 trials, 6 higher-quality) also included trials of psychological therapies as part of interdisciplinary interventions[722]. We excluded an outdated Cochrane review[723] and five other outdated systematic reviews[193, 346, 386, 597, 724].

Results of search: trials
Thirty-five unique trials of psychological therapies for chronic low back pain were included in the systematic reviews[301, 722]. We did not search for additional trials.

Efficacy of psychological therapies versus wait list control

For chronic low back pain, the Cochrane review[301] included four trials (one higher-quality[725]) that found combined cognitive-behavioral therapy moderately superior to wait list control for short-term pain intensity (SMD=0.59, 95% CI 0.10 to 1.09), but not for functional status (SMD=0.31, 95% CI -0.20 to 0.82). It also included two lower-quality trials that found progressive relaxation associated with large effects on short-term pain (SMD=1.16, 95% CI 0.47 to 1.85) and behavioral outcomes (SMD=1.31, 95% CI 0.61 to 2.01). Evidence regarding effects of

electromyography (EMG) biofeedback versus wait list control was mixed from four trials (one higher-quality[726]). Although three trials (one higher-quality) found a moderate positive effect on pain intensity (SMD=0.84, 95% CI 0.32 to 1.35), a fourth trial found no differences. In addition, there were no differences between EMG biofeedback and wait list control for behavioral outcomes. Three trials (one higher-quality[725]) of operant treatment versus wait list controls found inconsistent effects on pain intensity and no benefits for general functional status or behavioral outcomes.

The second systematic review (22 trials) also found cognitive-behavioral and self-regulatory treatments (such as relaxation therapy) moderately superior to wait list control for pain intensity (SMD=0.62, 95% CI 0.25 to 0.98 and SMD=0.75, 95% CI 0.35 to 1.15, respectively)[722]. Self-regulatory therapy was also moderately superior to wait list controls for measures of depression (SMD=0.81, 95% CI 0.11 to 1.52).

Efficacy of psychological therapies versus other active interventions

For workers with subacute low back pain, the Cochrane review[301] included one higher-quality trial[632] that found operant treatment in combination with a graded activity program associated with earlier return to work and reduced long-term sick leave compared to usual care[632].

For chronic low back pain, one lower-quality trial included in the Cochrane review[301] found no difference between behavioral therapy and exercise on pain intensity, functional status, and behavioral outcomes through 12 months[727]. The other systematic review found no differences between psychological therapies (either alone or as part of multidisciplinary treatment) and other active interventions (including physical therapy interventions and usual care) for pain intensity, pain interference, health care visits, or medication use[722]. However, psychological therapies were slightly to moderately superior to other interventions for short- and long-term disability (3 trials, SMD=0.36, 95% CI 0.06 to 0.65 and 4 trials, SMD=0.53, 95% CI 0.19 to 0.86, respectively).

Efficacy of one psychological therapy intervention versus another

In head-to-head comparisons, neither systematic review found clear differences between different types of psychological therapies[301, 722]. In the Cochrane review[301], the best-studied comparisons were cognitive-behavioral versus operant therapy (three higher-quality trials[725, 728, 729]) and cognitive versus respondent therapy (three lower-quality trials[730-732]).

Harms

Safety was not assessed in any of the systematic reviews.

Costs

One trial that compared different operant interventions found no significant differences in costs or utilities[733].

Summary of evidence

- For chronic low back pain, there is consistent evidence from four trials (one higher-quality) that cognitive-behavioral therapy is moderately more effective than wait list control for short-term pain intensity, though there were no significant differences in functional status and other outcomes (level of evidence: good).
- For chronic low back pain, two lower-quality trials found progressive relaxation associated with large beneficial effects on pain intensity and behavioral outcomes compared to wait list control (level of evidence: fair).
- For chronic low back pain, evidence on EMG biofeedback versus wait list control is mixed, though moderate benefits on pain intensity were reported in three out of four trials (one higher-quality) (level of evidence: fair).
- For chronic low back pain, operant therapy was not associated with any clear benefits relative to wait list controls in three trials (one higher-quality) (level of evidence: good).
- For chronic low back pain, psychological therapies have not clearly been shown to be superior to other non-invasive interventions for most outcomes, though one systematic review found psychological therapies associated with moderate beneficial effects on short- and long-term disability (level of evidence: fair).
- There is no clear evidence from head-to-head trials that one psychological therapy intervention is superior to any other (level of evidence: fair to good).

Recommendations and findings from other guidelines

- The AHCPR guidelines recommend against biofeedback in patients with acute low back problems (strength of evidence: C).
- The VA/DoD guideline recommendations are similar.
- The UK RCGP guidelines found conflicting evidence on effectiveness of biofeedback for chronic low back problems, and no evidence on effectiveness for acute low back problems (strength of evidence: *).
- The European COST guidelines recommend against psychological therapy for acute low back pain, but recommend it in patients with chronic low back pain.

Massage

Massage involves soft tissue manipulation using the hands or a mechanical device. It is administered using a variety of techniques, which vary in intensity and in the amount of pressure that is applied.

Results of search: systematic reviews
We identified one higher-quality Cochrane review[700, 701] (8 trials, 5 higher-quality) and one lower-quality systematic review[555] of massage for low back pain. We excluded two outdated systematic reviews[399, 734] and one systematic review that evaluated case reports of adverse events associated with massage for any condition[735].

Results of search: trials
Eight unique trials of massage for low back pain were included in the two systematic reviews[555, 700, 701]. We did not search for additional trials.

Efficacy of massage versus placebo or sham massage

Conclusions of the two systematic reviews were generally consistent[555, 700, 701]. Neither systematic review included any trial of massage versus placebo or sham massage. For subacute or chronic low back pain, the Cochrane review[700, 701] included one higher-quality trial that found massage moderately superior to sham laser for short- and long-term pain intensity (SMD=-0.80, 95% CI -1.37 to -0.23 and -0.49, 95% CI -1.05 to 0.06, respectively) and substantially superior for short- and long-term functional status (SMD=-1.06, 95% CI -1.65 to -0.47 and SMD=-0.96, 95% CI -1.58 to -0.35, respectively[736].

Efficacy of massage versus other interventions

Nearly all trials that compared massage to other interventions only assessed outcomes during or shortly following (within one month) a course of treatment in patients with subacute to chronic low back pain. Interpretation of results from these trials is a challenge because several trials with negative results evaluated superficial massage techniques, brief (10 to 15 minutes) treatment sessions, or few (<5) sessions.

For back pain of varying duration, the Cochrane review included three lower-quality trials of massage versus spinal manipulation[390, 737, 738]. Two of the trials evaluated light or minimal massage techniques[390, 737]. Two trials found massage inferior to spinal manipulation for immediate (after the first session) relief of pain and improvement in function[390, 738]. In one of the trials, effects of spinal manipulation and massage were similar by the end of treatment and through three weeks of follow-up[738]. In the other trial, interpretation of findings is a challenge because of differences in baseline function scores[390]. A third trial found no differences between spinal manipulation and massage at any time point[737].

Other interventions have only been compared to massage in one or two trials each. For acute low back pain, one lower-quality trial found no difference between massage and application of a faradic current[737]. For chronic low back pain, one higher-quality trial found minimal massage inferior to TENS for the proportion of patients with at least 50% reduction in pain during the course of treatment (85% vs. 38%)[708]. One lower-quality trial found massage moderately superior to relaxation therapy[739].

Three trials (two higher-quality[369, 736]) compared massage to other interventions for subacute to chronic low back pain. One lower-quality trial found no differences between minimal massage and TENS or a corset[390, 391]. One higher-quality trial found no differences between massage and exercise therapy[736]. Another higher-quality trial found massage moderately superior to acupuncture or self-care education, with beneficial effects persisting through one year of follow-up[369].

Efficacy of one massage technique versus another

The Cochrane review found no clear difference between results of trials of manual massage and those that used a mechanical device[700, 701]. One higher-quality study[740] found acupuncture massage superior to classical (Swedish) massage for improvements in pain and function. The greatest benefits from massage were observed in trials that used a trained massage therapist with many years of experience or a licensed massage therapist[369, 736, 739]. No conclusions could be drawn regarding differential effects associated with the number or duration of massage sessions[700, 701].

Harms

One higher-quality trial included in the Cochrane review reported minor adverse events (such as "significant pain or discomfort") in 13% of patients who received massage[369]. No serious adverse events were noted in any of the trials included in the Cochrane review[700, 701], though most trials didn't report adverse events at all. One systematic review on safety of massage for any condition included case reports of serious adverse events (one large hematoma with slight anemia and one case of renal embolization) in two patients that received massage for low back pain[735].

Costs

One trial found no significant differences (p=0.15) between HMO-related costs among massage ($139), acupuncture ($252), and a self-care education booklet ($200)[369].

Summary of evidence

- For acute low back pain, there is insufficient evidence to judge efficacy of massage. One lower-quality trial found no difference between massage and application of a faradic current (level of evidence: poor).
- For subacute or chronic low back pain, massage was moderately superior to sham laser for short- and long-term pain relief and moderately to substantially superior for functional outcomes in one higher-quality trial (level of evidence: fair).
- For back pain of varying duration, massage was inferior to spinal manipulation in two of three trials (all lower-quality) for immediate (after the first session) pain relief and improvement in functional status. However, differences were no longer present by the end of treatment sessions in two of three trials, the third trial evaluated groups with significant baseline differences in function scores, and two of the trials evaluated minimal massage interventions (level of evidence: poor).
- For chronic or subacute low back pain, minimal massage was inferior to TENS in one higher-quality trial, but there were no differences between minimal massage and TENS in one lower-quality trial (level of evidence: poor).
- For chronic or subacute low back pain, one trial found no difference between massage and exercise plus a corset, one trial found massage moderately superior to relaxation therapy, and one trial found massage moderately superior to acupuncture or a self-care education book. Most trials only evaluated short-term outcomes, but one trial found that beneficial effects of

massage compared to acupuncture or a self-care education book persisted for one year (level of evidence for each comparison: poor to fair).

- One higher-quality trial found acupuncture massage superior to classical (Swedish) massage (level of evidence: fair).
- No serious adverse events were reported in trials of massage for low back pain, though quality of reporting was suboptimal (level of evidence: poor).

Recommendations and findings from other guidelines

- The AHCPR guidelines found physical agents and modalities (including massage) of insufficiently proven benefit to justify their cost (strength of evidence: C).
- The VA/DoD and UK RCGP guidelines reached similar conclusions.
- The European COST guidelines recommend against massage for acute low back pain and found insufficient evidence to recommend massage for chronic low back pain.

Modified work

Results of search: systematic reviews
We excluded two lower-quality systematic reviews on effectiveness of return-to-work interventions for low back pain because neither specifically evaluated benefits or harms associated with modified work[645, 741]. We excluded another outdated systematic review on modified work for low back pain that only included one randomized trial (discussed below)[742].

Results of search: trials
The systematic reviews all included one lower-quality randomized trial evaluating an occupational intervention (including modified work if necessary) versus a clinical intervention, both interventions, or neither intervention (also reviewed in the section on interdisciplinary interventions)[646]. We identified one other randomized trial not included in the systematic reviews that evaluated effects of efforts of an intervention to promote utilization of active sick leave, but it did not meet inclusion criteria because it did not evaluate effects of modified work on individual patients[743, 744].

Efficacy of modified work versus no modified work

For subacute low back pain, one lower-quality randomized trial that compared an occupational intervention (including modified work), clinical intervention, both interventions, and neither intervention (usual care) found workers randomized to the two arms with the occupational intervention had about half as many lost work days than those randomized to the other two arms (60 and 67 days versus 120 and 131)[646]. However, it is difficult to assess the effects of modified work from this trial, as the occupational intervention also involved a work site visit and ergonomic adjustments, with modified work (light duties) only prescribed if deemed necessary. The excluded cluster randomized trial randomized municipalities in Norway to a proactive intervention versus a passive or no intervention to increase use of active sick leave[743]. It found no differences between interventions in median days of sick leave or proportion of patients returning to work before 50 weeks. The proactive intervention only slightly increased use of

active sick leave (18% vs. 12%), and the trial was not designed to evaluate effects of modified work on individual patients[744].

An outdated systematic review on modified work included only one randomized trial (discussed above)[742]. It also included 12 higher-quality observational studies that were consistent with the conclusion that modified work increases return to work. Only four of the 12 studies specifically evaluated low back pain patients, and only one of the four was prospective. In most studies the modified work intervention was evaluated as part of a more comprehensive occupational intervention.

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- For workers with subacute low back pain, there is insufficient evidence (one lower-quality trial) to evaluate effects of modified work on rates of return to work or other outcomes (level of evidence: poor).

Recommendations and findings from other guidelines

- The AHCPR guidelines state that activity recommendations for the employed patient with acute low back symptoms need to consider the patient's age and general health, and the physical demands of required job tasks (strength of evidence: D).
- The VA/DoD guidelines are similar.
- The European COST guidelines state that temporary modified work (which may include ergonomic workplace adaptations) can be recommended, when needed, in order to facilitate earlier return to work for workers sicklisted due to low back pain (level B).

Spa therapy and balneotherapy

Balneotherapy involves immersion in baths containing thermal mineral waters at temperatures above 20 °C. Spa therapy differs from balneotherapy in that it also involves physical therapy interventions (exercise and physical modalities) provided at a spa resort.

Results of search: systematic reviews
We identified one higher-quality systematic review on efficacy of spa therapy and balneotherapy for low back pain[745].

Results of search: trials
The systematic review included three trials of spa therapy for chronic low back pain[746-748] and two trials of balneotherapy for subacute or chronic low back pain[696, 749]. All trials were conducted in Europe.

Because the systematic review was published after we completed our initial draft of this report, we had already conducted a search for trials. From 88 potentially relevant citations, we identified the same five trials as the systematic review, and rated three higher-quality[747-749]. The systematic review rated two of the 5 trials higher-quality (at least 3 points on the 5-point Jadad scale)[747, 749] and the other received 2 out of 5 points[696, 746, 748]. This difference did not affect conclusions.

Efficacy of spa therapy or balneotherapy versus no spa therapy or balneotherapy

For chronic low back pain, three trials (two rated higher-quality[747, 748] found spa therapy associated with large benefits compared to no spa therapy for pain (differences of 20 to 30 points on a 100 point pain scale) and analgesic intake at the end of a three-week course of treatment, with benefits persisting for up to 9 months[746-748]. The systematic review calculated a WMD of 26.7 on a 100 point pain scale (95% CI 20.4 to 32.8). In two[747, 748] of three[746] trials, spa therapy was also superior to no spa therapy for functional status or disability.

Table 54. Trials of spa therapy versus no spa therapy

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Constant, 1995[748] (chronic LBP)	n=126 6 months	**Spa therapy vs. no spa therapy** (mean improvement from baseline at 6 months) Pain, VAS (0 to 100 scale): -22.4 vs. +1.0, p<0.0001 Overall patient evaluation, (0 to 100 scale): +28.7 vs. +1.6, p<0.0001 RDQ Score (0 to 24): -5.1 vs. -0.9, p<0.0001	5/9
Constant, 1998[747] (chronic LBP)	n=224 3 months	**Spa therapy vs. no spa therapy** (mean improvement from baseline at 3 months) Pain, VAS (0 to 100 scale): -37.6 vs. -14.2, p<0.0001 Overall patient evaluation (0 to 100 scale): +24.8 vs. +3.9, p<0.0001 RDQ Score (0 to 24): -4.0 vs. -1.1, p<0.0001	5/9
Guillemin, 1994[746] (chronic LBP)	n=104 9 months	**Spa therapy vs. no spa therapy** (mean improvement from baseline at 9 months) Pain, VAS (0 to 100 scale): -34.4 vs. +7.1, p<0.0001 Waddell disability score: +0.09 vs. +0.18, NS	4/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Efficacy of balneotherapy versus other interventions

For subacute to chronic (one to six month duration) low back pain, one higher-quality trial compared balneotherapy plus exercise to exercise alone (Table 55)[749]. It found no differences in pain scores one month after completion of a three-week course of treatment. For subacute or chronic low back pain, another lower-quality trial found balneotherapy superior to flexion and extension exercises by about 20 points on a 100 point pain scale after four weeks, though there were no differences in pain outcomes after one year[696]. Daily analgesic use significantly decreased in the balneotherapy group but not in the exercise group. There were no differences between balneotherapy and either underwater traction or underwater massage. Although the systematic review calculated a WMD of 18.8 points (95% CI 10.3 to 27.3) on a 0 to 100 pain scale in favor of balneotherapy based on these two trials, it only pooled early, short-term results.

Data from longer term follow-up (1 month to 1 year) showed smaller effects and no significant differences (Table 55).

Table 55. Trials of balneotherapy versus other interventions

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Konrad, 1992[696] (subacute)	n=170 1 year	**Balneotherapy vs. underwater massage vs. underwater traction vs. exercise** (mean improvement from baseline at 1 year) Pain, VAS (0 to 100 scale): -13.9 vs. -10.9 vs. -13.7 vs. -6.6 (NS)	4/9
Yurtkuran, 1997[749] (subacute or chronic LBP)	n=50 7 weeks	**Balneotherapy + exercise versus exercise alone** (mean improvement from baseline at 1 month) Pain, VAS (0 to 10 scale): -2.95 vs. -1.35 (NS)	5/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- There is no evidence on spa therapy for acute low back pain.
- For chronic low back pain, spa therapy was moderately to substantially superior to no spa therapy for pain in three trials (two higher-quality, all trials conducted in Europe) up to nine months after a three-week course of treatment, though effects on functional status were mixed (level of evidence: fair).
- For subacute or chronic low back pain, balneotherapy was no better than underwater massage, underwater traction, or exercise for pain relief after one month in one lower-quality trial (level of evidence: poor).
- For subacute or chronic low back pain, balneotherapy plus exercise therapy was no better than exercise therapy alone for pain relief after one year in one lower-quality trial, though balneotherapy was moderately superior for short-term pain relief (level of evidence: poor).

Recommendations and findings from other guidelines

- The other guidelines do not address spa therapy.

Spinal manipulation

Spinal manipulation refers to manual therapy in which loads are applied to the spine using short or long lever methods. Using these methods, high-velocity thrusts are applied to a spinal joint beyond its restricted or normal range of movement. Spinal mobilization (low-velocity, passive movements within or at the limit of joint range) is often used in conjunction with manipulation.

Results of search: systematic reviews
We identified 12 systematic reviews of spinal manipulation for low back pain that met inclusion criteria. Six (including a Cochrane review of 39 trials[66, 67]) were rated higher-quality[100, 555, 750-752] and six lower-quality[753-758]. Four other systematic reviews specifically evaluated harms of spinal manipulation (most including observational studies as well as randomized trials)[759-762] and one higher-quality systematic review evaluated whether trials that permitted discretion in manipulation techniques found larger benefits than trials that didn't allow discretion[763]. We excluded 17 outdated systematic reviews[193, 345, 346, 623, 764-776] and three systematic reviews that either evaluated cervical manipulation only or cervical and lumbar manipulation together[777-779].

Results of search: trials
Sixty-nine unique trials on efficacy of spinal manipulation were included in twelve systematic reviews. Nearly all of the trials evaluated patients with non-specific low back pain, mixed populations with and without sciatica, or did not specify presence or absence of sciatica. For example, in the Cochrane review,12 of 39 trials included patients with or without sciatica, but only three reported results specifically in patients with sciatica. The number of manipulation sessions in the trials ranged from 1 to 24.

We also identified two large (n=681 and n=1334), recently published trials (the UK BEAM Trial[629] and the UCLA Low Back Pain Study[780, 781]) and one smaller (n=102) trial of spinal manipulation for acute low back pain with sciatica and herniated lumbar disc[782] not included in the systematic reviews.

Efficacy of spinal manipulation versus sham, placebo, or therapies judged ineffective

For acute low back pain, the Cochrane review found spinal manipulation slightly to moderately superior to sham manipulation for short-term pain relief in a meta-regression (WMD=-10 mm on a 100 mm VAS, 95% CI=2 to 17)[66, 67]. However, the only trial that reported pain relief for acute low back pain was a lower-quality trial that included patients with acute or subacute (<3 months duration) sacroiliac pain[783] Based on two trials (one higher-quality[784, 785]), spinal manipulation was moderately more effective than sham manipulation on short-term function (RDQ), but the difference did not reach statistical significance (WMD=-2.8, 95% CI -5.6 to +0.1). Compared to therapies judged to be ineffective or harmful (traction, bed rest, home care, topical gel, no treatment, diathermy, and minimal massage) spinal manipulation was statistically superior for short-term pain relief, but the difference was not clinically significant (WMD=-4 on a 0 100 mm VAS, 95% CI -8 to -1). Compared to ineffective or possibly harmful therapies, difference on the short-term RDQ favored spinal manipulation but did not reach statistical significance (WMD=-2.1, 95% CI -4.4 to +0.2). There were no differences between spinal manipulation and either sham manipulation or the therapies judged to be ineffective or harmful in long-term pain or function.

Only one lower-quality trial in the Cochrane review evaluated efficacy of spinal manipulation versus sham, placebo, or ineffective therapies specifically in patients with sciatica. It found no significant differences between spinal manipulation and a placebo gel for either acute/subacute

or chronic sciatica, though trends favored manipulation[356]. For acute sciatica with a radiologically confirmed herniated disc, a higher-quality trial not included in the Cochrane review found spinal manipulation substantially superior to sham manipulation for the proportion free of radicular pain after six months (55% vs. 20%, p<0.0001), though there were no significant differences in SF-36 scores (Table 56)[782].

Table 56. Trial of spinal manipulation for acute sciatica with prolapsed lumbar disc

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Santilli, 2006[782]	n=102 6 months	**Manipulation vs. sham manipulation** Proportion pain-free (radiating pain) at 180 days: 55% (29/53) vs. 20% (10/49), p<0.0001 Proportion pain-free (local pain) at 180 days: 28% (15/53) vs. 6% (3/49) Use of NSAIDs (days): 1.8 vs. 3.7 days SF-36: No differences Kellner symptom scale: No differences	5/9

For chronic low back pain, the Cochrane review found spinal manipulation associated with moderate improvements in short- or long-term pain and short-term function compared to sham manipulation (3 trials) or therapies judged to be ineffective or harmful (5 trials)[66, 67]. Against sham manipulation, differences in short- and long-term pain averaged 10 mm (95% CI 3 to 17) and 19 mm (95% CI 3 to 35) on a 100 mm VAS, and differences for short-term function averaged 3.3 points (95% CI 0.6 to 6.0) on the RDQ. Conclusions were insensitive to different cutoffs for classification of studies as higher-quality or to the profession of the manipulator (chiropractor or other). There was insufficient data to judge effects of presence or absence of sciatica on benefits. No trials evaluated efficacy of spinal manipulation under anesthesia[66, 67, 786].

A recent technology report funded by the Canadian Coordinating Office for Health Technology Assessment (CCOHTA) reviewed 14 published systematic reviews of spinal manipulation[750]. It concluded that the Cochrane review[66, 67] was the best available summary of clinical effectiveness because it received a high quality score, was published recently, and included the largest number of trials. The CCOHTA report also identified two additional randomized trials and two non-randomized trials that did not change the overall conclusions of the Cochrane review. Four other higher-quality[100, 555, 751, 752] and six lower-quality[753-758] systematic reviews also found spinal manipulation superior to placebo, sham, or therapies thought to be ineffective.

One higher-quality systematic review found that trials that permitted providers to tailor specific spinal manipulation techniques to individual patients did not report better outcomes than trials that did not allow therapeutic discretion[763]. In fact, spinal manipulation was associated with better short-term outcomes in trials that didn't allow discretion, though long-term outcomes were similar. These conclusions should be interpreted with caution because they involve indirect, cross-trial comparisons.

Efficacy of spinal manipulation versus usual care or other interventions

For acute low back pain, the Cochrane review found spinal manipulation associated with no clinically or statistically significant advantages over usual general practitioner care or analgesics (3 trials), physical therapy or exercises (5 trials), and back school (2 trials)[66, 67]. For chronic low back pain, there were no differences between manipulation and general practitioner care or analgesics (6 trials), physiotherapy or exercises (4 trials), and back school (3 trials). For sciatica of varying duration, three trials found no differences between spinal manipulation and other interventions[151, 356, 389]. Five other higher-quality systematic reviews (including one that focused on patients with sciatica[100]) also found no clear differences between spinal manipulation and other interventions[100, 555, 750-752].

The two most comprehensive lower-quality systematic reviews found spinal manipulation superior to some other effective interventions[754, 758]. However, conclusions regarding superiority of spinal manipulation over other interventions were generally based on sparse data (one to three trials, often lower-quality, and often with small sample sizes) or did not appear to adequately consider inconsistency when results of some trials or outcomes demonstrated no differences.

Two large, recently published trials reported results consistent with the Cochrane review. For low back pain of unspecified duration, the higher-quality UCLA Low Back Pain Study found no differences in pain or functional status scores between those randomized to chiropractic versus medical care through 18 months (Table 57), though patients randomized to chiropractic care perceived themselves to be more improved[780, 781]. The other trial found manipulation slightly superior to usual care for back-specific functional status, pain, and disability in patients with subacute or chronic low back pain, though beneficial effects were diminished after 12 months compared to after 3 months[629]. There were no significant differences between manipulation and exercise, though trends favored manipulation.

Table 57. Results of the UK BEAM Trial and the UCLA Low Back Pain Study

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Hurwitz, 2002[780, 781] UCLA Low Back Pain Study	n=681 6 months	**Chiropractic care vs. medical care** (adjusted between-group difference in improvement from baseline) Most severe pain (0 to 10 scale): -0.25 (95% CI -0.96 to 0.45) at 6 months, -0.64 (95% CI -1.38 to -0.21) at 18 months Average pain (0 to 10 scale): -0.26 (95% CI -0.81 to 0.29) at 6 months, -0.50 (-1.09 to 0.08) at 18 months RDQ score (0 to 24 scale): -0.37 (95% CI -1.63 to 0.90) at 6 months, -0.69 (-2.02 to 0.65) at 18 months	7/9**
UK BEAM Trial, 2004[629]	n=1334 12 months	**Manipulation + exercise versus manipulation alone versus exercise alone** (all results are net benefit relative to usual care at 12 months) RDQ score (0 to 24 scale): 1.30 (95% CI 0.54 to 2.07) vs. 1.01 (95% CI 0.22 to 1.81) vs. 0.39 (95% CI -0.41 to 1.19) Modified Von Korff pain score (0 to 100 scale): 6.71 (95% CI 2.47 to 10.95) vs. 5.87 (95% CI 1.58 to 10.17) vs. 4.90 (95% CI 0.30 to 9.50) Modified Von Korff disability score (0 to 100 scale): 6.71 (95% CI 2.62 to 10.80) vs. 5.65 (95% CI 1.57 to 9.72) vs. 4.56 (95% CI 0.34 to 8.78)	2/10*

* Excludes criteria involving blinding of care providers, for maximum score of 10
** Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Harms

Five systematic reviews consistently found serious adverse events such as worsening lumbar disc herniation or cauda equina syndrome following lumbar spinal manipulation therapy to be very rare[555, 759-762]. One systematic review found no serious complications reported in over 70 controlled clinical trials[760]. Including data from observational studies, the estimated risk for serious adverse events was lower than 1 per 1 million patient visits[761, 762]. Current guidelines recommend against spinal manipulation in patients with severe or progressive neurologic deficits.

Costs

In the UCLA Low Back Pain Study, costs were higher with chiropractic care relative to medical care ($560 versus $369, p<0.001)[787]. Because outcomes were very similar for the two interventions, this is essentially a cost-minimization analysis. In the UK BEAM Trial, manipulation was associated with an incremental cost-effectiveness of £4800/QALY (about $9,264/QALY) relative to best care and £2300/QALY ($4,439/QALY) relative to exercise[629]. Two other trials that compared spinal manipulation to exercise therapy found similar costs and outcomes for the two interventions[367, 788, 789]. In one of the trials, chiropractic care was more costly then a self-care booklet ($429 versus $153), with only modest differences in patient outcomes[367].

Summary of evidence

- For acute low back pain, spinal manipulation was slightly to moderately superior to sham manipulation for pain relief, but results are primarily based on a small, lower-quality trial of patients with acute or subacute sacroiliac symptoms. Spinal manipulation was moderately superior to sham manipulation for functional outcomes in two trials (one higher-quality), but the difference just missed reaching statistical significance. Spinal manipulation was not effective versus sham manipulation for long-term outcomes (level of evidence: fair).
- For acute low back pain, spinal manipulation was statistically superior to no treatment or therapies thought to be ineffective or harmful for short-term pain relief, but differences were not clinically meaningful. Spinal manipulation was moderately superior for short-term functional status, but the difference just missed reaching statistical significance (level of evidence: good).
- For acute low back pain, there are no clear differences between spinal manipulation and analgesics/usual care (3 trials), exercise therapy (6 trials), or back school (2 trials) (level of evidence: fair).
- For chronic low back pain, evidence from eleven trials found spinal manipulation moderately superior to sham, no treatment, or therapies thought to be ineffective or harmful for pain relief and functional status (level of evidence: good).
- For chronic low back pain, there is no consistent evidence from a number of trials of clinically significant differences between spinal manipulation and other non-invasive interventions thought to be effective (level of evidence: good).
- For acute sciatica, one higher-quality trial found spinal manipulation substantially superior to sham manipulation for the proportion free of radicular pain after 6 months (level of evidence: fair).
- For sciatica of mixed duration, outcomes favored spinal manipulation over a placebo gel in one lower-quality trial, but differences were not significant (level of evidence: poor).
- For sciatica of mixed duration, there were no differences between spinal manipulation and other non-invasive interventions in three trials (level of evidence: fair).
- In patients without severe or progressive neurologic deficits, serious adverse events such as cauda equina syndrome or worsening lumbar disc herniation following lumbar spinal manipulation are very rare (level of evidence: good).

Recommendations and findings from other guidelines

- The AHCPR guidelines found that manipulation can be helpful in patients with acute low back problems without radiculopathy when used within the first month of symptoms (strength of evidence: B).
- The AHCPR guidelines found insufficient evidence to recommend manipulation in patients with radiculopathy (strength of evidence: C).

- The AHCPR guidelines found that a trial of manipulation in patients without radiculopathy with symptoms longer than one month is probably safe, but efficacy unproven (strength of evidence: C).
- The AHCPR guidelines recommended an appropriate diagnostic assessment to rule out serious neurologic conditions prior to initiating manipulation therapy when progressive or severe neurologic deficits are present (strength of evidence: D).
- The VA/DoD guidelines for manipulation are essentially identical to the AHCPR guidelines.
- The UK RCGP guidelines found manipulation superior for short-term improvement in pain and activity levels and higher patient satisfaction compared to comparison treatments in patients with acute and subacute back pain (strength of evidence: **).
- The UK RCGP guidelines found that the risks of manipulation for low back pain are very low, provided patients are selected and assessed properly and manipulation is performed by a trained therapist or practitioner (strength of evidence: **).
- The UK RCGP guidelines found no firm evidence regarding what kind of manipulation is most effective, or optimum timing of manipulation (strength of evidence: *).
- The UK RCGP guidelines recommend against manipulation under general anesthesia (strength of evidence: *).
- The European COST guidelines recommend considering referral for spinal manipulation patients with acute low back pain who are failing to return to normal activities, and a short-course of spinal manipulation/mobilization as a treatment option for chronic low back pain.

Table 58. Systematic reviews on efficacy of non-pharmacologic therapies for low back pain

Author, year	Type of systematic review	Number of included trials (number rated higher-quality)*	Number of trials not included in any other relevant systematic review	Duration of treatment in included trials	Sample sizes in included trials	Interventions evaluated (number of trials)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Acupuncture (51 unique trials in three systematic reviews)								
Furlan, 2005[69, 70]	Qualitative and quantitative	35 (14)	11	1 to 20 sessions	17 to 492 (median=54)	Acupuncture (32), dry needling (3)	Acupuncture vs. no treatment for chronic LBP: SMD=-0.73 (95% CI -1.19 to -0.28) for short-term pain (2 RCTs) and SMD=-0.63 (95% CI -1.08 to -0.19) for short-term function (2 RCTs) Acupuncture vs. sham acupuncture: WMD=-17.79 (95% CI -25.5 to -10.07) for short-term pain (6 RCTs), WMD= -5.74 (95% CI -14.7 to 3.25) for long-term pain (3 RCTs), no difference for function	7
Manheimer, 2005[68]	Quantitative	33 (5)	10	1 to 20 sessions	17 to 194 (median=60)	Chinese acupuncture (29), Western acupuncture (4), electro-acupuncture (14), acupuncture for antenatal LBP (3)	Acupuncture vs. no additional treatment for chronic LBP: SMD=-0.69 (95% CI -0.98 to -0.40) for short-term pain (8 RCTs), SMD=-0.74 (95% CI -1.47 to -0.02) for long-term pain (5 RCTs), SMD=-0.62 (95% CI -0.95 to -0.30) for short-term function (6 RCTs) Acupuncture vs. sham acupuncture: SMD=-0.58 (95% CI -0.36 to -0.80), for short-term pain (4 RCTs), SMD=-0.59 (95% CI -1.29 to +0.10) for long-term pain (2 RCTs), no difference for function	6
Back schools (31 unique trials in three systematic reviews)								
Elders, 2000[588]	Qualitative and quantitative	6 trials of back schools (quality not assessed)	3	Not reported	51 to 975 (median=194)	Not described	Back school vs. control: Rate difference for return to work rate ranged from -7% to 29% after 21 to 42 days (4 RCTs); 30% to 37% after 180-200 days (3 RCTs); -1% to 42% after 360 days (4 RCTs)	3

Table 58. Systematic reviews on efficacy of non-pharmacologic therapies for low back pain

Author, year	Type of systematic review	Number of included trials (number rated higher-quality)*	Number of trials not included in any other relevant systematic review	Duration of treatment in included trials	Sample sizes in included trials	Interventions evaluated (number of trials)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Heymans, 2005[586, 587]	Qualitative	19 (6)	8	1, 4-hour session to 21, 85-minutes sessions	37 to 975 (median=106)	Swedish or modified Swedish back school (6), Maastricht (2), others (11)	Conflicting evidence from 8 RCTs on effectiveness of back schools for chronic LBP versus wait-list control or placebo for short-, intermediate-, or long-term pain, functional status, and return to work Back school in occupational setting appeared to more effective	7
Maier-Riehle, 2001[589]	Quantitative	13 (quality not assessed)	9	1 to 22 hours (median=5)	29 to 299 (median=76)	Not described	Back school vs. any control: SMD +0.14 (p=0.026) for pain intensity at <3 months (9 RCTs), SMD=0.44 (p=0.001) for recurring back pain through 6 months (6 RCTs), no significant differences for functional status (7 RCTs) or recurring back pain after 6 months	4
Exercise (seventy-nine unique trials in seven systematic reviews)								
Clare, 2004[616]	Quantitative	5 (3)	1	Not reported	25 to 321	All trials evaluated McKenzie method	McKenzie therapy versus control (booklet, strength training, spinal mobilization, or massage): WMD= -8.6 (95% CI -13.7 to -3.5) on a 100 point scale for short-term (<3 months) pain (3 RCTs) and WMD=-5.4 (95% CI -8.4 to -2.4) for short-term disability (5 RCTs); no differences for intermediate-term disability	6

Table 58. Systematic reviews on efficacy of non-pharmacologic therapies for low back pain

Author, year	Type of systematic review	Number of included trials (number rated higher-quality)*	Number of trials not included in any other relevant systematic review	Duration of treatment in included trials	Sample sizes in included trials	Interventions evaluated (number of trials)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Hayden, 2005[613, 615]	Quantitative and qualitative	61 (28)	41	2 to 150 hours	17 to 473 (median=75)	McKenzie (6), extensor (5), flexion (9), isometric (3), aerobics (8), strengthening (16), stretching (12), graded activity (2), other or multiple (17)	Exercise therapy vs. no treatment for acute LBP: WMD=-0.59 (95% CI -12.69 to 11.51) on 100 point scale for short-term pain (3 RCTs), no differences for function Exercise therapy vs. no treatment for chronic LBP: WMD=10.2 (95% CI 1.31 to 19.09) for short-term pain (19 RCTs) and WMD=3.00 (95% CI -0.53 to 6.48) for short-term function (17 RCTs); results similar at longer-term follow-up	7
Kool, 2004[617]	Qualitative and quantitative	14 (9)	7	3 weeks to 12 months	80 to 476 (median=166)	Outpatient exercise therapy (9), inpatient (3), back school (3), inter-disciplinary/ functional restoration (5)	Exercise vs. usual care: SMD=-0.24 (95% CI -0.36 to -0.11) for number of sick days during first year follow-up (9 RCTs), RR=1.37 (95% CI=1.05 to 1.78) for proportion at work after one year (3 RCTs)	7
Liddle, 2004[618]	Qualitative	16 (8)	4	Not reported	28 to 222 (median=99)	Strength/ flexibility (9), multimodal (3), other (4)	Exercise vs. control: 9 of 16 RCTs reported a "positive result" (on any outcome) vs. control (waiting list, advice, or electrotherapy), 7 other RCTs reported "positive result" but no difference compared to control (usually exercise-based); 5 of 7 RCTs reported “positive result” for back-specific function	3

Table 58. Systematic reviews on efficacy of non-pharmacologic therapies for low back pain

Author, year	Type of systematic review	Number of included trials (number rated higher-quality)*	Number of trials not included in any other relevant systematic review	Duration of treatment in included trials	Sample sizes in included trials	Interventions evaluated (number of trials)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Machado, 2006[619]	Quantitative	11 (6)	3	Not clearly reported	24 to 321 (median=75)	All trials evaluated McKenzie method	McKenzie versus passive therapy (educational booklets, bed rest, ice packs, and massage) for acute LBP: WMD=-4.16 (95% CI -7.12 to -1.20) on 100 point scale for pain (4 RCTs) and WMD=-5.22 (95% CI -8.28 to -2.16) for disability at 1 week follow-up; no differences at 4 weeks (4 RCTs) McKenzie versus advice to stay active for acute LBP: WMD=+3.85 (95% CI +0.30 to +7.39) for disability at 12 weeks follow-up (2 RCTs) No differences between McKenzie and other exercise therapy	7
McNeely, 2003[620]	Qualitative (exercise therapy for spondylo-lysis and spondylo-listhesis)	2 (1)	1	Not reported	44 and 65	Strengthening (1), flexion/ extension (1)	Unable to draw firm conclusions regarding exercise therapy for spondylolysis and spondylolisthesis	4

Table 58. Systematic reviews on efficacy of non-pharmacologic therapies for low back pain

Author, year	Type of systematic review	Number of included trials (number rated higher-quality)*	Number of trials not included in any other relevant systematic review	Duration of treatment in included trials	Sample sizes in included trials	Interventions evaluated (number of trials)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Functional restoration (18 trials in one systematic review)								
Schonstein, 2003[302, 303]	Qualitative and quantitative	18 (9)	12 trials not included in systematic reviews of inter-disciplinary therapy	One session to weekly sessions for 1.5 years	45 to 542 (median=165)	Cognitive-behavioral component (10), no cognitive-behavioral component (8)	Physical conditioning vs. usual care for time lost from work: WMD=-45 (95% CI -88 to -3) for number of sick leave days after one year (2 RCTs); OR 0.80 (95% CI 0.58 to 1.09) for proportion off work at 12 months (3 RCTs) Physical conditioning vs. physical conditioning plus psychological treatment: OR=0.93 (95% CI 0.44 to 1.97) for proportion off work at 6 or 12 months (2 RCTs)	6
Inter-disciplinary therapy (16 unique trials in three systematic reviews)								
Guzman, 2001[643, 644]	Quantitative (chronic low back pain)	10 (3)	10	Once weekly to daily sessions	20 to 476 (median=170)	Higher intensity (4), lower intensity (4), other (3)	Strong evidence that intensive (>100 hour) daily interdisciplinary therapy is more effective than usual care or less intensive therapy for function (3 RCTs) Moderate evidence that less intensive (<30 hour) interdisciplinary therapy is no more effective than usual care or non-multidisciplinary therapy (5 RCTs)	6
Karjalainen, 2001[299, 300]	Qualitative (sub-acute low back pain)	2 (0)	1	Not reported	103 and 130	Interdisciplinary therapy not categorized	Moderate evidence that multidisciplinary rehabilitation with a work site visit or more comprehensive occupational health care intervention is more effective than usual care for return to work, sick leave, and subjective disability (2 RCTs)	7

Table 58. Systematic reviews on efficacy of non-pharmacologic therapies for low back pain

Author, year	Type of systematic review	Number of included trials (number rated higher-quality)*	Number of trials not included in any other relevant systematic review	Duration of treatment in included trials	Sample sizes in included trials	Interventions evaluated (number of trials)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Tveito, 2004[645]	Qualitative	5 (0)	4	Not reported	128 to 1645 (median=234)	Interdisciplinary therapy not categorized	Moderate evidence that interdisciplinary therapy has a positive effect on sick leave (4 trials), no evidence of a positive effect on pain (1 trial)	5
Massage (8 unique trials in two systematic reviews)								
Furlan, 2002[700, 701]	Qualitative	8 (5)	Not applicable	5 to 9 sessions	24 to 262 (median=106)	Massage with hands (6), massage with mechanical device (2)	Massage superior to sham laser in 1 RCT Relative to other therapies, massage superior to relaxation therapy, acupuncture, and self-care education; massage similar to corset and exercises; light massage inferior to manipulation and TENS	6
Lumbar supports (six trials in one systematic review)								
Jellema, 2001[385]; Van Tulder, 2000[384]	Qualitative	6 trials of treatment (2)	Not applicable	3 to 8 weeks (median=3.5 weeks)	19 to 334 (median=190)	Lumbar support with rigid stay (2), pneumatic lumbar support (1), other or not specified (3)	Insufficient evidence to assess efficacy of lumbar support versus no treatment (1 RCT); lumbar support superior to other interventions in 1 of 4 RCTs	7
Neuroreflexotherapy (three trials in one systematic review)								
Urrutia, 2004[582]	Qualitative	3 (2)	Not applicable	1 to 1.4 treatments	78 to 104	Neuroreflexotherapy (3)	Neuroreflexotherapy substantially superior to sham therapy (2 RCTs) and usual care (1 RCT)	6

Table 58. Systematic reviews on efficacy of non-pharmacologic therapies for low back pain

Author, year	Type of systematic review	Number of included trials (number rated higher-quality)*	Number of trials not included in any other relevant systematic review	Duration of treatment in included trials	Sample sizes in included trials	Interventions evaluated (number of trials)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Psychological therapies (35 unique trials in two systematic reviews)								
Hoffman, 2007[722]	Quantitative	22† (6)	14	Not reported	20 to 239 (median=76)	Not described	Any psychological intervention or multidisciplinary intervention vs. wait list controls: SMD=0.50 (95% CI 0.23 to 0.77) for pain intensity (7 RCTs), SMD=0.50 (95% CI 0.00 to 0.83) for health-related quality of life (4 RCTs) Cognitive-behavioral treatment vs. wait list controls: SMD=0.62 (95% CI 0.25 to 0.98) for pain intensity (7 RCTs) Self-regulatory treatment vs. wait list controls: SMD=0.75 (95% CI 0.35 to 1.15) for pain intensity (4 RCTs)	6
Ostelo, 2005[790]	Quantitative and qualitative	21 (7)	13	3 to 12 weeks	17 to 161 (median=66)	Cognitive behavioral (14), operant (7), relaxation (11), biofeedback (6)	Progressive relaxation versus wait list controls: SMD=1.16 (95% CI 0.47 to 1.85) for pain intensity (2 RCTs) Biofeedback versus wait list controls: SMD=0.84 (95% CI 0.32 to 1.35) for pain intensity (3 RCTs) Operant therapy versus wait list controls: SMD=0.29 (95% CI -0.14 to 0.72) for pain intensity (2 RCTs) Cognitive-behavioral therapy: SMD=0.59 (95% CI 0.10 to 1.09) for pain intensity (4 RCTs)	6

Table 58. Systematic reviews on efficacy of non-pharmacologic therapies for low back pain

Author, year	Type of systematic review	Number of included trials (number rated higher-quality)*	Number of trials not included in any other relevant systematic review	Duration of treatment in included trials	Sample sizes in included trials	Interventions evaluated (number of trials)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Spa therapy and balneotherapy (five trials in one systematic review								
Pittler, 2006[745]	Quantitative	5 (2)	Not applicable	3 to 4 weeks with 3 to 6 sessions weekly	50 to 224 (median=126)	Spa therapy (2), balneotherapy (3)	Spa therapy vs. wait list control for chronic LBP: WMD=-26.6 (95% CI -32.8 to -20.4) for pain relief (3 RCTs) Balneotherapy vs. NSAIDs or exercise therapy: WMD=-18.8 (95% CI -27.3 to -10.3) for immediate pain relief (2 RCTs)	7
Spinal manipulation (69 unique trials in twelve systematic reviews)								
Assendelft, 2003[66, 67]	Quantitative	39 (10)	1	1 session to 24 sessions over 3 weeks	21 to 741 (median= 103)	Rotational manipulation (6), Maitland method (5), thrust (3), sacroiliac (2), other or not specified (23)	Spinal manipulation vs. sham for acute LBP: WMD=-10 mm (95% CI -17 to -22) on 100 mm VAS for short-term pain and WMD=-2.8 (95% CI -5.6 to +0.1) for short-term function (RDQ) Spinal manipulation vs. sham for chronic LBP: WMD=-10 mm (95% CI -17 to -33) on 100 mm VAS for short-term pain, WMD=-19 mm (95% CI -35 to -3) for long-term pain, and WMD= -3.3 (95% CI -6.0 to -0.6) for short-term function (RDQ) No differences between spinal manipulation and other therapies judged effective for either acute or chronic LBP	7
Avery, 2004[753]	Qualitative	3 (quality not assessed)	0	Not reported	155 to 323	Chiropractic spinal manipulation (2), osteo-pathic (1)	Insufficient new evidence to assess efficacy of spinal manipulation (updates previous review by Mohseni-Bandpei et al[774])	2

Table 58. Systematic reviews on efficacy of non-pharmacologic therapies for low back pain

Author, year	Type of systematic review	Number of included trials (number rated higher-quality)*	Number of trials not included in any other relevant systematic review	Duration of treatment in included trials	Sample sizes in included trials	Interventions evaluated (number of trials)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Bronfort, 2004[754]	Qualitative	31 (5)	0	1 to 24 sessions	5202 subjects (mean=168)	Spinal manipulation (26), mobilization only (5)	Moderate evidence that spinal manipulation is similar to prescriptions non-steroidal anti-inflammatory drugs for chronic low back pain; limited to moderate evidence that spinal manipulation is superior to some other interventions for acute and chronic LBP	4
Brown, 2005[750]	Qualitative	14 (6) systematic reviews and 2 (2) RCTs	0	Not reported	Not reported	Not reported	Spinal manipulation is as effective as other non-invasive treatments	6
Ernst, 2003[755]	Qualitative	12 (6)	1	4 to 12 sessions	12 to 741 (median= 69)	All trials evaluated chiropractic manipulation	Chiropractic spinal manipulation superior to control treatments in 5 of 12 RCTs. Chiropractic manipulation consistently superior to sham manipulation. Beneficial effects usually small or moderate. No clear difference between results for acute vs. chronic low back pain.	4
Ferreira, 2002[752]	Quantitative	8 (4)	0	4 to 12 sessions	19 to 395 (median=63)	Not specified	Spinal manipulation vs. placebo: WMD=7 mm (95% CI 1 to 14) on 100 mm VAS for short-term pain (2 RCTs) Spinal manipulation vs. NSAIDs: WMD=14 mm (95% CI -11 to 40) for short-term pain (2 RCTs) and 6 points (95% CI 1 to 12) on 100 mm scale for disability (2 RCTS) No differences between spinal manipulation and other effective therapies	7

Table 58. Systematic reviews on efficacy of non-pharmacologic therapies for low back pain

Author, year	Type of systematic review	Number of included trials (number rated higher-quality)*	Number of trials not included in any other relevant systematic review	Duration of treatment in included trials	Sample sizes in included trials	Interventions evaluated (number of trials)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Ferreira, 2003[751]	Quantitative	27 (11)	2	1 to 14 sessions (mean 6.8)	3817 subjects (mean=146)	High-velocity thrust (11), high-velocity thrust plus other techniques (8), high-velocity thrust plus low-velocity mobilization (7), compared different types of manip-ulation (1)	High-velocity thrust spinal manipulation vs. sham manipulation or no treatment for LBP <3 months: WMD=18 (95% CI 13 to 24) on a 100 point scale for short-term pain (3 RCTs), WMD=9 (95% CI 1 to 17) on a 100 point scale for short-term disability (3 RCTs) No differences between spinal manipulation and other effective therapies	5
Gay, 2005[756]	Qualitative	1 (quality not assessed)	1	Not reported	30	Distraction manipulation (1)	Insufficient evidence to assess efficacy of distraction manipulation	2
Licciardone2005[757]	Quantitative	6 (quality not assessed)	1	4 to 11 sessions	30 to 178 (median=93)	All trials evaluated osteopathic spinal manipulation	Osteopathic spinal manipulation vs. control treatment: SMD=-0.30 (95% CI -0.47 to -0.13) for pain reduction (8 comparison from 6 RCTs)	4

Table 58. Systematic reviews on efficacy of non-pharmacologic therapies for low back pain

Author, year	Type of systematic review	Number of included trials (number rated higher-quality)*	Number of trials not included in any other relevant systematic review	Duration of treatment in included trials	Sample sizes in included trials	Interventions evaluated (number of trials)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Woodhead, 2005[758]	Qualitative	62 (27)	17	1 to 14 sessions	12 to 1633 (median=95)	Rotational (8), Maitland (5), sacroiliac (3), other or not specified (46)	Limited evidence that spinal manipulation is more effective than placebo for acute LBP and moderate evidence that spinal manipulation is more effective than placebo for chronic or subacute LBP Moderate evidence that spinal manipulation is more effective than some other interventions for acute LBP and strong evidence that spinal manipulation is more effective than some other interventions for chronic LBP	4
Superficial heat (9 trials in 1 systematic review)								
French, 2006[398]	Quantitative	9 (5)	Not applicable	Single application to 7 days	36 to 371 (median=90)	Superficial heat (9), superficial cold (2)	Heat wrap versus oral placebo or non-heated wrap for acute or subacute LBP (4 RCTs): WMD=1.06 (95% CI 0.68 to 1.45 on a 0 to 5 scale) for pain relief up to day 5 (2 RCTs); WMD= -2.10 (95% CI -3.19 to -1.01) for RDQ (2 RCTs) Insufficient evidence to assess efficacy of superficial heat versus superficial cold	7

Table 58. Systematic reviews on efficacy of non-pharmacologic therapies for low back pain

Author, year	Type of systematic review	Number of included trials (number rated higher-quality)*	Number of trials not included in any other relevant systematic review	Duration of treatment in included trials	Sample sizes in included trials	Interventions evaluated (number of trials)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Traction (24 unique trials in three systematic reviews)								
Clarke, 2005[676, 677]	Qualitative	23 (5)	11	1 week to 8 weeks	25 to 400 (median=52)	Mechanical or manual traction (13), autotraction (6), Tru-Trac (3), underwater (1), other (3)	Strong evidence that continuous traction is not superior to placebo, sham, or no treatment for any outcome at 3 months or 6 weeks in patients with or without sciatica (2 RCTs) Moderate evidence that autotraction is more effective than placebo, sham, or no treatment for pain, global improvement, or work absenteeism in patients with sciatica (2 RCTs); moderate evidence that other forms of traction not more effective than control (8 RCTs)	6
Harte, 2003[678]	Qualitative	13 (1)	1	1 week to 8 weeks	16 to 334 (median=62)	Mechanical or manual traction (7), autotraction (2), Tru-Trac (2), other (3)	Traction vs. sham traction: 6 RCTs (1 higher-quality) reported negative results (1 RCT inconclusive)	7
Transcutaneous electrical nerve stimulation (11 trials in six systematic reviews)**								
Khadilkar, 2005[698, 699]	Qualitative	2 (1)	2	Single session and 4 weeks	30 and 145	TENS given at clinic (1), TENS self-administered at home (1)	TENS vs. placebo (2 RCTs, 1 good-quality): TENS not superior to placebo for any outcomes measured (pain, functional status, range of motion, use of medical services) in 1 good-quality RCT In the other RCT, TENS superior for subjective pain intensity for 60 minutes post treatment; no longer-term follow-up	7

Table 58. Systematic reviews on efficacy of non-pharmacologic therapies for low back pain

Author, year	Type of systematic review	Number of included trials (number rated higher-quality)*	Number of trials not included in any other relevant systematic review	Duration of treatment in included trials	Sample sizes in included trials	Interventions evaluated (number of trials)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Multiple interventions								
Cherkin, 2003[555]	Qualitative	8 systematic reviews, 9 RCTs (quality not assessed)	0	2 to 12 weeks (RCTs)	24 to 262 (RCTs)	Acupuncture (20), massage (3), spinal manipulation (26)	Effectiveness of acupuncture unclear. Massage effective for subacute and chronic LBP in 3 RCTs Spinal manipulation equivalent to other commonly used therapies	4
Philadelphia Panel, 2001[399]	Qualitative	12 (4) trials of traction or ultrasound	2 (RCTs of ultrasound)	1 to 5 weeks	16 to 322 (median=60)	Traction (10), ultrasound (2)	No benefit demonstrated for traction or ultrasound for acute, subacute, or chronic LBP	5
Vroomen, 2000[100]	Quantitative	8 (3) trials of traction, exercise, or spinal manipulation	0	Not reported	44 to 322 (median=77)	Traction (7), exercise (2), spinal manipulation (2)	Traction vs. sham, infrared heat, or corset for sciatica: OR=1.2 (95% CI 0.7 to 2.0) for 'treatment success' (4 RCTs) Insufficient evidence to evaluate efficacy of exercise or spinal manipulation for sciatica	5

*Trials adequately meeting at least half of the quality rating criteria or rated as good or higher-quality if the number of criteria met was not reported
**Including trials of TENS included in systematic reviews of acupuncture[68], massage[701], superficial heat[398], and traction[676]
† 22 trials of behavioral therapy alone or as part of interdisciplinary rehabilitation
CI=confidence interval, ODI=Oswestry Disability Index, LBP=low back pain, OR=odds ratio, RCT=randomized controlled trial, RDQ=Roland-Morris Disability Questionnaire, RR=relative risk, TENS=transcutaneous electrical nerve stimulation, WMD=weighted mean difference

Table 59. Summary of evidence on non-pharmacologic therapies for acute low back pain

Intervention	Number of trials (number rated higher-quality by at least one systematic review)	Net benefit*	Effective vs. placebo, sham, wait list, or no treatment?	Inconsistency?†	Directness of evidence?	Overall quality of evidence	Comments
Acupressure	0	No evidence	No evidence	No evidence	No evidence	No evidence	
Acupuncture	4 (3)	Unable to estimate	Unclear (2 trials)	Some inconsistency	Direct	Poor	
Back schools	1 (0)	Unable to estimate	Unclear (1 trial)	Not applicable	Direct	Poor	
Brief educational interventions	0	No evidence	No evidence	No evidence	No evidence	No evidence	
Dry needling	1 (0)	Unable to estimate	No evidence	Not applicable	Not applicable	Poor	
Exercise	13 (7)	Not effective	No (9 trials)	Some inconsistency	Direct	Good	Most trials found no effect
Functional restoration	4 (3)	Not effective	Yes (3 trials)	Some inconsistency	Direct	Fair	Most trials found no effect, but studies were heterogeneous
Hydrotherapy	0	No evidence	No evidence	No evidence	No evidence	No evidence	
Interdisciplinary rehabilitation	0	No evidence	No evidence	No evidence	No evidence	No evidence	
Interferential therapy	0	No evidence	No evidence	No evidence	No evidence	No evidence	
Low-level laser therapy	0	No evidence	No evidence	No evidence	No evidence	No evidence	
Lumbar supports	1 (0)	Unable to estimate	No evidence	Not applicable	Direct	Poor	
Massage therapy	1 (0)	Unable to estimate	No evidence	Not applicable	Direct	Poor	
Neuroreflexotherapy	0	No evidence	No evidence	No evidence	No evidence	No evidence	
Percutaneous electrical nerve stimulation	0	No evidence	No evidence	No evidence	No evidence	No evidence	
Psychological therapies	0	No evidence	No evidence	No evidence	No evidence	No evidence	

Table 59. Summary of evidence on non-pharmacologic therapies for acute low back pain

Intervention	Number of trials (number rated higher-quality by at least one systematic review)	Net benefit*	Effective vs. placebo, sham, wait list, or no treatment?	Inconsistency?†	Directness of evidence?	Overall quality of evidence	Comments
Shortwave diathermy	1 (0)	Unable to estimate	No evidence	Not applicable	Direct	Poor	
Spa therapy and balneotherapy	0	No evidence	No evidence	No evidence	No evidence	No evidence	
Spinal manipulation	11 (2)	Small to moderate	Yes (2 trials)	No	Direct	Fair	
Superficial heat	5 (5)	Moderate	Yes (2 trials)	No	Direct	Good	
Traction	0	No evidence	No evidence	No evidence	No evidence	No evidence	Most trials included patients with back pain of varying duration, with or without sciatica
Transcutaneous electrical nerve stimulation (TENS)	1 (0)	Unable to estimate	No evidence	Not applicable	Direct	Poor	
Ultrasound	0	No evidence	No evidence	No evidence	No evidence	No evidence	
Yoga	0	No evidence	No evidence	No evidence	No evidence	No evidence	

* Based on evidence showing medication is more effective than placebo, and/or evidence showing medication is at least as effective as other medications or interventions thought to be effective, for one or more of the following outcomes: pain, functional status, or work status. Versus placebo, small benefit defined as 5-10 points on a 100-point Visual Analogue Scale (VAS) for pain (or equivalent), 1-2 points on the Roland Morris Disability Questionnaire (RDQ), 10-20 points on the Oswestry Disability Index (ODI), or a standardized mean difference (SMD) of 0.2-0.5. Moderate benefit defined as10-20 points on a VAS for pain, 2-5 points on the RDQ, 10-20 points on the ODI, or a SMD of 0.5-0.8. Large benefit defined as >20 points on a 100 point VAS for pain; >5 points on the RDQ, >20 points on the ODI, or a SMD of >0.8.
† Inconsistency defined as <75% of trials reaching consistent conclusions on efficacy (no effect vs. positive effect considered inconsistent)

Table 60. Summary of evidence on non-pharmacologic therapies for chronic or subacute low back pain

Intervention	Number of trials (number rated higher-quality by at least one systematic review)	Net benefit*	Effective vs. placebo, sham, usual care, or no treatment?	Important inconsistency?†	Directness of evidence?	Overall quality of evidence	Comments
Acupressure	2 (2)	Moderate to substantial	No evidence	No	Direct	Fair	Both trials conducted in Taiwan by same set of investigators; physical therapy comparison treatments not standardized
Acupuncture	24 (8)	Moderate	Yes (12 trials)	Some inconsistency (versus sham acupuncture)	Direct	Fair	Efficacy of acupuncture versus sham acupuncture inconsistent
Back schools	26 (3)	Small	Yes (13 trials)	Some inconsistency	Direct	Fair	Back schools based on Swedish model appeared most effective
Brief educational interventions	4 (3)	Moderate (for return to work)	Yes (3 trials versus usual care)	No	Direct	Good	Three of four trials were in workers with subacute low back pain
Dry needling	2 (2)	Moderate	Yes (1 trial)	No	Direct	Fair	
Exercise	62 (29)	Moderate	Yes (24 trials)	No	Direct	Good	
Functional restoration	12 (9)	Moderate	Yes (7 trials)	No	Direct	Fair	
Hydrotherapy	3 (0)	Moderate	Unclear (1 trial)	No	Direct	Fair	Hydrotherapy similar to land-based exercise therapy in two trials
Interdisciplinary rehabilitation	11 (2)	Moderate	Yes (4 trials)	No	Direct	Good	More intense interdisciplinary rehabilitation more effective than less intense interdisciplinary rehabilitation
Interferential therapy	3 (1)	Unable to estimate	No evidence	No	Direct	Poor	

Table 60. Summary of evidence on non-pharmacologic therapies for chronic or subacute low back pain

Intervention	Number of trials (number rated higher-quality by at least one systematic review)	Net benefit*	Effective vs. placebo, sham, usual care, or no treatment?	Important inconsistency?†	Directness of evidence?	Overall quality of evidence	Comments
Low-level laser therapy	6 (4)	Unable to estimate	Unclear (5 trials)	Some inconsistency	Direct	Poor	Trials evaluated different types and intensity of laser, with inconsistent findings
Lumbar supports	2 (1)	Unable to estimate	Unclear (1 trial)	Some inconsistency	Direct	Poor	
Massage therapy	4 (3)	Moderate	No evidence	Some inconsistency (versus spinal manipulation)	Direct	Fair	Some trials evaluated minimal or light massage techniques
Neuroreflexotherapy	3 (2)	Substantial	Yes (2 trials)	No	Direct	Fair	All trials conducted in Spain by same investigator
Percutaneous electrical nerve stimulation	3 (0)	Unable to estimate	Unclear (2 trials)	No	Direct	Poor	
Psychological therapies	35 (11)	Moderate (cognitive-behavioral treatment), substantial (progressive relaxation), unable to estimate (biofeedback), no effect (operant therapy)	Yes (11 trials)	Some inconsistency (for EMG biofeedback)	Direct	Good (cognitive-behavioral and operant therapy)) fair (progressive relaxation), poor (biofeedback)	
Shortwave diathermy	1 (0)	Not effective	No evidence	Not applicable	Direct	Poor	
Spa therapy and balneotherapy	5 (3)	Moderate to substantial (for spa therapy), unable to estimate (for balneotherapy)	Yes (3 trials of spa therapy)	No	Direct	Fair (for spa therapy), poor (for balneotherapy)	All trials conducted in Europe at spa resorts
Spinal manipulation	29 (15)	Moderate	Yes (13 trials)	No	Direct	Good	

Table 60. Summary of evidence on non-pharmacologic therapies for chronic or subacute low back pain

Intervention	Number of trials (number rated higher-quality by at least one systematic review)	Net benefit*	Effective vs. placebo, sham, usual care, or no treatment?	Important inconsistency?†	Directness of evidence?	Overall quality of evidence	Comments
Superficial heat	3 (0)	Unable to estimate	Unclear (3 trials)	No	Direct	Poor	Three lower-quality trials
Traction	6 (3)	Not effective (for continuous traction)	No (2 trials)	No	Direct	Fair	
Transcutaneous electrical nerve stimulation (TENS)	9 (2)	Unable to estimate	Yes (2 trials)	Yes (for TENS vs. sham or no treatment)	Direct	Poor	
Ultrasound	1 (0)	Unable to estimate	Unclear (1 trial)	Not applicable	Direct	Poor	
Yoga	3 (1)	Moderate (for Viniyoga)	No evidence	No	Direct	Fair (for Viniyoga)	Insufficient evidence to judge non-Viniyoga techniques

* Based on evidence showing medication is more effective than placebo, and/or evidence showing medication is at least as effective as other medications or interventions thought to be effective, for one or more of the following outcomes: pain, functional status, or work status. Versus placebo, small benefit defined as 5-10 points on a 100-point Visual Analogue Scale (VAS) for pain (or equivalent), 1-2 points on the Roland Morris Disability Questionnaire (RDQ), 10-20 points on the Oswestry Disability Index (ODI), or a standardized mean difference (SMD) of 0.2-0.5. Moderate benefit defined as10-20 points on a VAS for pain, 2-5 points on the RDQ, 10-20 points on the ODI, or a SMD of 0.5-0.8. Large benefit defined as >20 points on a 100 point VAS for pain; >5 points on the RDQ, >20 points on the ODI, or a SMD of >0.8.
† Inconsistency defined as <75% of trials reaching consistent conclusions on efficacy (no effect vs. positive effect considered inconsistent)

Table 61. Summary of evidence on non-pharmacologic therapies for radiculopathy or sciatica

Intervention	Number of trials (number rated higher-quality by at least one systematic review)	Net benefit*	Effective vs. placebo, sham, or no treatment?	Important Inconsistency?†	Directness of evidence?	Overall quality of evidence	Comments
Percutaneous electrical nerve stimulation	1 (0)	Unable to estimate	Unclear (1 trial)	Not applicable	Direct	Poor	
Spinal manipulation	3 (0)	Moderate	No evidence	No	Direct	Fair	No clear differences compared to other interventions
Traction	16 (4)	Not effective (continuous or intermittent traction); small to moderate (autotraction)	No for continuous or intermittent traction (8 trials), yes for autotraction (2 trials)	Some inconsistency (for autotraction versus continuous or intermittent traction)	Direct	Fair	Other trials of traction included patients with back pain of varying duration
Ultrasound	1 (0)	Unclear	Unclear (1 trial)	Not applicable	Direct	Poor	

* Based on evidence showing medication is more effective than placebo, and/or evidence showing medication is at least as effective as other medications or interventions thought to be effective, for one or more of the following outcomes: pain, functional status, or work status. Versus placebo, small benefit defined as 5-10 points on a 100-point Visual Analogue Scale (VAS) for pain (or equivalent), 1-2 points on the Roland Morris Disability Questionnaire (RDQ), 10-20 points on the Oswestry Disability Index (ODI), or a standardized mean difference (SMD) of 0.2-0.5. Moderate benefit defined as10-20 points on a VAS for pain, 2-5 points on the RDQ, 10-20 points on the ODI, or a SMD of 0.5-0.8. Large benefit defined as >20 points on a 100 point VAS for pain; >5 points on the RDQ, >20 points on the ODI, or a SMD of >0.8.
† Inconsistency defined as <75% of trials reaching consistent conclusions on efficacy (no effect vs. positive effect considered inconsistent)

Key Question 5

How effective are decision tools or other methods for predicting which patients are more likely to respond to specific therapies like spinal manipulation or different types of exercise therapy?

Results of search:
We identified four systematic reviews (three rated higher-quality[791-794]) on the reliability and validity of physical exam maneuvers for determining whether manipulative treatments[791, 792, 795] or treatments that target the sacroiliac joint[794] are indicated. We identified no systematic reviews on effectiveness of decision tools, clinical prediction rules, or other methods for identifying patients more likely to respond to specific therapies.

Results of search: trials
The systematic reviews included no randomized trials of physical exam maneuvers for identifying manipulable low back pain or sacroiliac joint pain. From 327 potentially relevant citations, we identified one higher-quality randomized trial that prospectively evaluated how well a clinical prediction rule identified patients with back pain (any duration) more likely to respond to spinal manipulation (Table 62)[796]. The prediction rule was based on a previous study that identified five factors (symptom duration <15 days, Fear Avoidance Beliefs Questionnaire work subscale score <19, lumbar hypomobility, hip internal rotation range of motion >35 degrees, and no symptoms distal to the knee) associated with greater likelihood of success with spinal manipulation[797]. We also identified one recent, small (n=54) observational study that derived a clinical prediction rule for identifying patients likely to benefit from a stabilization exercise program[798] and two recent, higher-quality trials on the effectiveness of using a patient classification system to individualize physical therapy interventions for acute or subacute low back pain[799, 800].

Reliability and validity of manual spinal palpatory exam or clinical tests of the sacroiliac joint

Three systematic reviews on the reliability and validity of manual spinal palpatory maneuvers each found suboptimal evidence, poor reproducibility of examination findings, and uncertain validity for identifying 'manipulable' conditions[791, 792, 795]. One systematic review found poor or inconsistent reliability for most pain provocation and mobility tests for the sacroiliac joint, though two higher-quality studies included in the review found good reliability (kappa=0.61 to 0.80) for the Gaenslen test and thigh thrust[793]. The same authors found estimates of diagnostic accuracy for pain provocation and mobility tests of the sacroiliac joint inconsistent and difficult to interpret due to poor methodologic quality of the studies, lack of a valid reference standard, and poor test reliability[794].

Utility of clinical prediction rules for spinal manipulation

The randomized trial by Childs et al allocated patients (n=131) with a median duration of 27 days of low back pain to spinal manipulation or exercise therapy[796]. It applied a previously derived clinical prediction rule to all patients and prospectively evaluated whether outcomes from spinal manipulation correlated with classification of patients using the prediction rule. It

found treatment effects greatest in the subgroup of patients positive on the rule (met at least 4 of 5 criteria) who received manipulation. Relative to patients who were negative on the rule and received exercise, the odds ratio for a successful outcome (improvement in ODI at least 50%) in this subgroup was 60.8 (95% CI 5.2 to 704.7), compared to 2.4 (95% CI 0.83 to 6.9) for those negative on the rule who received manipulation and 1.0 (CI 0.28 to 3.6) for those positive on the rule who received exercise. Patients positive on the rule who received manipulation had a 92% chance of a successful outcome, with an associated number needed to treat for one successful outcome (relative to treatment with exercise) of 1.9 (95 % CI 1.4 to 3.5).

One potential shortcoming of the prediction rule evaluated in this trial is that it may not be readily applied in everyday practice because it requires the clinician to perform and interpret potentially unfamiliar physical exam maneuvers (spinal mobility and hip range of motion tests) and administer a specific, potentially unfamiliar questionnaire (Fear-Avoidance Beliefs Questionnaire). The authors of the trial have developed a 'pragmatic' version of the prediction rule with two factors (duration <16 days and no symptoms extending distal to the knee) that also predicted outcomes with manipulation (positive likelihood ratio=7.2, 95% CI 3.2 to 16.1 in patients meeting both criteria)[801]. However, this variation of the prediction rule was developed retrospectively and has not yet been prospectively validated.

Table 62. Randomized trial evaluating decision tool for predicting success from spinal manipulation

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Childs, 2004[796]	n=131 6 months	**Manipulation + exercise vs. exercise alone** "Success" at 4 weeks: 44/70 (63%) vs. 22/61 (36%) Likelihood of success at 4 weeks, relative to patients negative on rule who received exercise: Positive on rule and received manipulation OR 60.8 (5.2 to 704.7, p=0.002), negative on rule and received manipulation OR 2.4 (0.83 to 6.91), positive on rule and received exercise OR 1.0, 95% CI (0.28 to 3.6) Positive likelihood ratio for positive rule in manipulation group at predicting success at 1 week: 13.2 (3.4 to 52.1)	7/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

This trial was designed to confirm the predictive ability of a clinical prediction rule in a setting other than the one from which it was originally derived[796]. One classification scheme categorizes clinical prediction rules validated in this manner as level 2[802]. This trial does not meet criteria for a level 1 (highest classification) clinical prediction rule, which is defined as one that has been shown to affect clinician behavior and improve outcomes. One method for demonstrating effects of this clinical prediction would be to compare clinical outcomes in patients randomized to receive the prediction rule and spinal manipulation if they met criteria for it, compared to patients who had therapy selected without the aid of the prediction rule.

Clinical prediction rules for exercise

One study (n=54) prospectively derived a clinical prediction rule for determining which patients with low back pain are more likely to respond to a stabilization exercise program[803]. It found that presence of three or more of the following factors was associated with a greater likelihood of treatment success (positive likelihood ratio=4.0, 95% CI 1.6 to 10.0, negative likelihood radio=0.52, 95% CI 0.30 to 0.88): positive prone instability test, presence of aberrant movement, average straight leg raise test >91 degrees, or age <40 years. This prediction rule would be classified as level 4 (derived but not validated)[802].

Patient classification systems for individualizing physical therapy interventions

One higher-quality trial compared a standardized exercise regimen (low-stress aerobic exercise, general muscle reconditioning, and advice to stay active) with an approach using a classification scheme to match patient signs and symptoms to specific exercises or other treatments (such as manipulation, mobilization, or traction) in workers with back pain for less than three weeks (Table 63)[799]. It found patients receiving physical therapy according to the classification scheme had greater improvements in ODI scores at 4 weeks (between-group mean difference=10.9, 95% CI 1.9 to 19.9) and at one year (mean difference=9.0, 95% CI 0.30 to 17.7), and were less likely to have continued work restrictions (42% vs. 17%, p=0.017). One difficulty in interpreting results, however, is that the intensity of the standardized exercise regimen was unclear.

A second higher-quality trial also used a system to classify patients with acute or subacute low back pain into manipulation, specific exercise, and stabilization exercise subgroups[800]. Patients randomized to ‘matched’ treatment (i.e. the treatment matched their classification) experienced slightly greater improvements in ODI scores after 4 weeks and 1 year (6-8 points) than those who received ‘unmatched’ treatment, and a greater proportion had an improvement in ODI scores at least 20 points or 33% from baseline. The classification system used in this trial has not yet been validated in other settings.

Table 63. Trial comparing standardized exercise therapy to individualized treatment based on a classification scheme

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Fritz, 2003[799]	n=78 1 year	**Standard exercise vs. classification-based therapy (mean differences between groups relative to baseline)** ODI: 10.9 (95% CI 1.9 to 19.9) at 4 weeks, 9.0 (0.30 to 17.7) at 1 year SF-36 physical component summary: 5.6 (0.6 to 10.7) at 4 weeks, 3.6 (-2.1 to 9.3) at 1 year SF-36 mental component summary: 5.7 (1.8 to 9.5) at 4 weeks, 3.6 (-1.4 to 8.7) at 1 year Continued work restrictions after four weeks: 42% (15/36) vs. 17% (7/41)	7/9
Brennan, 2006[800]	n=123 1 year	**"Matched" vs. "unmatched" therapy** ODI, change from baseline: 29.9 vs. 23.3 at 4 weeks (p=0.03), 27.9 vs. 19.6 at 1 year (p=0.006) Proportion with improvement in ODI >20 points or at least 33%: 78% vs. 60% at 4 weeks (p=0.039)	5/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Harms
No trial reported adverse events.

Costs
The trial that compared standardized exercise therapy to classification-based treatment found higher total median costs with the former ($1,004 versus $774), though the difference was not significant (p=0.13)[799].

Summary of evidence

- Five systematic reviews found spinal palpatory tests for manipulable low back pain and clinical tests of the sacroiliac joint have poor or inconsistent reproducibility and uncertain validity (level of evidence: fair).
- For back pain of any duration, a decision tool accurately identified patients who experienced benefit from spinal manipulation. However, the tool has only been validated in one study, evidence of beneficial effects on clinical outcomes from applying the decision tool is not yet available, and the tool may not be practical for use in many primary care setting. A more pragmatic version has not yet been prospectively validated (level of evidence: fair).
- A decision tool for identifying patients likely to benefit from stabilization exercise has not yet been validated (level of evidence: poor).
- For acute low back pain, one recent, higher-quality trial found a standardized exercise regimen inferior to physical therapy tailored according to patient symptoms and physical exam findings. However, the intensity of the standardized exercise regimen in this trial was unclear (level of evidence: fair).

- For acute or subacute low back pain, one recent, higher-quality trial found patients randomized to a physical therapy intervention that matched their symptoms and physical exam findings had slightly superior outcomes compared to those who received an unmatched physical therapy intervention. The classification system has not yet been validated in other populations and settings (level of evidence: fair).

Recommendations and findings from other guidelines

- The UK RCGP guidelines found no firm evidence that it is possible to select which patients will respond to manipulation (strength of evidence: **).
- The European COST guidelines found insufficient evidence to recommend the use of spinal palpatory and range of motion tests to identify patients with manipulable lesions.

Key Question 6

How effective is referral from primary care providers to back specialty providers for improving patient outcomes? What are the outcomes for patients who are managed by different types of care providers or by multidisciplinary or interdisciplinary clinics?

Results of search: systematic reviews
We found no systematic review on effects of referral by a primary care provider (defined here as a family practitioner, general internist, or general practitioner) to a non-surgical back specialist (defined here as a neurologist, rheumatologist, physiatrist, occupational medicine physician, neurologist, or pain physician) on patient outcomes. The efficacy of interdisciplinary rehabilitation, behavioral therapies, acupuncture, and spinal manipulation is reviewed in Key Question 4, and the efficacy of surgical and non-surgical invasive interventions in Key Questions 8 and 9. In general, trials focused on the intervention rather than the provider managing care, and did not specify whether patients were referred by a primary care provider, managed without a referral, or co-managed by multiple providers.

Results of search: trials
From 525 potentially relevant citations, we found no trial on effects of referral from primary care providers to back specialty providers on patient outcomes. One recent large, higher-quality trial (the UCLA Low Back Pain Study) evaluated chiropractic versus medical care for patients with low back pain of unspecified duration (Table 64)[780, 781]. We also identified one well-designed, prospective cohort study on outcomes of acute low back pain episodes in patients managed by different provider types[19].not in the qual table

Efficacy of referral to back specialty providers on patient outcomes from low back pain

The UCLA Low Back Pain Study found no significant differences in pain or disability through 18 months in patients (n=339) randomized to chiropractic care versus medical care without physical therapy, with specific chiropractic interventions chosen at the discretion of the assigned providers[780, 781]. Adding physical therapist care (including of one or more of the following: heat or cold, ultrasound, electrical muscle stimulation, soft tissue and joint mobilization, traction,

and/or supervised exercises) to medical care was associated with statistically significant but small benefits in pain scores (<1 point on a 10 point scale) and the RDQ (1.7 to 2.1 points) through 18 months. However, the addition of physical therapy care was associated with substantially increased costs (average $760 vs. $369 per patient)[787].

Table 64. Results of UCLA Low Back Pain Study

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Hurwitz, 2002[780, 781]	n=681 for all four arms 6 months	**Chiropractic care vs. medical care** (adjusted between group difference in improvement from baseline) Most severe pain (0 to 10 scale): -0.25 (95% CI -0.96 to 0.45) at 6 months, -0.64 (95% CI -1.38 to -0.21) at 18 months Average pain (0 to 10 scale): -0.26 (95% CI -0.81 to 0.29) at 6 months, -0.50 (-1.09 to 0.08) at 18 months RDQ score (0 to 24 scale): -0.37 (95% CI -1.63 to 0.90) at 6 months, -0.69 (-2.02 to 0.65) at 18 months **Medical care + physical therapist care vs. medical care alone** Most severe pain: -0.61 (95% CI -1.31 to 0.10) at 6 months, -0.95 (95% CI -1.69 to -0.21) at 18 months Average pain: -0.63 (95% CI -1.19 to -0.08) at 6 months -0.76 (-1.35 to -0.17) at 18 months RDQ score: -1.78 (95% CI -3.05 to -0.51) at 6 months, -2.11 (95% CI -3.46 to -0.77) at 18 months **Chiropractic care + physical modalities vs. chiropractic care** Most severe pain: -0.15 (95% CI -0.85 to 0.55) at 6 months, +0.25 (-0.49 to 0.98) at 18 months Average pain: -0.26 (95% CI -0.81 to 0.29) at 6 months, +0.12 (-0.46 to 0.71) at 18 months RDQ score: +0.12 (95% CI -1.15 to +1.38) at 6 months, -0.01 (95% CI -1.35 to +1.32) at 18 months	7/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

A well-designed prospective observational study from North Carolina found little difference in time to functional recovery, return to work, and complete recovery in patients with acute back pain managed by primary care providers, chiropractors, or orthopedic surgeons[19]. Despite similar baseline pain and back-related disability, orthopedists were more likely to order CT or MRI of the spine compared to primary care providers (17% vs. 6-11%). Chiropractors saw patients an average of 9 to 13 visits for the acute back episode, compared to around 2 visits for primary care providers and orthopedists. Satisfaction with care was greater with chiropractors than with the other providers. The mean cost per episode was higher for orthopedic or chiropractic care ($611 to $783: 1993 dollars) than with primary care providers ($435 to $508). A survey of physicians from the early 1990's found that given the same clinical situations, use of diagnostic tests varied considerably among eight medical specialties (family practice, internal medicine, osteopathic general practice, physical medicine, rheumatology, neurology, orthopedic surgery, neurosurgery)[15]. Neurosurgeons and neurologists were more likely to order imaging studies, physiatrists and neurologists more likely to order electromyograms, and rheumatologists more likely to order laboratory tests.

Summary of evidence

- There is no direct evidence on effects of referral from primary care to back specialty providers on patient outcomes, though evidence on effects of interventions offered by specialty providers is reviewed elsewhere.
- For low back pain of unspecified duration, one recent large, higher-quality trial found medical care and chiropractic care associated with similar patient outcomes. Observational data also suggests no significant differences for back pain episodes managed by different provider types, though patterns of care varied (level of evidence: fair).

Recommendations and findings from other guidelines

- All guidelines recommend consideration of referral to a back specialist if low back pain is not improving despite non-invasive, usual interventions (strength of evidence: not assessed).
- For active duty personnel who have not improved after 4 to 6 months, the VA/DoD guidelines specifically recommend consideration of referral to the Medical Evaluation Board for possible reclassification or discharge from service (strength of evidence: not assessed).

Key Question 7

What is the diagnostic accuracy and what are the potential harms associated with invasive tests for identifying patients who may benefit from invasive procedures? How effective is prior use of these tests for selecting patients for invasive procedures in improving outcomes?

Provocative discography

Provocative discography involves the injection of radiographic contrast material into the nucleus of an intervertebral disc, which may elicit pain. It is most commonly performed in patients with persistent, chronic low back pain in order to help identify those who may benefit from invasive procedures intended to treat "discogenic" back pain. The usefulness of provocative discography in patients with low back pain remains controversial[804]. Much of the debate centers on whether provocative discography is accurate for identifying painful lumbar discs, the uncertain natural history of discogram-positive low back pain (in one retrospective study, 68% of un-operated patients improved[805]), and whether use of provocative discography improves patient outcomes or leads to unnecessary and potentially harmful interventions. Many studies show good correlation between results of provocative discography and abnormalities on CT or MRI imaging[806, 807]. However, because the presence of radiographic degeneration or other abnormalities is not necessarily associated with patient symptoms, imaging is considered an inadequate reference standard for assessing diagnostic accuracy. Nonetheless, no other reliable reference standard for discogenic low back pain is available.

We focused our review on several specific types of studies of provocative discography. First, we identified studies on rates of positive discography responses in populations of persons without serious back pain. Studies that addressed this type of question—"Do test results in patients with the target disorder differ from those in normal people?"—have been categorized as the lowest level (Phase I) on a hierarchy of diagnostic research[808]. Because Phase II ("Are

patients with certain test results more likely to have the target disorder than patients with other test results?") and Phase III ("Does the test result distinguish patients with and without the target disorder among patients in whom it is clinically reasonable to suspect that the disease is present?") studies cannot be reliably interpreted in the absence of an appropriate reference standard, we did not review the literature comparing provocative discography to CT or MRI imaging results. However, we searched for studies that evaluated accuracy of provocative discography based on alternative reference standards. We also included studies that evaluated whether use of provocative discography to select patients for procedures intended to treat presumed discogenic back pain improves clinical outcomes compared to not using provocative discography. Such evidence addresses the highest level (Phase IV) question in the hierarchy of diagnostic research[808]—"Do patients who undergo this diagnostic test fare better in their ultimate health outcomes than similar patients who are not tested?"

Results of search: systematic reviews
We identified two lower-quality systematic reviews on lumbar discography for low back pain[806, 809]. We also included a lower-quality systematic review on risk of discitis following discography[810]. We excluded an earlier version[807] of one of the reviews[809]

Results of search: primary studies
The systematic reviews included a total of six higher-quality studies published since 1990 (when the Walsh criteria[811] were first introduced) on rates of positive pain responses to provocative discography in patients without significant chronic back pain[811-817]. Four other studies included in the systematic reviews evaluated factors associated with a higher likelihood for positive pain responses in patients with chronic low back pain[818-821] and one study included in the systematic reviews compared surgical outcomes in patients selected for fusion by results of discography versus those in whom fusion was performed without prior discography[822].

From 323 potentially relevant citations, we identified one additional study not included in the systematic reviews that evaluated positive responses to provocative discography after incorporation of low-pressure criteria in patients without significant chronic back pain[816], one study that used a novel reference standard to estimate diagnostic accuracy of discography[823], and one study that evaluated outcomes of surgery in patients selected for fusion based on response to temporary external transpedicular fixation with or without positive responses to provocative discography in adjacent discs[824]. We excluded two studies from the 1960's that reported high rates of positive provocative discography because they used outdated techniques[825, 826]. Quality ratings of provocative discography studies are shown in Appendix 8.

Rates of positive pain responses to provocative discography in patients without significant back pain

We included 7 studies that evaluated positive pain responses to provocative discography in patients without significant low back pain (Table 65). A study published by Walsh and colleagues in 1990 found that in ten asymptomatic, healthy young men undergoing provocative discography, none met criteria for a positive test[811]. By contrast, 6 of 7 (86%) of patients with low back pain for more than 6 months had a positive test. A positive test by the "Walsh criteria"

was defined as an abnormal disc in conjunction with pain rated as more severe than moderate plus pain-related behavior (at least two of the following: guarding/bracing/withdrawal, rubbing, grimacing, sighing, or verbalizing).

Carragee and colleagues subsequently conducted a series of studies that evaluated the rate of positive pain responses to provocative discography (as defined using the Walsh criteria) in patients without serious back pain, including asymptomatic persons (Table 65). They found that patients with somatization or abnormal psychometric testing had high rates of positive responses (70% to 83%), as did those who were disabled (86% or 5/6) or had an active worker's compensation or personal injury claim (89% or 8/9)[813, 814]. Patients with pain outside the back also frequently had positive results (50% or 4/8 following iliac crest harvest and 40% or 4/10 in those with neck pain following cervical surgery)[814, 815]. In patients with previous discectomy, positive pain responses were seen in 40% (8/20) of those with good surgical results[813].

More recently, investigators proposed adding pressure threshold criteria to the requirements for a positive response, to reduce potential false-positive findings[827]. With this adaptation, pain that is only provoked with high injection pressures (which can occur in normal discs) is not considered a positive response. In one study, 0% (0/16) of asymptomatic volunteers had a positive response when incorporating pressure criteria, compared to a 35% (100/282) rate of positive discograms in patients with chronic low back pain[817]. However, asymptomatic subjects in this study mainly consisted of physicians, which could limit generalizability of results[828]. In a re-analysis of data reported in earlier studies, Carragee and colleagues also reported no positive pain responses (0/10) in asymptomatic, low-risk patients without low back pain after incorporating pressure threshold criteria[816]. However, 36% (5/14) of patients without back pain but with either chronic pain or somatization, 25% (5/20) of pain-free patients following disc surgery, and 28% (7/25) of patients with mild low back pain would still be classified as having positive tests after incorporation of pressure threshold criteria.

Table 65. Rates of positive pain responses to provocative discography in persons without serious back pain

Author, year	Definition of positive pain response	Rates of positive pain responses	Quality score*
Carragee, 2006[816]	Walsh criteria, with added criteria of 'low pressure' response defined as pain provoked with static pressure of less than 22 psi	**A:** No LBP, but with chronic pain or somatization: 36% (5/14); 30% (3/10) in patients with chronic pain and 50% (2/4) in patients with somatization **B:** No LBP, history of prior successful lumbar discectomy (n=20): 25% (5/20) **C:** Mild persistent low back pain but not seeking or receiving treatment for it (also s/p cervical surgery): 28% (7/25); 23% (3/13) in patients with no chronic pain and 33% (4/12) in patients with chronic pain **D:** No LBP, no chronic pain: 0% (0/10)	8/9
Derby, 2005[817]	Negative discogram=no pain described as 'familiar', no pain ≥6/10 at pressures ≤50 psi above opening pressure and ≤3.5 ml total injected volume	**A:** Asymptomatic volunteers: 0% (0/16) **B:** Chronic low back pain with unremitting pain despite conservative treatment: 35% (100/282) of discs positive	7/9
Carragee, 2002[812]	Walsh criteria	**A:** Patients with mild persistent low back pain but not seeking or receiving treatment for it and s/p cervical spine surgery: 36% (9/25); 23% (3/13) in patients with good cervical surgery outcomes and 50% (6/12) in patients with worst cervical surgery outcomes **B:** Patients undergoing discography for consideration of surgery: 73% (38/52) In group A, 5/5 (100%) of patients with daily opioid had positive discogram vs. 3/17 (18%) without opioids	9/9
Carragee, 2000[813]	Walsh criteria	**A:** No low back pain 2 to 10 years following successful lumbar disc surgery, no depression: 40% (8/20) **B:** Chronic persistent or recurrent low back and leg problems 14 months to 6 years following posterior discectomy: 63% (17/27); 43% (3/7) in patients with normal psychometric scores and 70% (14/20) in those with abnormal scores	9/9
Carragee, 2000[814]	Walsh criteria	**A:** No low back pain, status post cervical discectomy and/or fusion 2 to 4 years previously with good surgical outcomes: 10% (1/10) **B:** No low back pain, status post cervical discectomy and/or fusion 2 to 4 years previously with poor surgical outcomes: 40% (4/10) **C:** No low back pain, somatization disorder and chronic pain present: 83% (5/6) Disabled: 86% (5/6) Active worker's compensation or personal injury claim: 89% (8/9)	9/9
Carragee, 1999[815]	Walsh criteria	**A:** No low back pain, status post iliac bone graft harvesting for reasons unrelated to lumbar spine: 50% (4/8)	8/9
Walsh, 1990[811]	Walsh criteria	**A:** Low back pain >6 months: 86% (6/7) **B:** No low back pain: 0% (0/10)	8/9

*See Methods for quality criteria used to evaluate studies assessing positive rates from provocative discography

Factors associated with higher rates of positive discography in patients with chronic low back pain

Two higher-quality studies of patients with chronic low back pain reported higher rates of positive pain responses to provocative discography in patients with abnormal psychometric testing[818] or abnormal pain drawings (Table 66)[821]. One other study found no clear association between presence or absence of somatization disorder and positive pain responses to provocative discography, but subjects appeared more highly selected, as they had already undergone negative testing for facet joint mediated pain as well as an epidural steroid injection[820]. A lower-quality study reported positive pain responses in 38% (51/136) of un-operated discs in patients with chronic low back pain following lumbar surgery, though the rate was higher in previously operated discs (72% or 73/102)[819].

Table 66. Trials evaluating predictors of positive pain responses to provocative discography in patients with chronic back pain

Author, year	Definition of positive pain response	Rates of positive pain responses	Quality score*
Manchikanti, 2001[820]	NASS criteria	**A:** Low back pain, negative testing for facet joint mediated pain and epidural steroids, with somatization disorder: 48% (12/25) **B:** Low back pain, negative testing for facet joint mediated pain and epidural steroids, without somatization disorder: 56% (14/25)	5/9
Heggeness, 1997[819]	Reproduction of patient's typical pain pattern	**A:** Postoperative disks: 72% (73/102) **B:** Unoperated disks: 38% (51/136)	2/9
Block, 1996[818]	Similar or exact pain reproduction	**A:** Low back pain, with at least 1 nondisrupted disc: 47% (34/72) Discordant pain response associated with higher scores on hysteria and hypochondriasis subscales of MMPI	7/9
Ohnmeiss, 1995[821]	Similar or exact pain reproduction	**A:** Low back pain with abnormal pain drawing: 50% (18/36) **B:** Low back pain with normal pain drawing: 12% (13/105)	5/9

*See Methods for quality criteria used to evaluate studies assessing positive rates from provocative discography

Estimating accuracy of provocative discography

One recent, higher-quality prospective cohort study by Carragee and colleagues (2006) attempted to estimate the positive predictive value of provocative discography by comparing the rate of successful surgical outcomes in patients with presumed discogenic pain by provocative discography relative to the rate of successful surgical outcomes in patients with single-level, unstable spondylolisthesis (a condition for which surgery is widely considered appropriate) (Table 67)[823]. Patients in the provocative discography group (n=32) were selected if they met low-pressure criteria for a positive response at a single level, failed conservative therapy, had negative facet joint and sacroiliac joint blocks, and had no other spinal or pelvic pathology or comorbidities associated with poorer surgical outcomes. Patients in the spondylolisthesis group (n=34) also had no comorbidities and had single-level Grade I or II isthmic spondylolisthesis of either L5-S1 or L4-L5 with radiologic segmental instability. Patients appeared well-matched on baseline demographics, pain scores, functional status, and other important covariates.

The rate of highly successful outcomes two years following spinal fusion was 72% (23/32) in the spondylolisthesis group compared to 27% (8/30) in the positive discography group (p=0.0004). The proportion of patients who met criteria for minimal acceptable outcomes as assessed by blinded and independent observers was 91% (29/32) in the spondylolisthesis group compared to 43% (13/30) in the positive discography group. The "positive predictive value" (rate of success in the positive discography group relative to rate of success in the spondylolisthesis group) was 42% to 43% for both outcomes. Using the most favorable assumptions about dropouts (2 dropouts in discogenic pain group considered successes and 2 dropouts in spondylolisthesis group considered failures), the positive predictive value of discography would be 55% to 57%.

Table 67. Study evaluating rates of successful surgical outcomes in highly selected patients with positive discography relative to patients with isthmic spondylolisthesis

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Carragee, 2006[823]	n=66 2 years	**Surgery for presumed discogenic pain (positive discography) vs. unstable single-level isthmic spondylolisthesis** "Success" (pain VAS ≤2/10, ODI ≤15, no opioid or daily analgesic use, return to full employment): (27% (8/30) vs. 72% (23/32) Minimal acceptable outcome (pain VAS <4/10, ODI <30, no opioid use, return to at least partial employment): 43% (13/30) vs. 91% (29/32) Pain VAS <2 (0 to 10 scale): 30% (9/30) vs. 84% (27/32) ODI score <15: 33% (10/30) vs. 72% (23/32) No opioid or daily analgesic: 30% (9/30) vs. 88% (28/32) Working in usual occupation: 30% (9/30) vs. 81% (26/32) "Positive predictive value" (positive outcome in discography group relative to spondylolisthesis group: 42% for "success", 43% for minimal acceptable outcome)	6/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Although this study met criteria for a higher-quality prospective cohort study, the reference standard is quite atypical because it compares outcomes following the same surgical procedure in patients with two different underlying conditions (rather than comparing results to a reference test in the same set of patients). Interpretation of "positive predictive value" estimates from this study depends on the key assumptions that surgical morbidity should be similar in both groups and that surgery for "true" discogenic pain should achieve similar outcomes as surgery for unstable spondylolisthesis in a matched group of patients without risk factors for poor surgical outcomes. A potential alternative interpretation of study results is that even though surgery for discogenic pain identified by provocative discography is associated with a lower rate of success compared to surgery for unstable spondylolisthesis in highly selected patients without comorbidities, this observation could reflect an imperfect treatment rather than an incorrect diagnosis. However, the authors of the study argue that surgical removal of the disc and annulus (the presumed pain generators) should be the definitive treatment if the disc is the true source of pain[823].

Effects of provocative discography for selecting patients for spinal fusion on clinical outcomes

One lower-quality observational study compared outcomes in patients selected for spinal fusion based on positive discography to those who underwent surgery without prior discography (Table 68)[822]. It was rated lower-quality because it used a historical control group, did not describe independent or blinded assessment of outcomes, and did not adjust for baseline differences or confounders. It found that after 2.4 to 2.8 years of follow-up, there were no significant differences in rates of satisfactory outcomes (defined as score of <40 on ODI), pain, or psychologic testing.

Another lower-quality observational study found that in patients who underwent fusion based on a positive temporary external transpedicular fixation trial, the likelihood of a successful outcome was not associated with presence of or absence of a positive response to provocative discography in adjacent disc segments[824].

Table 68. Study of outcomes in patients selected for spinal fusion with or without provocative discography

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Willems, 2007[824]	n=82 Mean 80 months	**Positive provocative discography in adjacent disc vs. no positive provocative discography in adjacent disc** Fusion successful (>30% improvement in pain score): 45% vs. 45%, p=0.58	4/9
Madan, 2002[822]	n=73 2.4 to 2.8 years	**Discography vs. no discography** "Excellent" or "good" ODI outcome: 81% vs. 76% "Excellent" ODI outcome: 62% vs. 58% ODI (mean scores): 34 vs. 34 Psychologic (mean scores): 22 vs. 15 Pain (VAS, 0-10): 4.2 vs. 4.4 Core set of surgical outcomes (range 10 to 50): 24 vs. 25	4/9

* Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Two other retrospective cohort studies were excluded because they didn't compare outcomes in patients who did and did not undergo discography prior to surgery. One found successful surgery more likely in patients with positive discography and an abnormal MRI compared to positive discography and a normal MRI (75% vs. 50%)[829]. The other found success rates higher with abnormal discs and positive pain provocation compared to patients with abnormal discs and no pain provocation (88% vs. 52%)[830]. Both studies failed to report independent or blinded assessment of outcomes and did not adjust for baseline differences or potential confounders.

Harms

The most common serious complication following discography is discitis. In one systematic review of observational studies, 12 cases of discitis occurred in 5,091 patients (13,205 disc injections) who underwent discography without prophylactic antibiotics (mean 0.24% using the number of patients as the denominator and 0.09% using the number of disc injections as the denominator)[810]. In the single study of patients who received prophylactic antibiotics (200

patients, 435 discs), no cases were reported[831]. Other rare complications that have been reported after discography include disc herniation after injection, retroperitoneal hemorrhage, and dural penetration[810]. Increased pain following the procedure is frequent but usually transient. However, one small study found that 20% to 67% of patients without back pain but with somatization or chronic pain at other sites reported persistent back pain one year after provocative discography[814]. Long-term effects of discography have not been well-studied, though one small study (n=36) found no increase in degenerative disc changes 10 to 20 years after discography[832].

Costs
We found no studies evaluating costs.

Summary of evidence

- In healthy, asymptomatic volunteers, positive responses to provocative discography were uncommon in several series of patients (level of evidence: fair).
- In patients without significant back pain, provocative discography was frequently and consistently associated with high rates of positive pain responses in patients with chronic pain at other sites, those with somatization, those with previous disc surgery, and those disabled or seeking monetary compensation (level of evidence: fair).
- In higher-risk subgroups of patients without significant low back pain (see above bullet), incorporation of pressure criteria into the definition for a positive response to provocative discography did not eliminate positive results in one small study (level of evidence: fair).
- In patients with chronic low back pain, previous back surgery, chronic pain, and abnormal psychometric testing were associated with increased rates of positive discography in several series of patients (level of evidence: fair).
- In patients without risk factors for poor surgical outcomes, one higher-quality cohort study found that relative to the rate of successful surgery for single-level isthmic spondylolisthesis, the rate of successful surgery for presumed discogenic back pain (based on provocative discography) was 43-44%. Interpretation of this finding as a “positive predictive value” depends on the critical assumptions that surgical morbidity and rates of successful surgery for presumed discogenic back pain should be equivalent to rates of successful surgery for isthmic spondylolisthesis if the disc is the true source of symptoms (level of evidence: fair).
- In patients who underwent spinal fusion, one lower-quality observational study found surgery outcomes similar with or without the use of provocative discography to select patients for surgery (level of evidence: poor).
- In patients who underwent spinal fusion based on results of a temporary external transpedicular fixation trial, one lower-quality observational study found presence of or absence of a positive response to provocative discography in adjacent discs did not predict clinical outcomes (level of evidence: poor).

- Discitis following provocative discography appears rare with or without antibiotics. Other serious adverse events also appear rare. In one study, persistent pain was reported in patients with somatization or chronic pain outside the back, but no back pain at the time of provocative discography, but who had somatization or chronic pain at other sites (level of evidence: fair).

Recommendations and findings of other guidelines

- The AHCPR guidelines recommend against discography in patients with acute low back pain because it is invasive and interpretation is equivocal (strength of evidence: C).
- The AHCPR guidelines recommend against CT-discography over MRI or CT for assessing patients with suspected nerve root compression due to lumbar disc hernia (strength of evidence: C).
- The European COST guidelines recommend against discography for diagnosis of discogenic pain in patients with chronic low back pain.

Diagnostic selective nerve root block

Diagnostic selective nerve root blocks involve the injection of local anesthetic around spinal nerves under fluoroscopy. A positive response is defined as relief of usual radicular symptoms and is thought to indicate that the target nerve is the source of those symptoms. Results of selective nerve root blocks correlate well with radiologic or surgical evidence of nerve compression[833]. However, because nerve root compression can usually be identified by non-invasive imaging, the main roles of diagnostic nerve root blocks are to evaluate the appropriate target level for interventions when multiple nerve roots are involved or to confirm radiculopathy when imaging is equivocal or when there is discordance between clinical findings and imaging. No reliable reference standard (such as electrophysiologic testing[329]) is available for estimating diagnostic accuracy of selective nerve root blocks for identifying “true” nerve root pain in these situations. We therefore focused our review on evidence on whether use of selective nerve root blocks to select patients for procedures intended to relieve nerve root compression improves clinical outcomes compared to not using selective nerve root blocks to select patients (Phase 4 evidence on the diagnostic research hierarchy[808]).

Results of search: systematic reviews
We identified one lower-quality systematic review on diagnostic accuracy of selective nerve root blocks[834]. However, it included no studies that evaluated whether use of diagnostic selective nerve root blocks to identify patients for procedures intended to relieve nerve root compression improves clinical outcomes compared to relying only on imaging or other non-invasive diagnostic methods to select patients. We excluded an earlier version of the systematic review[833].

Results of search: other studies
From 381 potentially relevant citations, we identified no relevant studies.

Effects of selective nerve root block on clinical outcomes

We could not assess effects on clinical outcomes of using selective nerve root blocks to select or guide procedures for relieving nerve root compression compared to using non-invasive diagnostic methods alone (no evidence).

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- There are no studies on how use of diagnostic selective nerve root blocks to evaluate patients for suspected nerve root compression affects choice of therapy and clinical outcomes compared to use of non-invasive methods alone.

Recommendations and findings from other guidelines

- The other guidelines do not address diagnostic selective nerve root blocks.

Diagnostic intra-articular facet joint block and medial branch block

Diagnostic intra-articular facet joint blocks involve the injection of local anesthetic under fluoroscopic guidance into the facet (zygapophysial) joints. Medial branch blocks involve injection of local anesthetic around the medial branches of the dorsal rami, which innervate the facet joints. Both procedures are performed in order to evaluate whether the facet joint is the source of low back pain. A positive response to either diagnostic procedure is defined as the relief of usual back pain. In a number of studies, positive intra-articular facet joint blocks and medial branch blocks have been reported in 15% to 45% of patients with chronic low back pain[835]. Use of control blocks can reduce the rate of positive responses by up to 50% compared to relying on a single block. However, as in other invasive diagnostic procedures for low back pain, no reliable reference standard for facet joint pain is available to estimate the diagnostic accuracy of intra-articular facet joint blocks and medial branch blocks. It is therefore unknown whether the decreased rate of positive responses is due to fewer false positives, fewer true positives, or some combination. Furthermore, results of intra-articular facet joint blocks and medial branch blocks do not correlate well with findings on imaging studies. We therefore focused our review on evidence that evaluated whether use of intra-articular facet joint blocks or medial branch blocks to select patients for procedures intended to treat presumed facet joint pain improves clinical outcomes compared to not using facet joint blocks to select patients (Phase 4 evidence on the diagnostic research hierarchy[808]).

Results of search:
We identified two systematic reviews on diagnostic utility or accuracy of intra-articular facet joint blocks and medial branch blocks[836, 837]. Neither included any study that evaluated whether use of intra-articular facet joint blocks or medial branch blocks to select patients for procedures

intended to treat presumed facet joint pain improves clinical outcomes compared to relying on other methods to select patients such procedures. We excluded an earlier version[835] of one of the systematic reviews[837].

Results of search: primary studies
From 46 potentially relevant citations, we identified one lower-quality trial not included in the systematic reviews that evaluated clinical outcomes in patients selected for percutaneous facet joint cryodenervation based on a positive uncontrolled medical branch block versus those selected based on a positive uncontrolled pericapsular block[838].

Effects of facet joint block on clinical outcomes

One lower-quality trial found no clear differences in pain relief between patients selected for percutaneous facet joint cryodenervation based on a positive uncontrolled medial branch block, versus those selected based on a positive uncontrolled pericapsular block (Table 69)[838]. However, results are difficult to interpret because efficacy of facet joint cryodenervation has not been evaluated in randomized trials. We found no trials that assessed whether use of intra-articular facet joint blocks or medial branch blocks to select patients for facet joint interventions evaluated in randomized trials (e.g., radiofrequency denervation or facet joint steroid injection) improves clinical outcomes compared to selection of patients based on non-invasive methods alone.

Table 69. Trial of outcomes in patients selected for percutaneous facet joint cryodenervation with uncontrolled medial branch versus uncontrolled pericapsular block

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Birkenmaier, 2007[838]	n=26 6 months	**Facet joint cryodenervation based on positive uncontrolled medial branch block versus cryodenervation based on positive pericapsular block** Mean pain score (0 to 10 scale): 4.2 vs. 3.2 at 2 weeks (p=0.33), 4.2 vs. 2.3 at 3 months (p=0.049), 4.0 vs. 2.7 at 6 months (p=0.148) Percent improvement in pain score: 51% vs. 44% at 2 weeks (p=0.61), 40% vs. 33% at 6 months (p=0.52) McNab score (0 to 3): 1.3 vs. 1.7 at 2 weeks, 1.5 vs. 2.0 at 6 months	4/10

* Excludes criteria involving blinding of care providers, for maximum score of 10

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- For presumed facet joint pain, one lower-quality trial found no clear differences in pain relief between patients selected for percutaneous facet joint cryodenervation based on a positive

uncontrolled medial branch block, versus those selected based on a positive uncontrolled pericapsular block (level of evidence: poor)

- There are no other studies on how use of facet joint injections or medial branch blocks to evaluate patients for facet joint pain affects choice of therapy and clinical outcomes compared to use of non-invasive methods alone.
- Evidence on interventions for treating presumed facet joint pain is outlined in Key Question 7. In all trials of facet joint interventions, patients were enrolled based on positive (primarily uncontrolled) diagnostic intra-articular facet joint blocks or medial branch blocks.

Recommendations and findings from other guidelines

- The European COST guidelines recommend against facet joint blocks for the diagnosis of facet joint pain.

Diagnostic sacroiliac joint block

Diagnostic sacroiliac joint injection involves the injection of local anesthetic into or around the sacroiliac joint in order to evaluate whether the sacroiliac joint is the source of low back pain. A positive response is defined as the relief of usual back pain. Rates of positive intra-articular sacroiliac joint blocks range from 2% to 27%, depending in part on the population evaluated and the method of block used (e.g. controlled or uncontrolled, fluoroscopic guidance or no fluoroscopic guidance)[83]. However, as in other invasive diagnostic procedures for low back pain, no reliable reference standard for sacroiliac pain is available for estimating the diagnostic accuracy of sacroiliac joint blocks. Furthermore, results of sacroiliac joint blocks may not correlate well with findings on imaging studies. We focused our review on studies that evaluated whether use of sacroiliac joint blocks to select patients for procedures intended to treat presumed sacroiliac joint pain improves clinical outcomes compared to other methods to select patients (Phase 4 evidence on the diagnostic research hierarchy[808]).

Results of search: systematic reviews
We identified one systematic review on diagnostic utility or accuracy of sacroiliac joint blocks[83]. It did not include any study that evaluated whether use of a diagnostic sacroiliac joint block to select patients for procedures intended to treat presumed sacroiliac joint pain improves clinical outcomes compared to relying on other methods to select patients for such procedures. We excluded an earlier version[186] of this systematic review.

Results of search: primary studies
From 46 potentially relevant citations, we identified no relevant trials.

Effects of diagnostic sacroiliac joint block on selection of therapies and clinical outcomes

We found no studies that assessed whether use of diagnostic sacroiliac joint blocks to select patients for interventions targeting the sacroiliac joint improves clinical outcomes compared to selection based on non-invasive methods alone.

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- There are no studies on how use of sacroiliac joint blocks to evaluate patients for sacroiliac joint pain affects choice of therapy and clinical outcomes compared to use of non-invasive methods alone.
- Evidence on interventions for presumed sacroiliac joint pain is reviewed in Key Question 7.

Recommendations and findings from other guidelines

- The other guidelines do not address diagnostic sacroiliac joint blocks.

Key Question 8

How effective are injections (and different injection interventions) and other interventional therapies for non-radicular low back pain, radicular low back pain, or spinal stenosis, and under what circumstances?

Injections outside the spine

Local injections

Local injections involve the placement of a local anesthetic (with or without corticosteroid) into the muscles or soft tissues of the back via a catheter. We defined trigger point injections, a type of local injection, as an injection performed at a tender area with a palpable nodule or band.

Results of search: systematic reviews
We identified one higher-quality Cochrane review[94] and one lower-quality systematic review[92] on local or trigger point injections. We excluded two earlier versions of the Cochrane review[86, 187].

Results of search: trials
Four randomized trials[131, 140, 142, 165] of local injections were included in the two systematic reviews.[92]. We rated two trials higher-quality[131, 140]. We identified no other trials of local injections for low back pain that met inclusion criteria. We excluded one non-randomized trial of local injections[200].

Efficacy of local injections versus placebo injection

For non-specific subacute or chronic low back pain, three small (n=15 to 41), placebo-controlled trials (one rated higher-quality[131]) each found local anesthetic injections superior to placebo for short-term (1 to 2 weeks post-injection) pain relief for subacute or chronic back pain (Table 70)[131, 142, 165]. However, the trials evaluated heterogeneous injection methods and patient populations. One trial evaluated a local anesthetic injection over the iliac crest for iliac crest

pain[131], one evaluated local anesthetic plus corticosteroid injections over the iliolumbar ligament for non-specified low back pain[165], and one evaluated local anesthetic trigger point injections for lumbar or cervical (2 of 15 patients) myofascial pain syndrome[142]. None evaluated longer-term outcomes. A higher-quality systematic review also found no strong evidence to support local injections.[94].

Table 70. Randomized, placebo-controlled trials of local injections

Author, year	Sample size Type of LBP Duration of symptoms	Duration of follow-up	Main results	Quality score*
Collee, 1991[131]	n=41 Iliac crest syndrome Duration not reported	2 weeks	**Iliac crest local anesthetic vs. saline injection** Pain score: 30.5 vs. 43.8 at 2 weeks, p<0.05 Improved or much improved (patient rated): 52% vs. 30%, NS Morning stiffness and medication use: No differences (data not reported)	7/11
Garvey, 1989[140]	n=63 Non-specific low back pain At least subacute	2 weeks	**Trigger point injection with lidocaine vs. trigger point injection with lidocaine plus corticosteroid vs. dry needle-stick vs. topical ethyl chloride plus acupressure** Proportion improved: 31% (4/13) vs. 36% (5/14) vs. 55% (11/20) 50% (8/16) (p=0.09 for trigger point groups vs. other groups)	8/11
Hameroff, 1981[142]	n=15 Myofascial low back pain Duration unclear	1 week	**Trigger point injection with bupivacaine vs. etidocaine vs. saline (mean percent improvement from baseline at 7 days, p values vs. saline)** Average pain (0 to 100 VAS): -7% (p=0.005) vs. -12% (p=0.001) vs. +13% % time pain felt (0 to 100 VAS): -3% (NS) vs. -5% (NS) vs. +7% Effect of pain on activity (0 to 100 VAS): -3% (NS) vs. -11% (NS) vs. +5% Effect of pain on sleep (0 to 100 VAS): -1% (NS) vs. -10% (NS) vs. +2% Effect of pain on mood (0 to 100 VAS): +2% (NS) vs. -11% (p=0.026) vs. +9%	2/11
Sonne, 1985[165]	n=30 Non-specific low back pain At least subacute	2 weeks	**Iliolumbar ligament steroid/local anesthetic vs. saline injection** Good or excellent improvement (patient rated): 64% (9/14) vs. 20% (3/15), p<0.05	4/11

Efficacy of local injection versus epidural steroid injections

Efficacy of trigger point injections versus epidural steroid injections is reviewed in the section on epidural steroids.

Efficacy of local injection versus dry acupuncture needlestick or topical ethyl chloride plus acupressure

For subacute or chronic back pain without sciatica, one higher-quality trial found no significant differences between trigger point injections (with steroid, lidocaine, or both) and a single dry

acupuncture needlestick (RR=1.47, 95% CI 0.74 to 2.92) or topical ethyl chloride plus 20 seconds of acupressure (RR=1.71, 95% CI 0.71 to 4.14) (Table 71)[140]. Interpretation of these results is a challenge because the comparator interventions could be considered active treatments.

Efficacy of trigger point injection with a local anesthetic versus a steroid

For acute or subacute sciatica, one higher-quality trial found that the addition of a corticosteroid to a local anesthetic trigger point injection was no better than a local anesthetic alone (proportion improved 45% with corticosteroid versus 40% without corticosteroid)[140].

Harms

One placebo-controlled trial reported no adverse events[142] and another didn't report adverse events[165]. In two other trials, adverse events following local injections included pain at the injection site, temporary paresthesia, and nausea (in both active and control injection groups)[131, 140].

Costs

We found no studies evaluating costs.

Summary of evidence

- For acute or subacute sciatica, adding a steroid to a local anesthetic for trigger point injections did not result in superior outcomes compared to a local anesthetic alone in one lower-quality trial (level of evidence: poor).
- For subacute or chronic low back pain, three small, lower-quality trials found local or trigger point injections with a local anesthetic superior to saline injection for short-term pain relief. The trials evaluated heterogeneous injection methods, and none evaluated longer-term outcomes (level of evidence: poor).
- There is no evidence on efficacy of local injections for long-term pain relief.
- For subacute or chronic low back pain without sciatica, one lower-quality trial found no significant differences between a trigger point injection with local anesthetic (with or without a steroid) and either a single dry needlestick or topical ethyl chloride plus acupressure (level of evidence: poor).
- One lower-quality trial found no difference between trigger point injection with a local anesthetic plus corticosteroid versus a local anesthetic alone (level of evidence: poor).
- See section on epidural steroids for summary of evidence on local or trigger point injections versus epidural steroids.

Recommendations and findings from other guidelines

- The AHCPR guidelines recommend against invasive trigger point injections in the treatment of patients with acute low back problems (strength of evidence: C).
- The VA/DoD guideline recommendations are similar.

- The UK RCGP guidelines found that studies of trigger point injections included patients with chronic low back pain, and findings were equivocal, with little evidence specifically in acute low back pain patients (strength of evidence: *).
- The European COST guidelines found insufficient evidence to recommend trigger point injections for chronic low back pain.

Botulinum toxin

Botulinum toxin is a product of the bacterium *Clostridum botulinum* that has anti-spasmodic activity. Injections of botulinum toxin have been shown to reduce pain associated with movement disorders and certain painful conditions. Two antigenically distinct serotypes of botulinum toxin (A and B) are available for use in clinical practice.

Results of search: systematic reviews
We excluded one review on botulinum toxin for low back pain because it did not report systematic methods[175]. We identified no other systematic reviews of botulinum toxin for low back pain.

Results of search: trials
We identified one small (n=31), higher-quality randomized trial[105] of botulinum toxin injection for chronic low back pain met inclusion criteria. We excluded one non-randomized trial[207] and two trials[202, 204] of botulinum toxin for neck pain.

Efficacy of botulinum toxin versus saline injection or no injection

For chronic low back pain failing to respond to standard treatments, a small (n=31), higher-quality RCT found botulinum toxin A superior to saline injection for short-term pain relief (proportion of patients with >50% pain relief 73% vs. 25% at 3 weeks, p=0.012, and 60% vs. 12.5% at 8 weeks, p=0.09) and for rates of improvement in ODI scores (67% vs. 19%, p=0.011) (Table 83)[105]. Effects were no longer present in most (60%) of responders after three to four months.

Table 71. Randomized, placebo-controlled trial of botulinum toxin injection

Author, year	Sample size Type of LBP Duration of symptoms	Duration of follow-up	Main results	Quality score*
Foster, 2001[105]	n=31 Non-specific low back pain Chronic	8 weeks	**Botulinum toxin A vs. saline injection** Degree of pain relief >50%: 73% (11/15) vs. 25% (4/16) at 3 weeks (p=0.012), 60% (9/15) vs. 12.5% (2/16) at 8 weeks (p=0.009) ODI, proportion with improvement at 8 weeks: 67% (10/15) vs. 19% (3/14) (p=0.011) 6/10 responders in botulinum toxin A group reported cessation of analgesic effect after 3 to 4 months	9/11

Harms
No side effects were reported in one randomized trial[105]. A case report exists of fatal anaphylaxis following injection of botulinum toxin A for chronic neck and back pain[839].

Costs
We found no studies evaluating costs.

Summary of evidence

- There is no evidence on effectiveness of botulinum toxin injection for acute low back pain.
- For chronic low back pain, a single, small, higher-quality trial found botulinum toxin injection moderately superior to saline injection for short-term pain relief and functional status in patients who failed to respond to standard treatments, though effects were no longer present in most responders after 3 to 4 months (level of evidence: poor).
- There is no evidence comparing botulinum toxin injection to other interventions.
- There is insufficient evidence to evaluate harms of botulinum toxin in patients with low back pain, though one case of fatal anaphylaxis has been reported.

Recommendations and findings from other guidelines

- The other guidelines do not address botulinum toxin.

Prolotherapy

Prolotherapy (also referred to as sclerotherapy) is a technique that involves the repeated injection of irritants into ligaments and tendinous attachments in order to trigger an inflammatory response. This theoretically leads to subsequent strengthening of ligaments and improvement in pain and disability. Prolotherapy injections are often supplemented by co-interventions such as trigger point injections, manipulation, and exercises that are thought to enhance the effectiveness of treatment or address underlying dysfunction contributing to the back pain. Because of the irritant nature of prolotherapy injections, patients are expected to experience transient pain at the injection site after receiving treatment.

Results of search: systematic reviews
We identified one recent, higher-quality Cochrane review on efficacy of prolotherapy for chronic low back pain[76]. We excluded an earlier version of the Cochrane review[197] and a review that did not clearly use systematic methods[182].

Results of search: trials
We identified five randomized, placebo-controlled trials of prolotherapy[134, 146, 151, 156, 168]. All were included in the Cochrane review[76]. We rated four of the five trials higher-quality[134, 146, 156, 168].

Efficacy of prolotherapy versus control injection

For chronic non-specific low back pain, three trials (two higher-quality[134, 168]) found no difference between prolotherapy and either saline or local anesthetic control injections for short- or long-term (up to 24 months) pain or disability

(Table 72)[151]. One higher-quality trial found prolotherapy associated with increased likelihood of short-term improvement in pain or disability versus control injection (RR=1.47, 95% CI 1.04 to 2.06), but both treatment groups received a number of co-interventions including spinal manipulation, local injections, exercises, and walking[146]. In the fifth trial, effects of prolotherapy could not be determined because the prolotherapy group received strong manipulation and the control injection group only light manipulation[156]. A higher-quality Cochrane review rated all five placebo-controlled trials higher-quality[76]. It also found prolotherapy to be ineffective when used alone for chronic low back pain.

Table 72. Randomized, placebo-controlled trials of prolotherapy

Author, year Type of LBP	Sample size Duration of symptoms	Duration of follow-up	Main results	Quality score*
Dechow, 1999[134] Non-specific low back pain	n=74 Chronic	6 months	**Prolotherapy vs. saline/lignocaine injection, mean scores at 6 months, estimated from graphs)** Pain (0 to 10): 5.2 vs. 4.4, NS ODI (0 to 100): 36 vs. 35, NS Zung Depression Score: 34.2 vs. 37.0, NS Present Pain Score: 1.9 vs. 1.9, NS	9/11
Klein, 1993[146] Non-specific low back pain	n=80 Chronic	6 months	**Prolotherapy vs. saline/lidocaine injection** >50% improvement in pain score: 77% (30/39) vs. 52% 21/40), p=0.04 RDQ (mean score at 6 months): 4.04 vs. 4.38, p=0.07 Pain score (0 to 8 VAS): 2.29 vs. 2.85, p=0.06	9/11
Mathews, 1987[151] Non-specific low back pain	n=22 Chronic	Up to 1 year	**Prolotherapy vs. tender point local anesthetic injection** Proportion recovered (pain score 5 or 6 on a 1 to 6 scale): 63% (10/16) vs. 33% (2/6) at 3 months (NS), no significant differences at 6 or 12 months. No further pain: 12% (2/16) vs. 17% (1/6) up to 1 year	4/11
Ongley, 1987[156] Non-specific low back pain	n=82 Chronic	6 months	**Prolotherapy plus forceful manipulation vs. saline injection plus non-forceful manipulation** >50% improvement in disability score: 88% (35/40) vs. 39% (16/41) at 6 months, p<0.003 Disability score (mean, 0 to 33 scale): 8.37 vs. 4.00 at 1 month (p<0.001) < 8.29 vs. 3.43 at 6 months (p<0.001) Pain score (mean, 0 to 7.5 scale): 3.06 vs. 2.13 at 1 month (p<0.01), 3.08 vs. 1.50 at 6 months (p<0.001)	6/11
Yelland, 2004[168] Non-specific low back pain	n=110 Chronic	2 years	**Prolotherapy vs. saline injection (mean change from baseline, positive values indicate improvement)** Pain intensity (0 to 100 VAS): 18.6 vs. 18.4 at 1 year (p=0.96), 18.4 vs. 16.4 at 2 years (p=0.93) Modified RDQ (0 to 23): 5.5 vs, 4.5 at 1 year (p=0.85), 4.9 vs. 4.2 at 2 years (p=0.60) Analgesic use (0 to 4): -0.1 vs. -0.1 at 1 year (p=0.60) Days of reduced activity in last 28 days: 3.2 vs. 2.4 at 1 year (p=0.66), 2.5 vs. 1.8 at 2 years (p=0.75) SF-12 Physical Component Summary score: 5.5 vs. 6.0 at 1 year (p=0.76), 1.4 vs. 3.3 at 2 years (p=0.30) SF-12 Mental Component Summary score: 0.6 vs. -0.2 at 1 year (p=0.75), -0.8 vs. 1.1 at 2 years (p=0.48)	11/11

Harms
In three[146, 156, 168] of the four trials, nearly all participants experienced the expected temporary increases in back pain and stiffness following prolotherapy injections. In two other trials, either no adverse events[151] or only a few cases of post-injection pain[134] were reported. Post-injection headaches suggestive of lumbar puncture occurred in two to four percent of patients in two trials[146, 168]. Other adverse events included postmenopausal spotting, leg pain (attributable to herniated disc), diarrhea, and other, generally transient symptoms, but there were no significant differences in any adverse event between treatment and control groups.

Costs
We found no studies evaluating costs.

Summary of evidence

- There is no evidence on efficacy of prolotherapy for acute low back pain.
- For chronic low back pain, three of four higher-quality trials found no differences between prolotherapy versus control injections. The fourth trial found prolotherapy more effective than control injections, but is difficult to interpret because both groups received a number of co-interventions (level of evidence: good).
- Serious adverse events have not been reported following prolotherapy treatments, though nearly all patients in most trials report increased back pain due to the irritant nature of the injections (level of evidence: fair).

Recommendations and findings from other guidelines

- The AHCPR guidelines recommend against ligamentous and sclerosant injections for patient with acute low back problems (strength of evidence: C).
- The VA/DoD and UK RCGP guideline recommendations are similar.
- The European COST guidelines recommend against injections of sclerosants (prolotherapy) for nonspecific chronic low back pain.

Intraspinal steroid injections and chemonucleolysis

Epidural steroid injection

Epidural steroid injections involve administration of corticosteroids via a catheter into the space between the dura and the spine. The anti-inflammatory effects of the steroid are thought to reduce swelling and pain. Epidural steroid injections have been used for sciatica, spinal stenosis, and non-specific low back pain. Epidural injections can be performed by the translaminar approach (via the interlaminar space in the spine), the transforaminal approach (through the neuroforamen ventral to the nerve root), or the caudal approach (through the sacral hiatus at the sacral canal).

Results of search: systematic reviews
We identified four higher-quality[84, 86, 94, 100] and five lower-quality systematic reviews [71, 74, 77, 92, 97] of epidural steroids for low back pain. We excluded eleven outdated or already updated

systematic reviews[170, 172, 178, 183, 184, 187, 189, 190, 193, 194, 386] and three reviews that were not clearly systematic[173, 181, 188].

Results of search: trials
We identified forty randomized trials (reported in 39 articles) of epidural steroid injections for low back pain[101, 102, 106, 107, 111, 115, 123, 125, 126, 128, 130, 132, 135, 143, 145, 147, 148, 151, 152, 158, 159, 161, 164, 167, 169, 840-853]. 33 trials were included in at least one of the nine systematic reviews[71, 74, 77, 84, 86, 92, 94, 97, 100] and we identified seven additional trials[101, 102, 106, 107, 111, 115, 842]. 21 trials (with two trials reported in one article[148]) were placebo-controlled[106, 123, 125, 126, 128, 130, 132, 135, 143, 145, 147, 148, 151, 152, 158, 159, 161, 164, 167, 169]. We rated eleven placebo-controlled trials higher-quality[106, 115, 123, 128, 130, 135, 145, 152, 159, 167, 843].

Efficacy of translaminar or caudal epidural steroid injection versus epidural placebo injection (saline or local anesthetic) for low back pain with sciatica or radiculopathy

For low back pain with radiculopathy, we found inconsistent results for short-term (up to one month following injection) benefits from 20 placebo-controlled trials of epidural steroid injection Table 73)[123, 125, 126, 128, 130, 132, 135, 143, 145, 147, 148, 151, 152, 158, 159, 161, 164, 167, 169]. Ten of 17 trials (including three of seven higher-quality trials) showed no differences in pain or function between epidural steroid and placebo injection[123, 125, 126, 128, 130, 132, 135, 143, 145, 147, 151, 152, 158, 161, 164, 167, 169]. Results were more consistent after trials were stratified according to whether the control intervention was an epidural or non-epidural (soft tissue) injection. Five[123, 135, 143, 158, 167] of six[151] trials found an epidural steroid injection associated with short-term benefits compared to a non-epidural (primarily interspinous ligament) placebo injection, including all three higher-quality trials[123, 135, 167]. Only two[126, 128] of eleven[125, 130, 132, 145, 147, 152, 161, 164, 169] trials found an epidural steroid injection associated with short-term benefits compared to epidural placebo (saline or local anesthetic). One of the positive trials was rated higher quality[128]; both were small (n=23 and 35) trials of caudal epidural injections. Three other trials reported mixed or unclear results[145, 147, 161]. Stratification of trials according to duration of symptoms, use of imaging to confirm presence of prolapsed disc, or study quality did not appear to reduce inconsistency in short-term findings.

Table 73. Randomized, placebo-controlled trials of epidural steroid injection for radiculopathy

Author, year	Sample size Type of LBP Duration of symptoms	Duration of follow-up	Main results	Quality score*
Arden, 2005[123]	n=228 Radiculopathy Subacute or chronic	1 year	**Interlaminar epidural steroid vs. interspinous ligament saline injection** (all results at 52 weeks unless otherwise noted) ODI, proportion with >75% improvement: 12% (15/120) vs. 4% (4/108) at 3 weeks (p=0.016), 32% (39/120) vs. 30% (32/108) at 52 weeks (p=0.64) SF-36: No significant differences Leg pain, >50% improvement: 48% (58/120) vs. 44% (48/108) (NS) Back pain (VAS 0 to 100), mean improvement from baseline: -8 vs. -9 (NS) Required surgery: 13% vs. 13% Off work due to sciatica: 24% (29/120) vs. 22% (24/108)	9/11
Beliveau, 1971[125]	n=48 Radiculopathy Duration not reported	1 to 3 months	**Epidural steroid vs. epidural local anesthetic** Proportion improved or completely relieved (clinician rated): 75% (18/24) vs. 67% (16/24)	1/11
Breivik, 1976[126]	n=35 Radiculopathy Chronic (mean duration not reported)	Unclear	**Caudal epidural steroid/local anesthetic vs. epidural local anesthetic plus large volume (100 cc) saline injection** Considerable pain relief: 56% (9/16) vs. 26% (5/19), duration of follow-up unclear, p<0.05	5/11
Bush, 1991 [128]	n=23 Radiculopathy Subacute or chronic	1 year	**Caudal epidural steroid vs. epidural saline injection (mean scores)** Pain (0 to 100): 16 vs. 45 at 4 weeks (p not reported), 14 vs. 30 at 1 year (NS) Function/lifestyle (6 to 18): 16 vs. 14 at 4 weeks (p not reported), 17 vs. 16 at 1 year (NS) Deterioration of symptoms: 8% (1/12) vs. 36% (4/11) (NS) (duration unclear)	6/11
Carette, 1997[130]	n=158 Radiculopathy with imaging-confirmed disk prolapse Subacute or chronic	3 months	**Translaminar epidural steroid vs. epidural saline injection (mean treatment effect, negative values favor epidural steroid))** ODI: -2.5 (CI -7.1 to 2.2) at 3 weeks, -1.9 (CI, -9.3 to 5.4) at 3 months Pain score (0 to 100 VAS): -8.6 (CI -17.5 to 0.3) at 3 weeks, -4.0 (CI, -15.2 to 7.2) at 3 months McGill Present Pain Intensity (0 to 5): 0.0 (CI -0.4 to 0.4) at 3 weeks, 0.2 (-CI -0.3 to 0.7) at 3 months Sickness Impact Profile (0 to 100): -2.5 (CI -5.1 to 0.1) at 3 weeks, -1.2 (CI -5.2 to 2.8) at 3 months ODI <20: 3.2% (CI -8.6% to 15.0%) at 3 weeks, -4.1% (CI -19.6 to 11.3%) at 3 months Marked or very marked improvement: 3.4% (CI -11.4% to 18.2%) at 3 weeks, -0.4% (CI -16.5% to 15.7%) at 3 months Subsequent surgery: 26% vs. 25% (p=0.90) at 12 months	10/11

Table 73. Randomized, placebo-controlled trials of epidural steroid injection for radiculopathy

Author, year	Sample size Type of LBP Duration of symptoms	Duration of follow-up	Main results	Quality score*
Cuckler, 1985[132]	n=73 Radiculopathy or neurogenic claudication Primarily chronic (mean duration 14 to 17 months)	13 to 30 months	**Interlaminar epidural steroid vs. epidural saline/local anesthetic injection** Average improvement: 42% vs. 44% (NS) Treatment success (>75% improvement): 32% (7/22) vs. 36% (5/14) in herniated disc group at 24 hours, 26% (6/23) vs. 15% (2/13) in herniated disc group at long-term (13 to 30 month) follow-up (NS for all comparisons) Surgery: 43% (10/23) vs. 23% (3/13) in herniated disk group at long-term (13 to 30 month) follow-up	5/11
Dilke, 1973[135]	n=100 Radiculopathy Primarily subacute and chronic (10% acute)	3 months	**Interlaminar epidural steroid vs. interspinous ligament saline injection** Analgesic consumption (pain clearly relieved, based on decrease on average daily dosing by 2 or more): 46% (16/35) vs. 11% (4/36) (p<0.01) during admission Pain "none" (patient assessment): 39% (16/41) vs. 24% (8/34) at 3 months Pain "none" or "not severe" (patient assessment): 98% (40/41) vs. 82% (28/34) at 3 months Analgesic consumption "none": 50% (19/38) vs. 38% (11/29) at 3 months Not returned to work: 8% (3/36) vs. 40% (14/35) at 3 months	7/11
Helliwell, 1985[143]	n=39 Radiculopathy Primarily chronic (mean duration 8 to 13 months)	3 months	**Epidural steroid injection vs. interspinous ligament saline injection** Pain (mean change, 0 to 10 VAS): -2.4 vs. -0.6 at 1 month (p<0.01) and -2.5 vs. -0.3 at 3 months (p<0.01) (estimated from figure) Analgesic consumption decreased by 50% or more: 64% (7/11) vs. 40% (4/10) at 3 months, NS Overall outcome "definite improvement" (patient rated): 70% (14/20) vs. 26% (5/19) at 3 months, p<0.001	2/11
Karppinen, 2001[145]	n=160 Radiculopathy Subacute or chronic	1 year	**Transforaminal epidural steroid vs. epidural saline injection (mean difference in change from baseline, positive values favor epidural steroid except for sick leave)** Leg pain (0 to 100): 12.5 (CI, 1.6 to 23.4, p=0.02) at 2 weeks, 2.3 (CI, -8.7 to 13.4, NS) at 4 weeks, NS or favors saline injection at 3, 6 and 12 months Back pain: 5.1 (CI, -0.3 to 10.4, NS) at 2 weeks, -12.2 (CI, -23.5 to -1.0, p=0.03) at 3 months, -8.4 (CI, -18.9 to 2.1, NS) at 12 months ODI: 5.1 (-0.3 to 10.4, NS) at 2 weeks, NS through 12 months Sick leave (days): -0.5 (CI, -4.9 to 3.9, NS) at 2 weeks, NS through 12 months Nottingham Health Profile: No difference at any follow-up time on sleep, pain, mobility, energy, and emotional reaction dimensions	10/11
Klenerman, 1984[147]	n=73 Radiculopathy Duration not reported (inclusion criteria <6 months)	2 months	**Epidural steroid vs. epidural local anesthetic vs. epidural saline vs. dry needle stick** Proportion failed (clinician assessment): 21% (4/19) vs. 31% (5/16) vs. 31% (5/16) vs. 17% (2/12) at 2 months, p=0.74 Pain (0 to 100 VAS, mean score): 25 vs. 16 vs. 19 vs. 29 at 2 months (p not reported)	2/11

Table 73. Randomized, placebo-controlled trials of epidural steroid injection for radiculopathy

Author, year	Sample size Type of LBP Duration of symptoms	Duration of follow-up	Main results	Quality score*
Kraemer, 1997a[148]	n=133 Radiculopathy with imaging-confirmed disk prolapse Duration not reported	3 months	**Targeted epidural steroid injection via an oblique interlaminar approach vs. standard interlaminar epidural steroid injection vs. epidural saline plus intramuscular steroid injection** Good results (based on modified MacNab criteria): 68% vs. 53% vs. 26%, p not reported	2/11
Kraemer, 1997b[148]	n=49 Radiculopathy with imaging-confirmed disk prolapse Duration not reported	3 months	**Targeted epidural steroid injection via an oblique interlaminar approach vs. epidural saline plus intramuscular steroid injection** Good results (based on modified MacNab criteria): 54% vs. 40% (estimated from graph), p not reported	5/11
Mathews, 1987[151]	n=57 Radiculopathy Acute and subacute (mean duration 4 weeks)	Up to 1 year	**Caudal epidural steroid vs. sacral hiatus or tender point local anesthetic injection** Proportion recovered (pain score 5 or 6 on a 1 to 6 scale): 67% (14/21) vs. 56% (18/32) at 1 month (NS) Proportion with no further pain: 39% (9/23) vs. 41% (14/34) at up to 1 year	4/11
Ng, 2005[152]	n=88 Radiculopathy Chronic	12 weeks	**Transforaminal epidural steroid injection vs. epidural local anesthetic injection** ODI improved >10 points: 55% (24/43) vs. 35% (15/43) at 12 weeks Leg pain improved >20 points: 48% (20/43) vs. 42% (18/43) Leg pain, mean improvement (100 mm VAS): 22 vs. 21 at 6 weeks, 23 vs. 22 at 12 weeks (NS) Back pain, mean improvement: 9.9 vs. 6.3 at 6 weeks, 4.8 vs. 8.0 at 12 weeks (NS) ODI, mean improvement: 7.8 vs. 12.9 at 6 weeks, 10.8 vs. 12.3 at 12 weeks (NS) Walking distance, mean improvement: No significant differences	11/11
Ridley, 1988[158]	n=39 Radiculopathy Mixed (51% >6 months)	2 weeks	**Interlaminar epidural steroid vs. interspinous ligament saline injection** Rest pain, median improvement: 46% vs. 0% at 2 weeks Walking pain, median improvement: 69% vs. 0% at 2 weeks Some improvement observed: 89% (17/19) vs. 19% (3/16), p<0.0005	5/11
Riew, 2000[159, 160]	n=55 Radiculopathy with imaging-confirmed disk prolapse or spinal stenosis Subacute or chronic	5 years	**Transforaminal epidural steroid vs. epidural local anesthetic injection** Failure of injection (proportion of patients who underwent surgery): 8/28 (29%) vs. 18/27 (67%), p<0.004 at 1 year; among non-surgery patients after 1 year, 3/12 vs. 1/9 (p=0.42) underwent surgery at minimum five years follow-up (8 patients lost to follow-up)	9/11

Table 73. Randomized, placebo-controlled trials of epidural steroid injection for radiculopathy

Author, year	Sample size Type of LBP Duration of symptoms	Duration of follow-up	Main results	Quality score*
Rogers, 1992[161]	n=30 Radiculopathy Chronic	1 month (primary outcomes)	**Interlaminar epidural steroid vs. epidural saline injection** Pain "none" or "mild": 47% (7/15) vs. 20% (3/15) at 1 month Work status "full": 53% (8/15) vs. 33% (5/15) at 1 month Analgesic intake reduced: 53% (8/15) vs. 40% (6/15) at 1 month Underwent surgery: 27% (4/15) vs. 27% (4/15) at mean 20 to 21 months	5/11
Snoek, 1977[164]	n=51 Radiculopathy with imaging-confirmed disk prolapse Mixed (mean duration 11 to 12 weeks)	2 days and 8 to 20 months	**Epidural steroid vs. epidural saline injection (mean improvement from baseline)** Relief of low back pain: 33% vs. 25% at 2 days, p=0.88 Relief of radiating pain : 25.9% vs. 12.5% at 2 days, p=0.37 Relief of pain interfering with sleep: 53.8% vs. 23.1% at 2 days, p=0.24 Discontinuation of analgesic medications: 40.0% vs. 15.8% at 2 days, p=0.19 Improvement (physiotherapist rated): 70.0% vs. 42.8% at 2 days, p=0.22 Improvement (patient rated): 66.7% vs. 41.7% at 2 days, p=0.13 Underwent surgery: 51.9% (14/27) vs. 58.3% (14/24) at 8 to 20 months follow-up	4/11
Wilson-MacDonald, 2005[167]	n=92 Radiculopathy with imaging-confirmed disk prolapse Subacute or chronic	2 years or longer	**Interlaminar epidural vs. intramuscular/interspinous ligament steroid injection** Proportion of patients undergoing surgery: 41% (18/44)vs. 31% (15/48), p=0.45 Pain: favors epidural group at 35 days (p<0.004) but raw data not reported	9/11
Zahaar, 1991[169]	n=63 Radiculopathy or neurogenic claudication with imaging-confirmed disk prolapsed or spinal stenosis Primarily chronic (mean 14 to 17 months)	20 to 21 months	**Caudal epidural steroid vs. epidural saline injection** Success (>75% improvement) at 24 hours: 65% (24/37) vs. 61% (16/26) overall; 74% (14/19) vs. 71% (10/14) in herniated disc group Success at mean 20 to 21 months: 49% (18/37) vs. 50% (13/26) overall; 58% (11/19) vs. 64% (9/14) in herniated disc group Underwent surgery at mean 20 to 21 months: 35% (13/37) vs. 38% (10/26) overall	3/11

Four[126, 143, 148, 159] of 18 trials reported long-term (greater than three months) benefits following epidural steroid injection, but three of these[126, 143, 148] were rated lower-quality and did not report statistical significance of results. Two[159, 854] of seven[123, 130, 161, 164, 167] trials found epidural steroid injection associated with lower rates of subsequent surgery compared to placebo injection. Among four higher-quality trials (total n=533)[123, 130, 159, 167], only one small (n=55) trial[159] reported this effect.

Three higher-quality systematic reviews reached discordant conclusions regarding short-term benefits following epidural steroid injection for sciatica or radiculopathy[84, 86, 100]. For non-acute (>4 weeks) sciatica, a Cochrane review found no difference between epidural steroid versus placebo injection for short-term (<6 weeks) pain relief, but only pooled data from four trials (RR=0.93, 95% CI 0.79 to 1.09)[86]. The highest quality and largest (n=158) trial reported results very similar to the pooled estimates (RR=0.94, 95% CI 0.76 to 1.15 and RR=1.00, 95% CI 0.71 to 1.41)[129]. A second, qualitative systematic review found no differences between epidural steroid and placebo injections in 5 of 7 trials, including 3 of 4 higher-quality trials[84]. The third higher-quality systematic review found epidural steroid superior to placebo injection for 'improvement in symptoms' (OR=2.2, 95% CI 1.0 to 4.7) for acute or chronic sciatica[100]. Its conclusions may be sensitive to inclusion of a trial that reported an unusually high odds ratio for short-term reduction in inpatient analgesic consumption immediately following the injection (OR=6.8, compared to 1.1 to 2.8 in the other trials)[135]. Although this trial was excluded from the Cochrane review because it allowed enrollment of patients with acute symptoms, only 10% had symptoms less than four weeks. Three lower-quality systematic reviews each found some evidence for short-term pain relief following epidural steroid injections for radiculopathy, but also at least some inconsistency between trials[71, 74, 97]. None of the systematic reviews evaluated results stratified according to use of epidural or soft tissue placebo injection.

One higher-quality trial found that if a first epidural injection was not effective, additional injections within the first six weeks were no more effective[123].

Efficacy of translaminar or caudal epidural steroid injection versus epidural placebo injection (saline or local anesthetic) for spinal stenosis

For spinal stenosis, one higher-quality trial found an epidural steroid plus local anesthetic injection or an epidural local anesthetic injection alone superior to an epidural saline injection on improved walking distance at one week, though no differences were observed after 3 months (Table 74)[106]. Two lower-quality trials that enrolled mixed populations of patients did not find beneficial effects of epidural steroids in small subgroups of patients with spinal stenosis[132, 169].

Table 74. Randomized, placebo-controlled trials of epidural steroid injection for spinal stenosis

Author, year	Sample size Type of LBP Duration of symptoms	Duration of follow-up	Main results	Quality score*
Cuckler, 1985[132]	n=73 Radiculopathy or neurogenic claudication Primarily chronic (mean duration 14 to 17 months)	13 to 30 months	**Interlaminar epidural steroid vs. epidural saline/local anesthetic injection** Average improvement: 42% vs. 44% (NS) Treatment success (>75% improvement): 25% (5/20) vs. 18% (3/17) in spinal stenosis group at 24 hours, 22% (5/23) vs. 14% (2/14) in spinal stenosis group at long-term (13 to 30 month) follow-up (NS for all comparisons) Surgery: 26% (6/23) vs. 29% (4/14) in spinal stenosis group at long-term (13 to 30 month) follow-up	5/11
Fukusaki, 1998[106]	n=53 Spinal stenosis (diagnosed by orthopedist) Subacute or chronic	3 months	**Interlaminar epidural steroid + local anesthetic vs. epidural local anesthetic alone vs. epidural saline** Walking distance: 87 vs. 92 vs. 23 at 1 week, 10 vs. 13 vs. 11 at 3 months ($p<0.05$ for A and B vs. C at week 1 only) Good results (walk >100 m): 63% vs. 56% vs. 12% at 1 week, 5% vs. 6% vs. 6% at 3 months (no difference between A and B)	6/11
Zahaar, 1991[169]	n=63 Radiculopathy or neurogenic claudication with imaging-confirmed disk prolapsed or spinal stenosis Primarily chronic (mean 14 to 17 months)	20 to 21 months	**Caudal epidural steroid vs. epidural saline injection** Success (>75% improvement) at 24 hours: 56% (10/18) vs. 50% (6/12) in spinal stenosis group Success at mean 20 to 21 months: 49% (18/37) vs. 50% (13/26) overall; 58% (11/19) vs. 64% (9/14) in herniated disc group Underwent surgery at mean 20 to 21 months: 35% (13/37) vs. 38% (10/26) overall	3/11

Efficacy of translaminar or caudal epidural steroid injection versus placebo epidural injection (saline or local anesthetic) for low back pain without sciatica or radiculopathy

For low back pain without sciatica or radiculopathy (non-specific low back pain), one small, lower-quality trial found no differences in pain or functional outcomes between epidural steroid injection versus intrathecal midazolam[852].

Efficacy of transforaminal epidural steroid injection versus placebo epidural injection for low back pain with sciatica or radiculopathy

Most placebo-controlled trials evaluated the interlaminar or caudal approach. Three higher-quality, placebo-controlled trials evaluating the transforaminal approach reported mixed results (Table 75)[145, 152, 159]. One small (n=55), higher-quality trial found that a lower proportion of patients with radicular pain randomized to transforaminal epidural steroid injection proceeded to surgery compared to those randomized to an epidural local anesthetic injection, after 1 year (29% vs. 67%)[159]. Five-year rates of surgery have also been reported from this trial, but results are difficult to interpret because 40% of the patients in the epidural steroid arm who had not

undergone surgery by 23 months were lost to follow-up[160]. Two other higher-quality trials found transforaminal epidural steroid injection to be no better on most outcomes compared to epidural saline injection through 12 months[145], or compared to epidural local anesthetic injection after 6 to 12 weeks[152] (Table 75).

Efficacy of epidural steroid injection versus local injections or dry needling of the interspinous ligament

For sciatica or radiculopathy, one higher-quality trial found no statistically significant differences between epidural steroid and trigger point injection in the proportion of patients who recovered after one month (67% vs. 56%), though the epidural steroid was superior at three months[151]. In a lower-quality trial, transforaminal and interlaminar epidural steroid injections were associated with a greater likelihood for a 'good' overall response at 3 months (68% and 53%, respectively) compared to a paravertebral local anesthetic injections (26%)[148]. However, it appeared that the paravertebral injection was meant to serve as a placebo control in this trial, and it was not clear if the local anesthetic was administered at tender points. One trial did not meet inclusion criteria because it was not randomized[208]. It found transforaminal epidural steroid injection superior to trigger point injection for the proportion of patients with a 'successful' outcome at 12 months (84% vs. 48%).

For sciatica, one small (n=74), lower-quality trial found no differences between epidural steroid injection and dry needling of the interspinous ligament in the proportion of patients improved or cured according to clinician assessment (79% or 15/19 versus 83% or 10/12)[147].

Efficacy of epidural steroid injection versus other interventions

One small (n=60), lower-quality trial found no differences between transforaminal epidural injection with steroid versus transforaminal epidural injection with hyaluronidase in patients with failed back surgery syndrome[844].

Five other recent (published since 2004) trials also compared epidural steroid injection to other interventions (Table 76)[102, 107, 115, 167, 842]. One higher-quality trial of patients with sciatica for at least six weeks found no significant difference between epidural steroid injection compared to intramuscular steroid (methylprednisolone 80 mg) plus local anesthetic injection in rates of subsequent surgery (41% vs. 31%) after two years or more[167]. Pain relief favored the epidural group at 35 days ($p<0.004$, other data not provided) but differences were no longer significant at subsequent follow-up. For large herniated disc with no improvement after at least six weeks, another higher-quality trial found epidural steroid injection moderately to substantially inferior to discectomy for most short-term (1-3 months) outcomes[842]. Differences were no longer observed for most outcomes by 2-3 years, but results are difficult to interpret because about one-third of the patients assigned to epidural steroids crossed over to surgery, and intention-to-treat results were not reported. Among patients randomized to epidural steroids that did not cross over to surgery, 42% to 56% considered their treatment a success, compared to 92% to 98% in patients allocated surgery and 82% to 93% in patients who crossed over to surgery. For chronic (more than two years duration) back pain with no response to a previous epidural steroid injection, a

third trial found epidural steroid alone substantially inferior to adhesiolysis either with or without hypertonic saline for pain relief, functional status, opioid intake, and psychiatric outcome measures[115]. Even though this trial was rated higher-quality, its results needs to be confirmed because of an unusually low response rate (defined as >50% pain relief at 12 months) in the epidural steroid group (0%) and very high response rates in the adhesiolysis groups (72% and 60%).

Two lower-quality trials not included in the systematic reviews evaluated efficacy of oxygen-ozone (O2-O3) injections. For acute or chronic low back pain with sciatica, one trial found a transforaminal epidural steroid injection inferior to transforaminal O2-O3 injection on rates of resolution of pain and return to normal activities in the subgroup of patients with a herniated or bulging disc at 6 months (58% vs. 74%), but not at earlier follow-up[102]. There were no differences between epidural steroid injection and oxygen-ozone injection in the subgroup of patients without a herniated or bulging disc. In patients with radicular pain and lumbar disc prolapse, the second trial found intradiscal plus intraforaminal epidural steroid injection inferior to intradiscal plus intraforaminal epidural steroid plus oxygen-ozone injection for achieving an ODI <20 at 6 months (47% vs. 74%, $p<0.01$), though differences were not significant at earlier follow-up[107].

Table 75. Recent trials of epidural steroid injection versus other interventions

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Bonetti, 2005[102]	n=306 6 months	**Transforaminal oxygen-ozone injection vs. transforaminal corticosteroid injection** Herniated or bulging disc group: Excellent result (resolution of pain and return to baseline activity): 85% vs. 80% (NS) at 1 week, 78% vs. 68% (p=0.13) at 3 months, and 74% vs. 58% (0.002) at 6 months Non-disc disease group: Excellent result: 80% vs. 78% (NS) at 1 week, 78% vs. 70% (p=0.25) at 3 months, and 76% vs. 63% (p=0.099)at 6 months	4/11
Buttermann, 2004[842]	n=100 3 years	**Epidural steroid versus discectomy** Motor deficit: 72% vs. 38% at 1-3 months (p<0.05), 9% vs. 4% at 2-3 years (NS) Back pain, mean score (0 to 10 VAS): 3 vs. 2 at 1-3 months (p<0.05), 1.8 vs. 2.4 at 2-3 years (NS) Leg pain, mean score (0 to 10 VAS): 4.1 vs. 1.4 at 1-3 months (p<0.05), 0.8 vs. 1.5 at 2- 3 years (NS) ODI, mean score: 34 vs. 22 at 1-3 months (p<0.05), 8 vs. 16 at 2-3 years (NS) Much less use of medication: 16% vs. 24% at 1-3 months, 57% vs. 32% at 2-3 years	5/9*
Gallucci, 2007[107]	n=159 6 months	**Transforaminal and intradiscal corticosteroid + oxygen-ozone versus corticosteroid alone** Treatment success (<20 on ODI): 88% vs. 90% (p=0.72) at 2 weeks, 78% vs. 67% (p=0.14) at 3 months, 74% vs. 47% (p<0.001) at 6 months	5/11
Manchikanti, 2004[115]	n=75 12 months	**Epidural steroid vs. adhesiolysis with hypertonic saline vs. adhesiolysis with isotonic saline** Proportion with >50% pain relief at 12 months: 0% vs. 72% vs. 60% (p<0.001) ODI score at 12 months: 32 vs. 23 vs. 24 (p<0.001) VAS pain score (0 to 10) at 12 months: 7.7 vs. 4.6 vs. 5.2 Taking opioids: 52% vs. 16% vs. 16% (p<0.001)	8/11
Wilson-MacDonald, 2005[167]	n=93 2 years or longer	**Epidural steroid versus intramuscular steroid plus local anesthetic** Proportion of patients undergoing surgery after at least 2 years: 41% vs. 31%, p=0.45	9/11

*Excludes criteria involving blinding patients and care providers, for maximum score of 9

Efficacy of different approaches for administering epidural steroids

In six trials (two rated higher-quality[101, 843]) that directly compared different methods for administering epidural steroids, no approach was clearly superior[148, 846, 847, 853]. One higher-quality trial (n=90) found the transforaminal approach superior to both the interlaminar and caudal approaches[101], but two lower-quality trials reported inconsistent results for the transforaminal versus interlaminar approaches[846, 853]. One lower-quality trial found an oblique interlaminar approach modestly superior to a standard translaminar approach[148], and another lower-quality trial found no differences between the caudal and translaminar approaches[847]. Radiologic confirmation of epidural placement with the translaminar approach was either not reported or not performed in any of these trials, and no trial compared outcomes of epidural

steroid injection with fluoroscopic guidance versus epidural steroid injection without fluoroscopic guidance.

One recent higher-quality trial compared epidural steroid via the caudal approach versus targeted steroid placement during spinal endoscopy in patients with radicular back pain for at least six months, with needle placement confirmed by fluoroscopy for both methods (Table 76)[843]. It found no difference in any outcome between the two approaches.

Table 76. Trial of epidural steroid via caudal approach versus targeted placement during spinal endoscopy

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Dashfield, 2005[843]	n=60 6 months	**Epidural steroid via caudal approach versus targeted placement during spinal endoscopy** Pain (VAS) mean improvement: -1.4 vs. -1.22 (NS) Present pain intensity, mean improvement: -0.8 vs. -1.0 (NS) Short-form McGill Pain Questionnaire (sensory), mean improvement: -2.3 vs. +0.5 (NS) Short-form McGill Pain Questionnaire (affective), mean improvement: 0 vs. 0 (NS) HAD-anxiety and -depression scales: no significant differences between groups	7/11

Harms

Although there are case reports of serious adverse events, including paralysis and infection, following epidural steroid injection[855-857], serious adverse events were rarely reported in randomized trials. However, reporting of harms was suboptimal. Ten placebo-controlled trials didn't report harms at all.[106, 126, 132, 145, 151, 158, 159, 161, 167, 169] When reported, adverse events were typically transient and minor and included headache, nausea, irregular periods, pruritus, and increased sciatic pain. A recent, large (n=228), high-quality trial reported post-injection headache in 3.3% (4/120) receiving epidural steroid, postdural puncture headache in 0.8% (1/120), nausea in 1.7% (2/120), and other adverse events in 4.2% (5/120)[123]. Serious adverse events were also uncommon in trials that evaluated the transforaminal approach[145, 148, 152, 846]. One trial reported a 1.9% incidence of headache[148], one trial reported one episode of acute hypertension[846], and another reported one retroperitoneal bleed in a patient on anticoagulation[145]. One trial found that all patients who underwent targeted placement of steroids during spinal endoscopy reported increased back pain, though no post-spinal headache, dural tap, or infection was observed[843].

Costs

One trial found no significant differences between transforaminal steroid and saline injections for cost per one response ($3,740 versus $3,629)[145]. However, a subgroup analysis suggested transforaminal steroid injection was more cost-effective for contained herniations ($4,432 versus $17,098 per responder, p=0.0073) than for extrusions ($7,165 versus $2,484, p=0.0058). Another trial estimated £44,701/QALY (about $86,273 U.S./QALY) for up to three translaminar

epidural steroid injections and £25,746 (about $49,689 U.S./QALY) for one injection from the provider perspective[123, 858]. From the purchaser perspective, incremental cost-effectiveness for one injection was £167,145 (over $300,000 U.S./QALY).

Summary of evidence

- For low back pain with sciatica, evidence of beneficial effects following epidural steroid injections by translaminar or caudal approaches is mixed. Although some higher-quality trials report short-term benefits versus placebo injection, results are inconsistent. Most trials found no longer-term benefits following epidural steroid injection, and one higher-quality trial found no additional benefits from repeated injections. Most evidence on epidural steroid injections is in patients with low back symptoms of at least one month's duration (level of evidence: fair).
- For low back pain with sciatica, evidence on efficacy of epidural steroid injection by the transforaminal approach is mixed, with two of three higher-quality trials showing no benefit compared to control injections (level of evidence: fair).
- For low back pain with sciatica, one higher-quality randomized trial found epidural steroid injection no better than trigger point injections at one month for overall outcomes, though modestly superior at three months. Other trials that compared epidural steroids and local injections were either not randomized or did not clearly inject tender points (level of evidence: fair).
- There is insufficient evidence (one lower-quality trial) to accurately judge relative efficacy of epidural steroids compared to dry-needling of the interspinous ligament (level of evidence: poor).
- For low back pain with sciatica, epidural steroid injections were not clearly superior to intramuscular steroids for long-term outcomes in one higher-quality trial (level of evidence: fair).
- For low back pain without radiculopathy, there is insufficient evidence (one lower-quality trial showing no benefit) to accurately judge efficacy of epidural steroids (level of evidence: poor).
- For spinal stenosis, one small, higher-quality trial found epidural steroids have no sustained effects on walking distance compared to a placebo injection and two small subgroup analyses found no clear benefits associated with epidural steroid injection (level of evidence: poor).
- In patients with chronic low back pain who failed a previous epidural steroid injection, one small, higher-quality trial found epidural steroid injection alone inferior to epidural adhesiolysis, but reported high rates of response in the adhesiolysis group (60% to 72%) and unusually low rates in the epidural arm (0%) (level of evidence: poor).
- For lumbar disc prolapse, one trial found epidural steroids superior to discectomy for short-term but not longer-term outcomes, but results are difficult to interpret because crossover rates were high and intention-to-treat results not reported (level of evidence: poor).
- For low back pain with sciatica, two lower-quality trials found transforaminal epidural steroid injections inferior to tranforaminal oxygen-ozone injections in patients with bulging or herniated disc for resolution of pain and improvement in function at 6 months, but not at earlier

assessments. One of the trials also evaluated intradiscal injections of steroids with and without oxygen-ozone (level of evidence: poor)

- Six trials (two higher-quality) that directly compared different approaches for administration of epidural steroids found inconsistent results, or no clear differences (level of evidence: poor).
- One higher-quality trial found no differences between caudal epidural steroid and targeted steroid placement during spinal endoscopy, with needle placement for both methods confirmed by fluoroscopy (level of evidence: fair).
- Serious adverse events were rare in trials of epidural steroid injections, but adverse events were generally not well reported (level of evidence: poor).

Recommendations and findings from other guidelines

- The AHCPR guidelines found no evidence to support the use of invasive epidural injections of steroids, local anesthetics, and/or opioids as a treatment for acute low back pain without radiculopathy (strength of evidence: D).
- The AHCPR guidelines recommend epidural steroids as an option for short-term relief of radicular pain after failure of conservative treatment and as a means of avoiding surgery (strength of evidence: C).
- The VA/DoD guidelines found limited evidence to support the use of epidural steroid injections for acute low back pain with nerve root pain and radicular neurologic deficit (strength of evidence: C).
- The UK RCGP guidelines found that epidural steroids with or without local anesthetic appear to produce better short-term relief of acute low back pain with sciatica than comparison treatments (strength of evidence: **).
- The UK RCGP guidelines found limited evidence that epidural injections are not beneficial for acute low back pain without radiculopathy (strength of evidence: *).
- The UK RCGP guidelines found that because of its invasive nature, epidural injections pose rare but serious potential risks (strength of evidence: **).
- The European COST guidelines recommend against epidural steroid injections for acute nonspecific low back pain and found insufficient evidence to recommend epidural injections for chronic, nonspecific low back pain.

Facet joint injection and medial branch block

Facet joint injections involve administration of corticosteroids into the facet joints in order to reduce pain and inflammation. The epidural space is not entered. Nerve blocks of the medial branch of the posterior primary ramus (medial branch blocks) are primarily used as a diagnostic procedure to identify patients with facet joint pain. However, some trials have also evaluated clinical or therapeutic effects of medial branch blocks.

Results of search: systematic reviews
We identified one higher-quality Cochrane review on efficacy of facet joint injections for chronic low back pain[94]. We also identified three lower-quality systematic reviews[75, 92, 93]. We excluded three systematic reviews that have already been updated[86, 171, 187].

Results of search: trials
Eight randomized trials evaluated facet joint injection or medial branch block.[116, 129, 150, 859-864] Seven were included in at least one of four systematic reviews[75, 92-94] and we identified one additional trial.[116] Two trials (both evaluating facet joint injection) were placebo-controlled.[129, 150] We excluded one trial that focused on the utility of bone scintigraphy for guiding facet joint injections [206].

Efficacy of facet joint steroid injection versus control (saline) facet joint injection

A higher-quality trial (n=101) by Carette et al enrolled patients with chronic low back pain who responded to a single local anesthetic injection into the facet joint with immediate pain relief (Table 77)[129]. It found no difference in the likelihood of pain relief in patients randomized to steroid or saline either one month or three months after the injection (RR=0.89, 95% CI 0.65 to 1.21 and RR=0.90, 95% CI 0.69 to 1.17, respectively). Although a higher proportion of patients in the corticosteroid injection group experienced marked or very marked improvement after six months (46% vs. 15%, p=0.002), the biologic rationale for such a delayed (after three months) benefit from steroids is unclear. In addition, differences at six months were attenuated after controlling for the increased use of co-interventions in the steroid group. The difference in the proportion of patients that experienced *sustained* improvement (improvement at one, three, *and* six months) was not statistically significant (22% vs. 10%, p=0.19); half of the 22 patients with improvement at 6 months did not show benefits at earlier time periods. A second, lower-quality trial found no difference in mean pain scores between facet joint intracapsular or pericapsular steroid and bupivacaine injection compared to saline injection[150, 860]. In this trial, patients were enrolled based on clinical criteria, and did not require a positive response to diagnostic facet joint blocks.

Table 77. Randomized, placebo-controlled trials of facet joint steroid injection

Author, year	Sample size Type of LBP Duration of symptoms	Duration of follow-up	Main results	Quality score*
Carette, 1991[129]	n=101 Presumed facet joint pain with positive response to uncontrolled facet joint block Chronic	6 months	**Facet joint intra-articular steroid vs. saline injection** Very marked or marked improvement: 42% vs. 33% at 1 month (p=0.53), 36% vs. 28% at 3 months (p=0.51), 46% vs. 15% at 6 months (p=0.002) Sustained improvement through 6 months: 22% vs. 10%, p=0.19 Mean VAS pain score (0 to 10): 4.5 vs. 4.7 at 1 month (NS), 4.0 vs. 5.0 at 6 months (p<0.05) McGill Pain Questionnaire (0 to 5): 2.3 vs. 2.6 at 1 month (NS), 2.1 vs. 2.9 at 6 months (p<0.05) Sickness Impact Profile Overall score (0 to 100): 9.3 vs. 9.8 at 1 month (NS), 7.8 vs. 10.8 at 6 months (NS) Mean days with complete restriction in main activity in last 2 weeks: 3.2 vs. 2.2 at 1 month (p=0.22), 1.3 vs. 2.9 at 6 months (p=0.07)	7/11
Lilius, 1989[150, 860]	n=109 Presumed facet joint pain without diagnostic facet joint block Chronic	3 months	**Facet joint intra-articular steroid vs. peri-capsular steroid vs. intra-articular saline** Return to work: No differences (data not reported) Pain score: No differences (data not reported) Pain improvement (categorical): No differences (data not reported)	4/11

A higher-quality Cochrane review[94] and two[92, 93] and two of three lower-quality systematic reviews also found no clear benefits associated with facet joint steroid versus placebo injection. A third lower-quality systematic review found moderate evidence that facet joint injections are associated with short-term improvement[75]. Reasons for the discrepancy in this review's conclusions include its exclusion of the trial by Lilius et al because it did not use diagnostic facet joint blocks to select patients[150, 860], its classification of the trial by Carette et al as showing benefits of facet joint injection[129], its classification of an active-controlled trial as demonstrating efficacy of facet joint injection because both intervention groups improved compared to baseline[859], and its inclusion of evidence from several small (N<100), non-randomized studies.

Efficacy of medial branch block versus placebo

We found no trials comparing therapeutic medial branch block versus placebo.

Efficacy of facet joint injection versus medial branch block

One higher-quality trial found no difference in pain relief one to three months after a facet joint injection with a steroid and local anesthetic compared to medial branch block of the posterior primary ramus with a steroid and local anesthetic[863]. A second, lower-quality trial not included in any previously published systematic review reported no benefit with either facet joint injection

with local anesthetic plus steroid or medial branch block with local anesthetic only, but outcomes were reported using unconventional and difficult to interpret methods (paired sequential analysis) (Table 78)[116].

Table 78. Additional trial not included in previously published systematic reviews of facet joint vs. medial branch nerve block

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Nash, 1989[116]	n=67 1 month	**Facet joint injection vs. medial branch nerve block** Overall outcome: No difference between groups based on paired sequential analysis (12 pairs nerve blockade more beneficial, 11 pairs intra-articular injection more beneficial, no results for 8 pairs)	2/11

Efficacy of facet joint injection plus home stretching versus home stretching alone

For patients with presumed lumbar segmental rigidity, one lower-quality trial found bilateral lumbar facet joint corticosteroid injection plus a home stretching program to be no more effective than stretching alone for pain or function[864].

Efficacy of different types of facet joint injection

For non-radicular back pain and at least moderate facet joint osteoarthritis on imaging (facet joint blocks not performed), one higher-quality trial[859] included in one systematic review[75] found no clear differences in pain, back-specific functional status, or other outcomes between facet joint injection with a steroid versus facet joint injection with hyaluronic acid (Table 79). All patients received facet joint injections bilaterally at the L3-L4, L4-L5, and L5-S1 levels.

Table 79. Facet joint injection with steroid vs. facet joint injection with hyaluronic acid

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Fuchs, 2005[859]	n=60 6 months	**Facet joint injection with steroid vs. facet joint injection with hyaluronic acid** **(mean improvement from baseline)** Pain (0 to 100 scale): -35.3 vs. -31.2 (hyaluronic acid non-inferior) RDQ (0 to 24 scale): -4.2 vs. -5.4 (p not reported) ODI (0 to 50 scale): -5.4 vs. -8.1 (p not reported) Low Back Outcome Score (0 to 75 scale): +11.4 vs. +14.1 (p not reported) SF-36: similar in both groups	6/11

Efficacy of different types of medial branch blocks

One small (n=73), higher-quality trial found no differences in outcomes become a medial branch block with a local anesthetic, Sarapin (a substance derived from the pitcher plant), and methylprednisolone versus the same intervention without the methylprednisolone[862]. A small (n=60) trial compared nerve block injection with bupivicaine alone, bupivicaine plus steroid,

bupivicaine plus sarapin, or bupivicaine plus sarapin and steroid. Response rates ranged from 73% to 93% at 3 to 12 months[861].

Harms
No adverse events other than transient local pain at the injection sites were reported in the lone higher quality trial[129].

Costs
We found no studies evaluating costs.

Summary of evidence

- There is no evidence on efficacy of facet joint injections or medial branch blocks for acute low back pain.
- For presumed chronic facet joint pain, two randomized trials found facet joint steroid injection no more beneficial than facet joint control injections for short-term pain relief or sustained pain relief (level of evidence: fair).
- There is no evidence on efficacy of medial branch block versus placebo injection for chronic low back pain.
- For presumed chronic facet joint pain, two trials (one higher-quality) found no difference between facet joint steroid injection and medial branch block with or without steroid (level of evidence: fair).
- For patients with presumed lumbar segmental rigidity, one lower-quality trial found no differences between bilateral facet joint corticosteroid injections plus stretching versus stretching alone (level of evidence: poor).
- For chronic non-radicular back pain with radiographic findings of at least moderate facet joint osteoarthritis, facet joint steroid injection and facet joint hyaluronic acid injection were associated with similar outcomes in one higher-quality trial (level of evidence: fair).
- For presumed chronic facet joint pain, there is insufficient published evidence (one small, higher-quality trial and one unpublished trial) to evaluate efficacy of medial branch blocks with local anesthetic plus Sarapin, with or without corticosteroid (level of evidence: poor).

Recommendations and findings from other guidelines

- The AHCPR guidelines recommend against facet joint injections in patients with acute low back problems (strength of evidence: C).
- The VA/DoD guideline recommendation is similar.
- The UK RCGP guidelines found that facet joint injection do not produce pain relief or global improvement, with neither the type of agent injected nor the site of injection making a significant difference to outcomes (strength of evidence: *).
- The UK RCGP guidelines also found no evidence on the efficacy of facet injections in acute low back problems (strength of evidence: *).

Sacroiliac joint steroid injection

Sacroiliac joint injections with corticosteroids are intended to decrease pain and inflammation in the sacroiliac joint when it is the presumed source of low back pain. However, diagnosis and treatment of sacroiliac joint pain in patients without spondyloarthropathy remains controversial (see Key Question 6).

Results of search: systematic reviews
We identified one higher-quality systematic review on sacroiliac joint injections[83]. We excluded an earlier version of this review[186].

Results of search: trials
We identified one higher-quality randomized trial of patients with presumed sacroiliac pain not due to spondyloarthropathy[114]. It evaluated a periarticular sacroiliac steroid injection and was excluded from the previously published systematic review. We excluded one small (n=10) randomized trial of sacroiliac joint injection that was included in the previously published systematic review because it enrolled patients with spondyloarthropathy[205].

Efficacy of sacroiliac joint injection versus control injection

For chronic pain in the sacroiliac joint area and at least one physical exam finding for sacroiliac joint pain, one small (n=24), higher-quality trial found a periarticular sacroiliac steroid injection substantially superior to control (local anesthetic) injection for improvement in one-month pain scores (Table 80)[114].

Table 80. Randomized, placebo-controlled trial of sacroiliac joint injection for suspected sacroiliac joint pain

Author, year	Sample size Type of LBP Duration of symptoms	Duration of follow-up	Main results	Quality score*
Luukainen, 2002[114]	n=24 Sacroiliac joint pain without spondyloarthropathy Chronic	1 month	**Periarticular sacroiliac joint steroid injection vs. control injection** VAS (0 to 100), improvement in median scores: -40 vs. -13, p=0.046 Pain index (0 to 12), improvement in median scores: -3 vs. 0, p=0.017	6/11

Harms
No adverse events were reported in the trial.

Costs
We found no studies evaluating costs.

Summary of evidence

- In patients thought to have sacroiliac pain not related to spondyloarthropathy, one higher-quality but very small (n=24) trial found sacroiliac joint steroid injection substantially superior to local anesthetic injection for short-term pain relief (level of evidence: poor).

Recommendations and findings from other guidelines

- The European COST guidelines found insufficient evidence to recommend the use of corticosteroid injections for nonspecific chronic low back pain.

Intradiscal steroid injections

Intradiscal steroid injections differ from epidural steroid injections because they involve direct injection of steroids into the intervertebral disc, rather than into the epidural space. They have been performed for presumed chronic discogenic low back pain and lumbar disc prolapse with sciatica or radiculopathy.

Results of search: systematic reviews
We identified a higher-quality Cochrane review on intradiscal steroid injections for low back pain[81, 82]. We excluded two outdated versions of this review[176, 177].

Results of search: trials
Six randomized trials evaluated intradiscal steroid injection[104, 109, 112, 119, 865, 866]. Two trials were included in the Cochrane review[81, 82] and we identified four additional trials[104, 109, 112, 119, 867]. Three trials were placebo-controlled[104, 112, 119]. All three placebo-controlled trials evaluated intradiscal steroid injection for degenerative disc disease.

Efficacy of intradiscal steroid versus control or no injection for presumed discogenic low back pain

For chronic low back pain with MRI evidence of degenerative disc disease and positive results on provocative discography, two trials (one higher-quality[119]) found no significant differences between intradiscal steroid and control injections (saline or local anesthetic) for either short- or long-term pain relief or improvement in functional status (Table 81)[112, 119]. In the trial that reported longer-term outcomes, the median pain score was unchanged in both groups at one year[112]. A third, lower-quality trial found that in patients with degenerative disc disease who failed an epidural steroid injection, intradiscal steroid injection was superior to discography only in the subgroup of patients with inflammatory endplate changes on MRI[104]. However, changes in outcome scores and levels of statistical significance were poorly reported in this study. At 1 to 2 years, rates of 'success' (not clearly defined) in the subgroup with inflammatory endplate changes were 25% in patients randomized to discography plus intradiscal steroid, and 0% in the group randomized to discography alone. The proportion of patients who subsequently underwent fusion in this subgroup was 50% among those randomized to intradiscal steroid compared to 76% among those randomized to discography alone. Intradiscal steroid injection was also superior for functional status (ODI), though not for pain scores.

Table 81. Randomized, placebo-controlled trials of intradiscal steroids

Author, year	Sample size Type of LBP Duration of symptoms	Duration of follow-up	Main results	Quality score*
Buttermann, 2004[104]	n=171 Presumed discogenic back pain Chronic	1-2 years	**Discography + intradiscal steroid vs. discography alone (estimated from graphs)** Inflammatory end-plate changes present: Pain, mean improvement in VAS (0 to 10): -0.3 vs. +0.6 ODI (0 to 100), mean improvement: -18 vs. +9 "Success" (not defined): 10/40 (25%) vs. 0/38 (0%) Underwent fusion: 50% vs. 76% No inflammatory end-plate changes present: Pain, mean improvement in VAS: -1.2 vs. +0.6 ODI (0 to 100), mean improvement: -1 vs. -1 "Success" (not defined): 5/46 (11%) vs. 1/47 (2%) Underwent fusion: 78% vs. 89% Much less use of medication: 16% vs. 24% at 1-3 months, 57% vs. 32% at 2-3 years	5/11
Khot, 2004[112]	n=120 Presumed discogenic back pain At least subacute	1 year	**Intradiscal methylprednisolone vs. intradiscal saline** ODI, mean improvement (percent): 2.28 vs. 3.42 (p=0.71) VAS pain score (0 to 10), median change: 0 vs. 0 (p=0.72)	4/11
Simmons, 1992[119]	n=25 Presumed discogenic back pain At least subacute	10-14 days	**Intradiscal methylprednisolone vs. intradiscal bupivicaine** Proportion improved overall: 3/14 (21%) vs. 1/11 (9%) (NS) Proportion improved on VAS pain scale: 43% vs. 36% (NS) Proportion improved on ODI: 36% vs. 27% (NS)	6/11

Efficacy of intradiscal steroid versus chemonucleolysis for low back pain with sciatica or radiculopathy

In patients with sciatica, two French-language trials[865, 866] (one higher-quality[865]) included in the Cochrane review found no differences between intradiscal steroid injection and chemonucleolysis for risk of failure or no improvement (OR=1.20, 95% CI 0.61 to 2.38). For chronic back pain and sciatica unresponsive to non-invasive therapy, a lower-quality trial also reported similar rates of "success" (defined as the proportion "virtually pain-free") with intradiscal steroids and chemonucleolysis (Table 82)[109].

Table 82. Trial of intradiscal steroid versus chemonucleolysis not included in previously published systematic review

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Graham, 1975[109, 867]	n=40 Duration of follow-up unclear	**Intradiscal steroids vs. chemonucleolysis** "Success" (proportion virtually pain-free): 45% vs. 45%	4/11

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- For presumed chronic discogenic low back pain (positive results on provocative discography), there is consistent evidence from three trials (one higher-quality) that intradiscal steroids are not associated with improved outcomes compared to control injections (level of evidence: good).
- For presumed chronic discogenic low back pain, a subgroup analysis from one lower-quality trial found intradiscal steroids superior to discography alone in a selected subgroup of patients that failed epidural steroid injections and had inflammatory endplate changes on MRI (level of evidence: poor).
- For prolapsed lumbar disc or sciatica, three trials (one higher-quality) consistently found no differences between intradiscal steroid injection and chemonucleolysis (level of evidence: good).
- None of the trials reported safety outcomes.

Recommendations and findings from other guidelines

- The European COST guidelines recommend against intradiscal steroids for chronic low back pain.

Chemonucleolysis

Chemonucleolysis involves the injection of a proteolytic enzyme into an intervertebral disc in order to break down the gelatinous nucleus. The goal of chemonucleolysis is to reduce disc size and relieve pressure on compressed nerve roots. Chemonucleolysis has most frequently been studied using chymopapain (derived from papaya) injections, though collagenase (which may be less likely to induce an allergic reaction) has also been used. Chemonucleolysis is practiced infrequently in the U.S.

Results of search: systematic reviews
We identified one higher-quality Cochrane review of surgery for lumbar disc prolapse that included trials of chemonucleolysis[81, 82]. We excluded two outdated Cochrane reviews[176, 177] and two other outdated systematic reviews[190, 191].

Results of search: trials
22 randomized trials evaluated chemonucleolysis[110, 122, 127, 133, 136, 144, 162, 366, 865, 866, 868-878]. Nineteen trials were included in the Cochrane review[81, 82] and we identified three additional trials[110, 122, 366]. One compared chemonucleolysis to spinal manipulation[366], one compared long-term outcomes of chemonucleolysis with chymopapain versus chemonucleolysis with collagenase[122], and one compared transforaminal posterolateral endoscopic discectomy plus low-dose chymopapain versus transforaminal posterolateral endoscopic discectomy alone[110]. Six of the 22 trials were placebo-controlled.[127, 133, 136, 144, 162, 871] We rated the four of the five English-language placebo-controlled trials higher-quality[127, 133, 144, 162]. A sixth, small (n=39) French-language placebo-controlled trial was included in the Cochrane review[871].

Efficacy of chemonucleolysis versus placebo for lumbar disc prolapse with radiculopathy

For lumbar disc prolapse, three[133, 136, 144] of four[162] English-language trials found chymopapain chemonucleolysis superior to placebo for achieving treatment success (variably defined) (Table 83). A fifth trial found collagenase chemonucleolysis superior to placebo, but 40% of patients in this trial were no longer blinded after 8 weeks[127]. Based on pooled results, a higher-quality Cochrane review that also included a French-language trial[871] found chymopapain chemonucleolysis associated with a lower-likelihood for a poor patient-reported overall outcome ("no success") compared to placebo after one year (OR=0.24, 95% CI 0.12 to 0.49, 2 trials), and lower likelihood of open discectomy within 6 to 24 months (OR=0.41, 95% CI 0.25 to 0.68, 5 trials)[81, 82]. A total of 446 patients enrolled in 5 trials were included in the pooled results of subsequent surgery rates[133, 136, 144, 162, 871].

Table 83. Randomized, placebo-controlled trials of chemonucleolysis

Author, year	Sample size Type of LBP Duration of symptoms	Duration of follow-up	Main results	Quality score*
Bromley, 1984[127]	n=30 Radiculopathy Duration not reported	10 to 24 months	**Chemonucleolysis with collagenase vs. intradiscal saline** Pain improvement "good" or "fair" (patient rated): 80% (12/15) vs. 33% (5/15) at 8 weeks, p<0.005 Pain improvement "good" or "fair" (clinician rated): 80% (12/15) vs. 33% (5/15) at 8 weeks, p<0.005; 80% (12/15) vs. 20% (3/15) at mean 16.8 months (p<<0.005)	8/11
Dabezies, 1988[133]	n=173 Radiculopathy with image-confirmed disk prolapse Duration not reported	6 months	**Chemonucleolysis with chymopapain vs. intradiscal placebo (cysteine-edetate-iothalamate)** Overall outcome moderately improved or pain-free (investigator-rated, lost to follow-up excluded): 73% (56/74) vs. 52% (42/81) at 6 weeks (p=0.01), 72% (46/64) vs. 49% (37/76) at 3 months, p=0.01, 71% (44/62) vs. 45% (33/74) at 6+ months (p=0.01) Treatment success (lost to follow-up considered failure): 72% (56/78) vs. 52% (42/81) at 6 weeks, 59% (46/78 vs. 46% (37/81) at 3 months, 56% (44/78) vs. 41% (33/81) at 6 months Subsequent surgery: 4% (7/78) vs. 25% (20/81)	7/11
Fraser, 1982[136, 137]	n=60 Radiculopathy Primarily non-chronic	6 months through 10 years	**Chemonucleolysis with chymopapain vs. intradiscal saline** Treatment success (patient-rated): 73% vs. 37% at 6 weeks (p=0.004), 80% vs. 57% at 6 months (p=0.047), 73% vs. 47% at 2 years (p<0.05), 80% (24/30) vs. 34% (9/26) at 10 years (p=0.0006) Sciatica moderately improved or pain-free (patient-rated): 83% vs. 50% at 6 weeks (NS), 83% vs. 60% at 6 months (p=0.038), 77% vs. 47% at 2 years (p<0.05), 77% (23/30) vs. 38% (10/26) at 10 years (p=0.0004) Back pain moderate improved or pain-free (patient-rated): 70% vs. 53% at 6 weeks (NS), 77% vs. 50% at 6 months (p=0.23), 73% vs. 43% at 2 years (p<0.05), 77% (23/30) vs. 38% (10/26) at 10 years (p=0.004) Sciatica moderately improved or pain-free (investigator-assessed): 77% vs. 53% at 6 months (p=0.052), 77% vs. 47% at 2 years (p<0.05), 77% (23/30) vs. 38% (10/26) at 10 years Subsequent surgery: 17% (5/30) vs. 37% (11/30) at 6 months, 20% (6/30) vs. 40% (12/30) at 2 years, 20% (6/30) vs. 47% (14/30) at 10 years	5/11

Table 83. Randomized, placebo-controlled trials of chemonucleolysis

Author, year	Sample size Type of LBP Duration of symptoms	Duration of follow-up	Main results	Quality score*
Javid, 1983[144]	n=108 Radiculopathy Duration not reported	6 weeks	**Chemonucleolysis with chymopapain vs. intradiscal saline** Success (composite outcome): 75% (41/55) vs. 45% (24/53) at 6 weeks, p=0.003 Overall response at least "fair" (patient rated): 85% (47/55) vs. 55% (29/53) at 6 weeks, p<0.001 Overall response at least "fair" (physician rated: 80% (44/55) vs. 47% (25/53) at 6 weeks, p<0.001	9/11
Schwestschenau, 1976[162]	n=68 Radiculopathy Mixed duration	Mean 20 to 25 weeks	**Chemonucleolysis with chymopapain vs. intradiscal saline** Overall outcome good or excellent: 29% (9/31) vs. 31% (11/35) at mean 20 to 25 weeks follow-up (p=0.21), 29% (9/31) vs. 37% (13/35) at 1 year Returned to full activity within 3 months: 29% (9/31) vs. 26% (9/35) Surgery rate: 32% (10/31) vs. 46% (16/35) at 1 year	6/11

Efficacy of chemonucleolysis versus standard discectomy for lumbar disc prolapse with radiculopathy

The Cochrane review[81, 82] included five lower-quality trials (total number of subjects 680) of chymopapain chemonucleolysis versus standard surgical discectomy[869, 870, 874, 875, 878]. It found consistent trends towards poorer results with chemonucleolysis, though most differences did not reach statistical significance. In addition, some between-study heterogeneity was present, and outcomes were inconsistently reported. At one year, patient randomized to chemonucleolysis were more likely to report overall outcomes as “unchanged” or “worse” compared to those randomized to placebo (2 trials, OR=1.64, 95% CI 0.81 to 3.33), and surgeons were also more likely to rate outcomes as “poor” (3 trials, OR=2.70, 95% CI 0.95 to 7.69). Chemonucleolysis was associated with a much higher rate of subsequent surgery compared to the rate of repeat surgery in patients who underwent initial discectomy (4 trials, OR=14.29, 95% CI 5.56 to 50). About 30% of patients who received chemonucleolysis subsequently underwent lumbar disc surgery within two years.

Efficacy of chemonucleolysis versus other interventions for lumbar disc prolapse with radiculopathy

One lower-quality trial not included in the Cochrane review found no significant differences after one year between patients randomized to chymopapain chemonucleolysis or spinal manipulation, though short-term outcomes (through six weeks) favored manipulation (Table 84)[103].

Table 84. Trial of chemonucleolysis versus spinal manipulation

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Burton, 2000[103]	n=40 1 year	**Chemonucleolysis vs. spinal manipulation (mean improvement from baseline at 12 months)** Leg pain (0 to 10): -1.38 vs. -1.87 (NS) Back pain (0 to 10): -1.18 vs. -1.52 (NS) RDQ score: -4.68 vs. -6.03 (NS)	3/9

* Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Three lower-quality trials that compared chemonucleolysis and intradiscal steroid injections are reviewed in the section on intradiscal steroids[109, 865, 866]. None reported any differences between interventions.

Efficacy of chemonucleolysis versus automated percutaneous discectomy, endoscopic discectomy, or microdiscectomy for lumbar disc prolapse with radiculopathy

One lower-quality trial included in the Cochrane review found chemonucleolysis associated with a greater likelihood of success at one year compared to automated percutaneous discectomy (OR=2.26, 95% CI 1.17 to 4.37)[876]. Another small (n=22), lower-quality trial included in the Cochrane review found no clear differences between chymopapain chemonucleolysis and automated percutaneous discectomy on ODI scores and neurologic symptoms, though outcomes were poorly reported[873].

Efficacy of low-dose chymopapain chemonucleolysis plus endoscopic discectomy versus endoscopic discectomy alone for lumbar disc prolapse with radiculopathy

A lower-quality trial not included in the Cochrane review found no clear differences between low-dose chymopapain chemonucleolysis plus endoscopic discectomy versus endoscopic discectomy alone through two years of follow-up, except for a slightly lower rate of recurrent herniation with combination therapy (6.9% vs. 1.6%, p=0.045)[110]. Pain and McNab scores were similar in the two groups.

Table 85. Trial of chemonucleolysis plus endoscopic discectomy versus endoscopic discectomy alone

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Hoogland, 2006[110]	n=280 2 years	**Low-dose chymopapain chemonucleolysis plus transforaminal posterolateral endoscopic discectomy vs. endoscopic discectomy alone** (mean improvement from baseline) Leg pain (0 to 10 scale): 6.4 vs. 6.3 at 1 year, 6.37 vs. 6.03 at 2 years Back pain: (0 to 10 scale): 5.7 vs. 5.7 at 1 year, 5.35 vs. 5.6 after 2 years McNab result 'excellent': 62.7% vs. 50.8% McNab 'excellent' or 'good': 89.9% vs. 84.6% Recurrent herniation: 1.6% vs. 6.9% (p=0.045) in first year after surgery	3/11

Efficacy of different chemonucleolysis methods

One trial included in the Cochrane review found no differences between low- and standard dose chymopapain chemonucleolysis[868]. Another trial found no differences between chemonucleolysis with chymopapain versus chemonucleolysis with collagenase[872]. One lower-quality trial not included in the Cochrane review evaluated long-term (five year) outcomes following chemonucleolysis with chymopapain or collagenase[122]. It found a greater proportion of "good" or "excellent" results in the chymopapain group (72% vs. 52%) using the McNab criteria, with much of this difference due to the proportion of patients proceeding to surgery (18% vs. 28%), who were considered failures (Table 86). However, improvements in pain scores were similar in the two groups (-7.8 vs. -7.7 on a 10 point scale).

Table 86. Additional trial not included in Cochrane review on efficacy of chemonucleolysis with chymopapain versus collagenase

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Wittenberg, 2001[122]	n=66 5 years	**Chemonucleolysis with chymopapain vs. collagenase** "Good" or "excellent" result at 5 years (with patients requiring surgery considered poor results): 72% vs. 52% Leg pain score, mean improvement (0 to 10 scale): -7.6 vs. -7.7 Required surgery: 18% vs. 28%	4/11

Harms

Earlier trials reported allergic reactions (including anaphylaxis) in 1.5% to 2% of patients who received chymopapain chemonucleolysis[127, 879, 880]. Estimates of allergic reactions may vary depending on how allergic reactions are assessed and defined and may be decreased by use of a lower test dose first. A more recent trial reported 12% of patients in the chymopapain arm experienced allergic reactions (flushing and itching), including one case of slight anaphylaxis[122].

Rare serious complications that have been reported following chemonucleolysis include lumbar subarachnoid hemorrhage and paraplegia[881, 882].

Costs
We identified two studies of costs associated with chemonucleolysis but excluded them because they used unreliable cost and outcomes data from a single observational study[883, 884].

Summary of evidence

- For prolapsed lumbar disc with radiculopathy, chemonucleolysis with chymopapain was moderately superior to placebo in five trials (four higher-quality) (level of evidence: good).
- There is insufficient evidence to accurately judge efficacy of chemonucleolysis with collagenase compared to placebo (one lower-quality trial) (level of evidence: poor).
- For prolapsed lumbar disc with radiculopathy, chemonucleolysis was consistently associated with trends towards worse outcomes compared to standard discectomy in five lower-quality trials, with about 30% of patients who underwent chemonucleolysis going on to discectomy (level of evidence: fair).
- For prolapsed lumbar disc with radiculopathy, chemonucleolysis with chymopapain and intradiscal steroid injections were consistently associated with similar outcomes in three lower-quality trials (level of evidence: fair).
- One lower-quality trial found no differences between chemonucleolysis with chymopapain and spinal manipulation after one year, though manipulation was superior at short-term (through 6 weeks) follow-up (level of evidence: poor).
- For prolapsed lumbar disc with radiculopathy, two lower-quality trials found inconsistent evidence on efficacy of chymopapin chemonucleolysis versus automated percutaneous discectomy, with one trial finding chemonucleolysis superior and the other finding no differences in functional status scores or rates of neurologic deficits (level of evidence: poor).
- One lower-quality trial found low-dose chymopapain chemonucleolysis plus transforaminal posterolateral endoscopic discectomy associated with a slightly lower rate of recurrent herniation compared to endoscopic discectomy alone, but there were no differences on other outcomes (level of evidence: poor).
- Chymopapain and collagenase chemonucleolysis were associated with similar pain outcomes in two lower-quality trials (one with five year follow-up), but chymopapain was associated with a trend towards reduced rate of subsequent surgery in one of the trials (level of evidence: fair).
- Chemonucleolysis with chymopapain is associated with allergic reactions in up to 12% of patients, though reporting of allergic reactions in trials was suboptimal. Serious complications (including anaphylaxis) with chymopapain appear uncommon and may be reduced by using lower or test doses or using collagenase (level of evidence: poor).

Recommendations and findings of other guidelines

- The AHCPR guidelines recommend chymopapain as an acceptable treatment for patients with a herniated disc, severe, disabling sciatica, evidence of nerve root compromise, and persistence after at least one month of therapy, though it is less efficacious than standard or microdiscectomy. Testing patients for chymopapain allergic sensitivity could reduce the incidence of anaphylaxis (strength of evidence: C).

Radiofrequency denervation, intradiscal electrothermal therapy (IDET), and related procedures

Radiofrequency denervation

Radiofrequency denervation is the destruction of nerves using heat generated by a radiofrequency current. It involves the placement of a catheter or electrode near or in the target nerve. Once the position of the catheter is confirmed by fluoroscopy, a radiofrequency current is applied in order to heat and coagulate adjacent tissues, including the target nerve. Radiofrequency denervation has been evaluated for treatment of presumed facet joint pain (target nerve medial branch of the primary dorsal ramus), presumed discogenic back pain (ramus communicans), and radicular back pain (dorsal root ganglia).

Results of search: systematic reviews
We identified a higher-quality Cochrane review (seven trials, six rated higher-quality) on efficacy of radiofrequency denervation for chronic low back pain[90, 91]. We also identified four other systematic reviews[75, 78, 92, 93]. One was rated higher-quality[78]. We excluded two earlier versions[171, 185] of one of the systematic reviews[75] and one other systematic review because it focused on technical aspects and did not evaluate efficacy[180].

Results of search: trials
Nine randomized trials evaluated radiofrequency denervation[108, 117, 118, 120, 121, 139, 149, 166, 885]. Four trials were included in at least one of five systematic reviews[75, 78, 90-93] and we identified five additional trials[108, 117, 118, 120, 121]. Eight of nine trials were placebo-controlled[108, 117, 118, 120, 121, 139, 149, 166].

Efficacy of radiofrequency denervation of the medial branch of the primary dorsal ramus versus sham or placebo for facet joint pain

For presumed facet joint pain, six placebo-controlled trials of radiofrequency denervation are difficult to interpret (Table 87)[117, 120, 121, 139, 149, 166]. The only trial (n=40) to use controlled facet joint blocks to select patients and an ablation technique believed to be optimal[180] found radiofrequency denervation superior to sham treatment by -1.4 to -1.6 points (0 to 10 VAS scale) for improvement in generalized, back, and leg pain after 6 months, but the difference was not statistically significant for back pain (the main symptom thought to be associated with facet pain)[117]. In addition, baseline pain scores in the radiofrequency denervation group averaged 1.6 points higher ($p<0.05$ for differences) than in the sham group, which suggests unsuccessful randomization and could be associated with regression to the mean or differential potential for improvement. Furthermore, final pain scores in both groups were identical. Three other trials

met criteria to be classified as higher-quality but used uncontrolled diagnostic facet joint blocks to select patients, may have used suboptimal techniques[180, 886, 887], and reported conflicting results[121, 149, 166]. One trial (n=30) found radiofrequency denervation associated with moderately greater improvement in mean VAS pain (-2.4 vs. -0.4 on a 0 to 10 scale, $p<0.05$) and ODI scores (-11.1 vs. +1.7, $p<0.05$) versus sham through 2 months[166]. Radiofrequency denervation was also associated with greater likelihood of experiencing at least a 2 point reduction in VAS pain score and greater than 50 percent improvement in global effect at 8 weeks (67% vs. 37.5%, $p=0.003$) and 12 months (46.7% vs. 12.5%, $p=0.02$). The second trial (n=70) found radiofrequency denervation superior to sham treatment for mean improvement in RDQ scores at four weeks (-8.4 vs. -2.2, $p=0.05$), but there were no statistically significant differences in ODI or VAS pain scores[149]. At twelve weeks, the difference in RDQ scores was no longer present. The third trial (n=82) found no differences between radiofrequency and sham intervention on any outcome[121].

Table 87. Randomized, sham-controlled trials of radiofrequency denervation for presumed facet joint pain

Author, year	Sample size Type of LBP Duration of symptoms	Duration of follow-up	Main results	Quality score*
Gallagher, 1994[139]	n=41 Presumed facet joint pain with positive uncontrolled facet joint block Chronic	6 months	**Radiofrequency denervation vs. sham denervation** Unable to interpret changes in VAS pain scores and McGill Pain Questionnaire, no intention-to-treat analysis and baseline differences in pain scores	3/11
Leclaire, 2001[149]	n=70 Presumed facet joint pain with positive uncontrolled facet joint block Chronic	3 months	**Radiofrequency denervation vs. sham denervation (mean difference in change from baseline, positive values favor radiofrequency denervation)** RDQ (transformed to 0 to 100 scale): 6.2 (CI, -1.3 to 13.8, p=0.05) at 4 weeks, 2.6 (CI, -6.2 to 11.4) at 12 weeks ODI (0 to 100): 0.6 (CI, -4.5 to 5.7, NS) at 4 weeks, 1.9 (CI, -3.2 to 7.0) at 12 weeks Pain (0 to 100): 4.2 (CI, -6.9 to 15.4) at 4 weeks, -7.6 (CI, -20.3 to 5.1) at 12 weeks	9/11
Nath, 2008[117]	n=40 Presumed facet joint pain with positive controlled facet joint blocks Chronic	6 months	**Radiofrequency denervation vs. sham denervation, changes from baseline** Generalized pain (0 to 10 VAS): -1.9 vs. -0.4, p=0.02 Back pain (0 to 10 VAS): -2.1 vs. -0.7, p=0.08 Leg pain (0 to 10 VAS): -1.6 vs. -0.1, p=0.046 Analgesic consumption (6 point scale): -1.40 vs. -0.60, p=0.04 Walking (6 point scale): -0.40 vs. -0.40, p=1.0 Sitting (6 point scale): -0.75 vs. -0.15, p=0.04 Sleep (6 point scale): -0.65 vs. -0.35, p=0.20 Standing (6 point scale): -1.00 vs. -0.25, p=0.04 Work (6 point scale): -1.60 vs. -0.15, p=0.004 Subjective global assessment (6 point scale): -1.1 vs. -0.30, p=0.004	8/11
Tekin, 2007[120]	n=60 Presumed facet joint pain (clinical criteria only) Chronic	1 year	**Pulsed radiofrequency denervation vs. conventional radiofrequency denervation vs. sham denervation** Pain, mean VAS score (0 to 10): 2.9 vs. 2.3 vs. 3.1 at 6 months (p<0.05 for sham versus pulsed or conventional denervation); 3.5 vs. 2.4 vs. 3.9 at 1 year (p<0.05 for conventional vs. pulsed or sham) ODI, mean score (0 to 100): 25 vs. 25 vs. 29 at 6 months (p<0.05 for conventional vs. sham) and 28 vs. 28 vs. 34 at 1 year (p<0.05 for pulsed or radiofrequency denervation vs. sham) Patient satisfaction good or excellent: 85% vs. 95% vs. 70% (p=0.03 for sham vs. denervation groups) Analgesic use: 75% vs. 40% vs. 95% (p not reported)	5/11

Table 87. Randomized, sham-controlled trials of radiofrequency denervation for presumed facet joint pain

Author, year	Sample size Type of LBP Duration of symptoms	Duration of follow-up	Main results	Quality score*
van Kleef, 1999[166]	n=30 Presumed facet joint pain with positive uncontrolled facet joint block Chronic	12 months	**Radiofrequency denervation vs. sham denervation (difference in change from baseline at 8 weeks)** VAS-mean (0 to 10 scale): unadjusted 1.94 (CI, 0.24 to 3.64, p<0.05); adjusted 2.46 (CI, 0.72 to 4.20, p<0.05) Global perceived effect (-3 to +3 scale): unadjusted -0.96 (CI, -1.70 to -0.22, p<0.05); adjusted -1.10 (CI, -1.89 to -0.30, p<0.05) Physical impairment (Waddell, 0 to 7 scale): unadjusted 0.27 (CI, -0.69 to 1.22, NS); adjusted 0.31 (CI, -0.74 to 1.35, NS) Analgesic tablets per 4 days: unadjusted 3.88 (CI, 1.19 to 6.57, p<0.05); adjusted 3.24 (CI, -0.13 to 6.60, NS) ODI (0 to 100): unadjusted 15.75 (CI, 4.16 to 21.35, p<0.01); adjusted 10.90 (CI, 1.76 to 20.0, p<0.05) Quality of life (COOP/WONCA, 0 to 35): unadjusted 1.51 (CI, -1.85 to 4.97, NS); adjusted 2.27 (CI, -1.77 to 6.30, NS) Treatment success (≥2 point reduction in VAS-mean or VAS-high and >50% global perceived effect): 67% vs. 38% at 8 weeks (OR unadjusted 3.33, CI 0.97 to 11.5; OR adjusted 9.53, CI 1.50 to 60.5); 47% vs. 12% at 12 months	7/11
van Wijk, 2005[121]	n=81 Presumed facet joint pain with positive uncontrolled facet joint block Chronic	3 months	**Radiofrequency denervation vs. sham injection** Clinical success (defined as at least 50% improvement in VAS-leg score, without drop in daily activities score or rise in analgesics rating scale, or improvement of at least 2% in VAS-leg score, daily activities score, and analgesic use score) at 3 months: 28% vs. 29% (p=0.86) Leg pain, change in VAS (0-10) score: -1.1 vs. -0.7 (NS) Back pain, change in VAS (0-10) score: -2.1 vs. -1.6 (NS) Change in daily activities: 1.5 vs. 0.9 (NS) Change in analgesics use: -0.1 vs. -0.2 (NS)	11/11

A lower-quality trial (n=60) found conventional but not pulsed radiofrequency denervation superior to sham denervation for pain, the ODI, and analgesic use through 1 year[120]. Effects on pain were small to moderate (0.8 to 1.5 points on a 0 to 10 scale) and on the ODI were small (4 to 6 points). Another sham-controlled trial had serious methodological shortcomings, including lack of intention-to-treat analysis[139].

Two higher-quality[78, 90, 91] and two lower-quality[92, 93] systematic reviews also found uncertain or inconsistent benefits associated with radiofrequency denervation for presumed facet joint pain, though none included the three[117, 120, 121] most recently published sham-controlled trials. A fifth systematic review concluded there is moderate evidence supporting benefits from radiofrequency denervation[75]. It excluded a higher-quality trial[149] with more neutral findings because it used a single block to identify facet joint pain, leaving only a single, small (n=31) higher-quality randomized trial—which also did not appear to use controlled blocks to select patients—demonstrating benefits[166]. Although it included observational studies, criteria for differentiating "positive" from "negative" trials were poorly defined ("results were considered positive if the treatment was effective by defined criteria [e.g., 50% pain relief] for the designated period of time"). Three of the ten observational studies included in this review found that fewer than 50% of patients experienced pain relief.

Efficacy of radiofrequency denervation of the ramus communicans nerve versus sham or placebo for presumed discogenic back pain

One small (n=49), lower-quality trial of patients with presumed discogenic back pain (non-radicular back pain with positive discography) who had failed IDET found radiofrequency denervation of the ramus communicans nerves associated with substantially better mean VAS pain scores (3.8 vs. 6.3 on a 0 to 10 scale, p<0.05), and moderately better SF-36 bodily pain (43.7 vs. 32.4, p<0.05) and physical function scores (58.9 vs. 46.5, p<0.05) compared to lidocaine injection after 4 months (Table 88)[118].

Table 88. Randomized, sham-controlled trials of radiofrequency denervation for presumed discogenic back pain

Author, year	Sample size Type of LBP Duration of symptoms	Duration of follow-up	Main results	Quality score*
Oh, 2004[118]	n=49 Presumed discogenic back pain Chronic	4 months	**Radiofrequency denervation vs. lidocaine injection** Pain, mean VAS (0-10) score at 4 months: 3.8 vs. 6.3 (p<0.05) SF-36 bodily pain subscale: 43.7 vs. 32.4 (p<0.05) SF-36 physical function subscale: 58.9 vs. 46.5 (p<0.05) 77% of patients in radiofrequency denervation group decreased analgesics by at least 50%	5/11

Efficacy of radiofrequency denervation versus sham or placebo for radicular low back pain

One higher-quality trial of patients with chronic (>6 months) radicular pain and a positive selective nerve root block found no difference between radiofrequency denervation of the dorsal root ganglia and sham treatment for the proportion with clinical success (16% vs. 25%, p=0.43), SF-36 scores, or use of analgesics (Table 89)[108]. There was a trend towards a higher proportion of patients in the sham intervention group reporting >50% reduction in VAS-pain scores for the leg (21% vs. 42%, p=0.051). Out of 1001 patients originally evaluated for potential inclusion, only 83 were enrolled.

Table 89. Randomized, sham-controlled trial of radiofrequency denervation for radiculopathy

Author, year	Sample size Type of LBP Duration of symptoms	Duration of follow-up	Main results	Quality score*
Geurts, 2003[108]	n=83 Radiculopathy Chronic	3 months	**Radiofrequency denervation vs. sham injection** Clinical success (see definition in van Wijk above): 16% vs. 25% (p=0.43) Leg pain, change in VAS (0-10) score: -0.7 vs. -2.0 (p=0.02) Back pain, change in VAS (0-10) score: -0.6 vs. -1.1 (p=0.32) Change in daily activities: -0.5 vs. -0.4 (p=0.85) Change in analgesics use: 0.1 vs. -0.2 (p=0.23)	11/11

Efficacy of intra-articular versus extraarticular radiofrequency denervation for presumed facet joint pain

One small (n=34), lower-quality trial[885] included in one systematic review[78] found extra-articular radiofrequency denervation substantially inferior to intra-articular radiofrequency denervation on mean pain scores and the ODI. However, baseline differences in ODI scores appeared to be present. No other RCT has evaluated intra-articular radiofrequency denervation.

Harms

One trial reported a case of subjective mild lower limb weakness following radiofrequency denervation for presumed discogenic back pain that resolved within two weeks[118]. In two trials of patients with presumed facet joint pain, adverse events did not differ between treatment and sham radiofrequency denervation, though there was a trend towards a higher rate of increased pain following true radiofrequency denervation[108, 121].

Costs

We found no studies evaluating costs.

Summary of evidence

- For presumed facet joint pain, evidence on efficacy of radiofrequency denervation of the medial branch of the primary dorsal ramus is difficult to interpret. The only trial (n=60) to use

controlled facet joint blocks to select patients and an ablation technique believed to be optimal found radiofrequency denervation to be moderately superior to sham denervation, but baseline differences between groups could invalidate results. Two of three other small (n=30 to 81), higher-quality trials showed no benefits of radiofrequency denervation compared to sham denervation. Interpretation of these results is controversial because these trials used uncontrolled facet joint blocks to select patients and the radiofrequency denervation technique may have been suboptimal in some of the trials (level of evidence: poor).

- For presumed facet joint pain, intra-articular radiofrequency denervation was superior to extra-articular radiofrequency denervation in one small trial. No other trial evaluated efficacy of intra-articular radiofrequency denervation (level of evidence: poor).
- For chronic radicular pain and a positive selective nerve root block, radiofrequency denervation of the dorsal root ganglion was not effective compared to sham in one small, higher-quality trial (level of evidence: poor).
- For presumed discogenic low back pain with positive discography, radiofrequency denervation of the ramus communicans nerve was moderately to substantially superior to sham denervation in one small, lower-quality trial (level of evidence: poor).
- Adverse events were poorly reported, but serious adverse events were not described in the trials following radiofrequency denervation.

Recommendations and findings from other guidelines

- The European COST guidelines found insufficient evidence to recommend radiofrequency denervation of dorsal root ganglion for chronic low back pain.

Intradiscal electrothermal therapy (IDET)

Intradiscal electrothermal therapy (IDET) involves the placement of an electrode or catheter into the intervertebral disc annulus or nucleus. The catheter is then slowly heated and kept at a predetermined temperature for a predetermined time. This is thought to treat pain by altering the biomechanics of the disc (possibly by shrinking collagen fibers) and/or destroying adjacent nociceptive pain receptors. It is used in patients with presumed discogenic back pain. We considered IDET and a similar procedure that uses radiofrequency energy rather than thermal energy, percutaneous intradiscal radiofrequency thermocoagulation (PIRFT), separately (see below).

Results of search: systematic reviews
We identified one higher-quality Cochrane review of IDET for chronic low back pain[79, 80]. We also identified one other higher-quality systematic review[99] and three lower-quality systematic reviews[72, 73, 87]. We excluded two older versions of the Cochrane review[176, 255] and three review articles that were not systematic[174, 179, 196].

Results of search: trials
Two higher-quality, sham-controlled, randomized trials evaluated IDET[138, 157]. The five previously published systematic reviews each included one[73, 87] or both[72, 79, 80, 99] of the trials.

One lower-quality, non-randomized prospective cohort study[203] comparing IDET to PIRFT was also included in three systematic reviews[72, 73, 99]. We excluded two non-randomized trials[198, 203].

Efficacy of intradiscal electrothermal therapy versus sham

For chronic low back pain with positive response to provocative lumbar discography, two small (n=57 and n=64), higher-quality trials of IDET versus sham IDET reported conflicting results (Table 90)[157, 888]. In one trial, IDET was associated with moderately greater improvements in mean VAS pain scores (0-10 scale, mean change 2.4 vs. 1.1, p=0.0045) and slightly greater improvements in mean ODI scores (0 to 100 scale, mean change 11 vs. 4, p=0.050) compared to sham IDET, but was no better on the SF-36 bodily pain or physical functioning subscales[157]. The proportion of patients with at least a two-point improvement in VAS pain scores also favored IDET (56% or 18/32 compared to 38% or 9/24). From a potential cohort of 4253 who were assessed for trial eligibility, 64 patients were enrolled. The other higher-quality trial (n=64) found no differences between IDET and sham IDET on the Low Back Pain Outcome Score, ODI, SF-36, or Zung Depression Index[888].

Table 90. Randomized, sham-controlled trials of intradiscal electrothermal therapy

Author, year	Sample size Type of LBP Duration of symptoms	Duration of follow-up	Main results	Quality score*
Freeman, 2005[138]	n=57 Presumed discogenic back pain with positive provocative discography Chronic	6 months	**IDET vs. sham IDET, difference in mean improvement from baseline through 6 months** Low Back Outcome Score: -1.708, p=0.111 ODI: -2.156, p=0.489 Zung: -0.873 , p=0.693 MSPQ: -0.873, p=0.945 SF-36, physical functioning: 1.044, p=0.819 SF-36, bodily pain index: -1.997, p=0.659 Low back pain outcome score improved >7 points: 0% vs. 0% SF-36 Physical Functioning and Bodily Pain Index improved >1 standard deviation: 3/36 (8.3%) vs. 3/19 (15.8%)	8/11
Pauza, 2004[157]	n=64 Presumed discogenic back pain with positive provocative discography Chronic	6 months	**IDET vs. sham IDET** VAS for pain (0-10), mean change: 2.4 vs. 1.1, p=0.0045 SF-36, bodily pain (0-100), mean change: 17 vs. 9, p=0.086 SF-36, physical functioning (0-100), mean change: 15 vs. 11, p=0.548 ODI (0-100), mean change: 11 vs. 4, p=0.050 Pain improved by >2.0 on VAS: 18/32 (56%) vs. 9/24 (38%) Pain improved by >75%: 7/32 (22%) vs. 1/24 (4.2%)	8/11

Two higher quality[79, 80, 99] and one lower-quality[87] systematic review also found inconsistent data on efficacy of IDET. Two other lower-quality systematic reviews concluded that IDET is effective, largely based on pooled rates of response to IDET from mostly observational

studies[72, 73]. In the only controlled observational study included in these reviews, IDET was associated with substantially better VAS pain scores at 3 months (3.5 vs. 8.0 on a 0 to 10 scale, p<0.0005) and 24 months (3.0 vs. 7.5, p=0.028), as well as a higher proportion pain-free at 24 months (20% or 7/35 vs. 0% or 0/17)[198]. The other observational studies included in these reviews were uncontrolled.

Efficacy of intradiscal electrothermal therapy versus percutaneous intradiscal radiofrequency ablation

One lower-quality, small (n=42), prospective cohort study found IDET substantially superior to PIRFT for improvement in pain (mean difference -21.8 on a 0 to 100 scale) at 1 year[203]. This study did not meet inclusion criteria because it was not a randomized trial. In addition, differences did not become statistically significant until 3 months after the procedure, and some baseline differences were present.

Harms

Most studies of IDET reported transient and mild complications ranging in incidence from 0% (0/58) to 15% (5/33)[89]. These included increased radicular pain (5/33), paresthesias and numbness (2/79), and foot drop (1/79). In one study, one patient developed a CSF leak[889]. There have also been case reports of cauda equina syndrome and vertebral osteonecrosis[89]. In one systematic review[73], five of seventeen studies (including observational data) did not mention complications at all, and in another, eleven of fourteen observational studies reported no periprocedural complications[72]. Rates of complications in the other three studies ranged from 9% to 16% but were primarily minor.

Costs

We found no studies evaluating costs.

Summary of evidence

- For chronic low back pain with positive provocative discography, there is conflicting evidence from two higher-quality trials on efficacy of IDET relative to sham IDET. In the one trial finding benefits from IDET, effects were moderate for pain relief and small for functional status in a highly selected population (level of evidence: poor).
- For chronic low back pain with positive provocative discography, no trial of IDET versus PIRFT met inclusion criteria. One small, non-randomized study found IDET superior to PIRFT for improvement in pain, but differences were not statistically significant until 3 months after the procedure, and some differences in baseline pain scores were present (level of evidence: poor).
- Periprocedural complications associated with IDET were poorly reported but generally appeared mild or transient, though there are case reports of cauda equina syndrome and vertebral osteonecrosis after IDET (level of evidence: poor).

Recommendations and findings from other guidelines

- The European COST guidelines found insufficient evidence to recommend IDET for nonspecific or 'discogenic' chronic low back pain.

Percutaneous intradiscal radiofrequency thermocoagulation (PIRFT) and Coblation® nucleoplasty

Like IDET, percutaneous intradiscal radiofrequency thermocoagulation (PIRFT) involves the insertion of an electrode or catheter into an intervertebral disc presumed to be the source of low back pain. Unlike IDET, the electrode or catheter itself does not become hot. Instead, heat is generated in surrounding tissues by an alternating radiofrequency current. Also, the catheter is placed into the center of the disc rather than around the annulus. Like IDET, PIRFT is not intended to shrink or coagulate tissue, but is thought to work by altering the biomechanics of the disc or nociceptive nerve fibers.

Coblation® nucleoplasty uses a bipolar radiofrequency current to create a series of channels in the target disc. Unlike IDET and PIRFT, the goal of Coblation® nucelopasty is tissue reduction. Coblation® nucleoplasty has been used both for treatment of contained lumbar disc prolapse as well as presumed discogenic low back pain.

Results of search: systematic reviews
Two different higher-quality Cochrane reviews evaluated efficacy of PIRFT for chronic low back pain[79, 80, 90, 91]. We identified one other higher-quality systematic review[99] and one lower-quality systematic review of PIRFT[87], and one lower-quality systematic review of Coblation® nucleoplasty[88].

Results of search: trials
Two randomized trials[124, 890] evaluated PIRFT. Both evaluated PIRFT for chronic low back pain and were included in previously published systematic reviews. Only one was a sham-controlled trial[124]. One excluded non-randomized study that compared IDET and PIRFT is discussed in the section on IDET[203]. We identified no trials of Coblation® nucleoplasty.

Efficacy of PIRFT versus sham therapy for presumed discogenic low back pain

For chronic, presumed discogenic low back pain (based on a positive response to analgesic discography), one small (n=28), higher-quality randomized trial[124] found no significant differences between PIRFT and sham PIRFT for improvement in VAS pain scores, global effect, ODI, or proportion of treatment success, defined as the number of patients with a 2-point reduction on a 10 point VAS pain scale and >50% pain reduction on global perceived effect (1/13 in active treatment group and 2/15 in sham group) (Table 91)[124]. A second trial compared two different durations of radiofrequency thermocoagulation[890]. It found no differences and minimal improvement with either intensity of PIRFT.

Table 91. Randomized, sham-controlled trials of percutaneous intradiscal radiofrequency thermocoagulation for presumed discogenic back pain

Author, year	Sample size Type of LBP Duration of symptoms	Duration of follow-up	Main results	Quality score*
Barendse, 2001[124]	n=28 Presumed discogenic back pain with positive provocative discography Chronic	1 year	**PIRFT vs. sham** Proportion classified as 'success' at 8 weeks: 1/14 vs. 2/14 (AOR 1.1, 0.04 to 33.3) Proportion classified as 'success' at 1 year: 1/14 vs. 0/14 Change in VAS: -0.61 vs. -1.14 (NS) Change in global perceived effect: 0.09 vs. 0.21 (NS) Change in Waddell impairment: 0.00 vs. 0.29 (NS) Change in number of analgesic tablets per 4 days: -1.38 vs. 0.43 (NS) Change in ODI: -2.62 vs. -4.93 (NS) Change in Coop/Wonca: -1.85 vs. -0.21 (NS)	10/11

Efficacy of Coblation® nucleopasty for presumed discogenic low back pain or contained lumbar disc prolapse

We identified no relevant trials of Coblation® nucleoplasty[88].

Harms

No trial reported adverse events.

Costs

We found no studies evaluating costs.

Summary of evidence

- For presumed discogenic back pain, one small, higher-quality trial found no differences between PIRFT and sham PIRFT (level of evidence: poor).
- For chronic low back pain with positive provocative discography, no trial of IDET versus PIRFT met inclusion criteria. One small, non-randomized study found IDET superior to PIRFT for improvement in pain, but differences were not statistically significant until 3 months after the procedure, and some differences in baseline pain scores were present (level of evidence: poor).
- There is insufficient data to judge harms associated with PIRFT.
- There is insufficient data (no trials) to judge efficacy of Coblation® nucleoplasty.

Recommendations and findings from other guidelines

- The European COST guidelines found insufficient evidence to recommend PIRFT for nonspecific or ‘discogenic’ chronic low back pain.

Spinal cord stimulation

Spinal cord stimulation involves the placement of electrodes in the epidural space adjacent to the area of the spine presumed to be the source of pain[85]. An electric current is then applied to achieve sympatholytic and other neuromodulatory effects. The number and type of electrode leads and parameters of electrical stimulation can vary. Electrodes may be implanted percutaneously or by laminectomy, and power for the spinal cord stimulator is supplied by an implanted battery or transcutaneously through an external radiofrequency transmitter. Typically, a trial of spinal cord stimulation is attempted, with permanent implantation of the device only in patients who respond to the trial. Spinal cord stimulation has been most frequently studied in patients with failed back surgery syndrome (see Key Question 11), but is also used for chronic back pain no associated with prior surgery.

Results of search: systematic reviews
We identified one higher-quality systematic review (reported in two publications) on efficacy of spinal cord stimulation for chronic back and leg pain[95, 96]. Two other recent systematic reviews only included studies of spinal cord stimulation for failed back surgery syndrome (see Key Question 11)[85, 98]. We excluded one outdated systematic review[192] and one review that did not use systematic methods[195].

Results of search: trials and observational studies
We identified no trials of spinal cord stimulation for low back pain without failed back surgery. The systematic review included 72 case series (mean duration of pain 6.5 years), 27 of which evaluated spinal cord stimulation for chronic back and leg pain without failed back surgery syndrome (median quality score 1 on a 1 to 7 scale)[95, 96]. None of the studies prospectively studied consecutive patients using independently assessed and validated outcomes measures. The systematic review did not report results separately for patients with or without failed back surgery syndrome.

Efficacy of spinal cord stimulation for chronic low back pain with leg pain

Based on case series, the systematic review reported overall pooled estimates for the proportion of patients with greater than 50% pain relief of 62% (95% CI 56-69%) shortly following spinal cord stimulator implantation and 48% (95% CI 43-53%) during follow-up testing[95, 96]. The percentage of patients that achieved pain relief was 15% to 20% lower in studies rated higher quality (4 or higher on a 7 point scale), was reduced by 5% for every additional 10 months of follow-up, was increased by 10% for multicenter compared to single center studies, and was 20% higher in studies of patients with failed back surgery syndrome or chronic leg and back pain than in studies of patients with other conditions[96]. The proportion of patients that didn't require an analgesic after implantation was 53% (95% CI 48-56%), the proportion returned to work 40% (95% CI 28-50%), and the proportion satisfied with the intervention 70% (95% CI 62-85%).

Harms
Only 18 of the 72 studies reported usable harms data[96]. Overall, 43% (48/112) of patients with chronic back and leg pain or failed back surgery syndrome experienced at least one

complication with spinal cord stimulation. The most frequent complication was related to electrode or lead problems (27%). Other complications included infections (6%), generator problems (6%), extension cable problems (10%) and other issues (such as cerebrospinal fluid leak in 7%). No neurologic-related adverse events were reported.

Costs
We found no studies evaluating costs.

Summary of evidence

- For chronic back and leg pain or failed back surgery syndrome, lower-quality evidence from multiple case series estimated that approximately half of patients experienced decreased pain after spinal cord stimulator implantation, and about 40% returned to work (level of evidence: poor).
- Spinal cord stimulation is associated with frequent complications, especially related to electrode or lead problems. Although most complications appear minor, infections (6% of complications) and cerebrospinal fluid leak (7%) have been reported (level of evidence: poor).

Recommendations and findings from other guidelines

- The European guidelines found insufficient evidence to recommend spinal cord stimulation for chronic nonspecific low back pain.

Table 92. Systematic reviews on efficacy of interventional therapies for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample sizes in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Chemonucleolysis (19 RCTs in one systematic review)								
Gibson, 2007[81, 82]	Qualitative and quantitative	19 (6)**	Not applicable	1 year (3 months to 10 years)	80 (29 to 173)	Chymopapain (17), collagenase (3)	Chemonucleolysis with chymopapain vs. placebo for lumbar disc prolapse Patient rated outcome 'no success' at 1 year (2 RCTs): OR 0.24 (95% CI 0.12 to 0.49) Surgeon rated outcome "no success" at 3 to 12 months (4 RCTs): OR 0.40 (95% CI 0.21 to 0.75) Further disc surgery within 6 to 24 months (5 RCTs): OR 0.41 (95% CI 0.25 to 0.68) Chemonucleolysis with chymopapain vs. discectomy for lumbar disc prolapse Patient rated outcome "unchanged" or "worse" at 1 year (2 RCTs): OR=1.64 (95% CI 0.81 to 3.33) Surgeon rated "poor outcome" at 1 year (3 RCTs): OR=2.70 (95% CI 0.95 to 7.69) Further disc surgery within 1 year (4 RCTs): OR=14.3 (95% CI 5.56 to 50.0)	7

Table 92. Systematic reviews on efficacy of interventional therapies for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample sizes in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Epidural steroid injection (33 unique RCTs in 8 systematic reviews)								
Abdi, 2007[71]	Qualitative	23 (18)	10	6 months (2 weeks to 5 years)	60 (23 to 228)	Interlaminar (10), caudal (8), transforaminal (5)	Lumbar interlaminar epidural injections for lumbar radicular pain/sciatica (11 RCTs): Strong evidence (8 of 11 positive RCTs) for short-term relief and limited evidence (2 of 11 positive RCTs) for long-term relief. Indeterminate evidence for axial low back pain and lumbar spinal stenosis Lumbar transforaminal epidural injections for lumbar radicular pain/sciatica (5 RCTs): Strong evidence for short-term (4 of 5 RCTs) and moderate evidence for long-term relief (4 of 5 RCTs) of lumbar radicular pain. Lumbar caudal epidural injections for lumbar radicular pain/sciatica (6 RCTs): Strong evidence (4 of 6 RCTs) for short-term relief and moderate evidence (4 of 6 RCTs) for long-term relief. Strong evidence (2 of 2 RCTs) for short-term relief of post lumbar laminectomy syndrome.	3
Armon, 2007[74]	Qualitative	6 (3)	0	12 months (3 months to 5 years)	64 (23 to 160)	Interlaminar or not specified (3), caudal (1), transforaminal (2)	Epidural steroid injection vs. control (4 higher-quality RCTs): Epidural steroid injections may improve radicular lumbosacral pain 2-6 weeks after injection vs. control (Level C, Class I-III evidence), but no difference with longer-term follow-up through 1 year. Average magnitude of effect is small. No effect on functional improvement or need for surgery.	4

Table 92. Systematic reviews on efficacy of interventional therapies for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample sizes in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
DePalma, 2005[77]	Qualitative	5 (1)	1	8 months (3 months to 5 years)	55 (30 to 160)	Interlaminar (3), caudal (1), transforaminal (5)	Transforaminal epidural corticosteroid injection vs. local anesthetic or saline placebo for lumbosacral radiculopathy (3 RCTs, 1 higher-quality): 1 RCT found steroid superior to anesthetic for proportion proceeding to surgery (71% vs. 33%), 1 RCT found steroid superior to saline for overall response (McNab criteria) at 3 months (54% vs. 40%), 1 RCT found no difference between steroid and saline at 12 months (65% response) Transforaminal epidural corticosteroid injection vs. interlaminar epidural steroid injection (2 RCTs, neither rated higher-quality): 1 of 2 RCTs found transforaminal superior to interlaminar Transforaminal epidural corticosteroid steroid injection vs. trigger point injection (1 RCT, lower-quality): Epidural superior for "successful" outcome at 12 months (84% vs. 48%) (trial mis-classified as randomized)	4

Table 92. Systematic reviews on efficacy of interventional therapies for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample sizes in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Luijsterburg2007[84]	Qualitative	13 (9)	1	6 months (2 weeks to 24 months)	51 (23 to 160)	Interlaminar or not specified (10), caudal (2), transforaminal (2)	Epidural corticosteroid vs. placebo injection for lumbosacral radiculopathy: Short-term pain (7 RCTs, 4 higher-quality): Conflicting evidence, with 5 RCTS (3 higher-quality) showing no difference and 2 RCTs (1 higher-quality) finding epidural steroid superior Longer-term pain (3 RCTs, 2 higher-quality): No difference (strong evidence) Short-term overall improvement (5 RCTs, 3 higher-quality): Conflicting evidence, with 4 of 5 RCTs (3 higher-quality) showing no difference Long-term overall improvement (3 RCTs, 2 higher-quality): No difference (strong evidence) Disability and return-to-work (3 higher-quality RCTs): No difference at short or longer-term follow-up (strong evidence)	7
Nelemans, 2001[86]	Qualitative and quantitative	11 (5)	1	4.5 months (3 hours to 24 months)	30 (20 to 158)	Interlaminar or not specified (8), caudal (3)	Epidural corticosteroid injection vs. placebo for low back pain with or without sciatica: RR=0.92 (95% CI 0.76 to 1.11) for pain relief >6 weeks after injection (3 RCTs); RR=0.93 (95% CI 0.79 to 1.09) for pain relief <6 weeks after injection Epidural corticosteroid injection versus various non-placebo comparators for low back pain with or without sciatica (6 RCTs): 4 of 6 trials found non-significant positive effect; 1 of 6 found significant short-term positive effect; 0 of 2 long-term trials reported significant differences	7

Table 92. Systematic reviews on efficacy of interventional therapies for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample sizes in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Resnick, 2005[92]	Qualitative	4 (0)	0	Range 2 months to 6 months	Range 20 to 35	Interlaminar (3), caudal (1)	Epidural corticosteroid injection vs. control injection for chronic low back pain without significant radiculopathy (4 RCTs): No clear differences except epidural corticosteroid + morphine more effective than epidural corticosteroid + saline at 6 weeks in one RCT	2
Staal, 2008[94]	Qualitative	5 (2)	1	Range 1 week to 6 months	Median 35 (24 to 206)	Interlaminar (4) Caudal (1)	Epidural corticosteroid injection vs. epidural indomethacin, midazolam, or morphine for low back pain without radiculopathy (3 RCTs): No difference for each comparison. Two of three trials evaluated post-laminectomy patients. Note: Two placebo-controlled trials enrolled patients with sciatica, though purpose of review was to evaluate efficacy of epidural injections for non-radicular low back pain.	5
Tonkovich-Quaranta, 2000[97]	Qualitative	9 (not rated)	1	3 months (1 week to 24 months)	48 (20 to 100)	Interlaminar or not specified (7), caudal (2)	Epidural corticosteroid injection vs. placebo or epidural local anesthetic for sciatica (6 RCTs): 4 of 6 studies found epidural corticosteroid injection superior for up to 12 weeks Epidural corticosteroid injection vs. placebo or epidural local anesthetic for LBP of mixed etiologies (3 RCTs): 2 of 3 RCTs found epidural corticosteroid injection superior	1
Vroomen, 2000[100]	Quantitative	4 (4)	0	Range 3 to 14 months	Range 51 to 158	Interlaminar or not specified (3), caudal (1)	Epidural corticosteroid injection vs. placebo injection for sciatica: OR 2.2 (95% CI 1.0-4.7) for "improvement" (4 RCTs); when including 8 excluded RCTs with <20 subjects in an arm, OR 2.0 (95% CI 1.1-3.7)	5

Table 92. Systematic reviews on efficacy of interventional therapies for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample sizes in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Facet joint injection or medial branch block (6 unique RCTs in 4 systematic reviews)								
Boswell, 2007[75]	Qualitative	4 (4)	2	9 months (6 months to 2.5 years)	80 (60 to 200)	Facet joint injection (2), medial branch block (2)	Lumbar facet joint corticosteroid injection for presumed lumbar facet joint pain (2 higher-quality RCTs): Moderate evidence (2 of 2 positive RCTs) for short-and long-term improvement relative to control or baseline Lumbar medial branch (facet joint nerve) block for presumed lumbar facet joint pain (2 higher-quality RCTs): Moderate evidence (2 of 2 positive RCTs, one unpublished) for short-term and long-term improvement of lumbar facet joint pain relative to control or baseline	4
Resnick, 2005[92]	Qualitative	3 (0)	0	3 months (3 to 6 months)	101 (89 to 109)	Facet joint injection (3), medial branch block (1)	Lumbar facet joint corticosteroid injection vs. control injection for presumed facet joint pain (3 RCTs): No clear difference between interventions in 3 RCTs	2
Slipman, 2003[93]	Qualitative	3 (1)	0	3 months (3 to 6 months)	101 (89 to 109)	Facet joint injection (3), medial branch block (1)	Lumbar facet joint corticosteroid injection vs. saline injection, extra-articular steroid, or medial branch block (3 RCTs, one higher-quality): No clear differences	3
Staal, 2008[94]	Qualitative	5 (2)	1	3 months (5 weeks to 6 months)	89 (60 to 109)	Facet joint injection (5), medial branch block (1)	Lumbar facet joint corticosteroid injection vs. placebo injection for presumed lumbar facet joint pain (1 higher-quality and 1 lower-quality RCT): In both trials, no differences in pain or functional status through 3 months; conflicting evidence on longer-term effects. Lumbar facet joint corticosteroid injection vs. facet joint injection without corticosteroid, medial branch block, exercise alone, or facet joint injection with hyaluronidase (4 RCTs, 1 higher-quality): No differences	7

Table 92. Systematic reviews on efficacy of interventional therapies for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample sizes in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Intradiscal corticosteroid injection (2 RCTs in 1 systematic review)								
Gibson, 2005[81, 82]	Qualitative	2 (1)**	Not applicable	6 months (both RCTs)	60 and 80	Intradiscal corticosteroid injection (2)	Intradiscal corticosteroid injection vs. chemonucleolysis (2 RCTs): No differences in 2 RCTs	7
Intradiscal electrothermal therapy (2 unique RCTs in 5 systematic reviews)								
Andersson, 2006[72]	Quantitative	2 (2)	0	6 months (both RCTs)	57 and 64	Intradiscal electrothermal therapy (2)	IDET for presumed discogenic LBP: Median 51% (range 22% to 71%) improvement in pain score (15 studies, including observational data); median 65% (range 52% to 72%) achieved at least 2 point improvement in 10 point pain scale (5 studies, including observational data) IDET vs. sham for presumed discogenic LBP (2 RCTs): Conflicting results, with 1 of 2 RCTs reporting no differences	2
Appleby, 2006[73]	Quantitative	1 (not rated)	0	6 months	64	Intradiscal electrothermal therapy (1)	IDET for presumed discogenic LBP: Mean 2.9 (95% CI 2.5 to 3.4) improvement in pain intensity on a 0 to 10 scale (13 studies, including observational data), mean=7.0 (95% CI 2.0 to 11.9) improvement in ODI in 3 studies (including observational data)	1
Gibson, 2005[79, 80]	Qualitative	2 (2)**	0	6 months (both RCTs)	57 and 64	Intradiscal electrothermal therapy (2)	IDET vs. sham for presumed discogenic LBP (1 RCT): IDET superior to sham in one of two RCTs for pain and disability through 2 years, but it evaluated a highly selected population (64 of potential cohort of 4253 randomized)	6

Table 92. Systematic reviews on efficacy of interventional therapies for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample sizes in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
NICE, 2004[87]	Qualitative	1 (not rated)	0	6 months	64	Intradiscal electrothermal therapy (1)	IDET vs. sham for presumed discogenic LBP (1 RCT): IDET superior for decrease in pain at 6 months (78% [25/32] vs. 46% [11/24]), but not for proportion with >50% pain relief (38% [12/32] vs. 33% [8/32]). IDET superior for improvement in ODI (11 vs. 4 points, p=0.050), but not for SF-36 bodily pain or physical function subscales.	4
Urrutia, 2007[99]	Qualitative	2 (2)	0	6 months (both RCTs)	57 and 64	Intradiscal electrothermal therapy (2)	IDET vs. sham for presumed discogenic LBP (2 higher-quality RCTs): Inconsistent results, with no differences through 6 months in the highest quality RCT and small differences in favor of IDET for pain and disability in the other RCT	6
Local injections (6 unique RCTS in 3 systematic reviews)								
Resnick, 2005[92]	Qualitative	4 (0)	0	2 weeks (7 days to 2 months)	36 (15 to 63)	Trigger point injection (2), iliac crest injection (1), iliolumbar injection (1)	Local injection vs. placebo for low back pain associated with degenerative disease (3 RCTs): Local injection superior to placebo for short-term symptoms Local injection vs. dry needle acupuncture stick for low back pain associated with degenerative disease (1 RCT): No difference (proportion responding 63% vs. 42%, p=0.09)	2

Table 92. Systematic reviews on efficacy of interventional therapies for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample sizes in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Staal, 2008[94]	Qualitative	3 (2)	0	Range 2 weeks to 2 months	Range 30 to 63	Trigger point injection (1) iliac crest injection (1) iliolumbar injection (1)	Iliolumbar ligament injection with corticosteroid plus local anesthetic versus placebo (1 lower-quality RCT): No difference in pain relief at 2 weeks, but higher self-reported improvement Iliac crest injection with local anesthetic versus saline (1 higher-quality RCT): Pain score significantly better in injection group at 2 weeks Trigger point injection with local anesthetic or local anesthetic + corticosteroid vs. single dry needlestick or ethyl chloride plus acupressure (1 higher-quality RCT): No differences between groups at two weeks in self-rated improvement.	7
Percutaeneous intradiscal radiofrequency thermocoagulation or Coblation® nucleoplasty (2 unique RCTs in 5 systematic reviews)								
Gibson, 2005[79, 80]	Qualitative	1 (1)**	0	8 weeks	28	Percutaneous intradiscal radiofrequency thermo-coagulation (1)	PIRFT vs. sham for presumed discogenic LBP (1 RCT): 1/13 vs. 2/15 judged a 'success' after eight weeks	6
NICE, 2004[88]	Qualitative	0	Not applicable	Not applicable	Not applicable	Not applicable	Coblation® therapy for presumed discogenic LBP: Case series data only, with mixed results (1 study reported no sustained pain relief at 12 months)	5
NICE, 2004[87]	Qualitative	2 (not rated)	0	8 weeks and 6 months	28 and 39	Percutaneous intradiscal	PIRFT vs. sham for presumed discogenic LBP (1 RCT): No differences in pain,	4

Table 92. Systematic reviews on efficacy of interventional therapies for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample sizes in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
						radiofrequency thermocoagulation (2)	functional improvement, global effect 1 of 2 case series reported improvement after PIRFT (16/39 improved at 16 months)	
Niemisto, 2003[90, 91]	Qualitative	1 (1)	0	12 weeks to 12 months	31 to 70	Percutaneous intradiscal radiofrequency thermocoagulation (3)	PIRFT vs. sham for presumed discogenic low back pain (1 RCT): Limited evidence that intradiscal radiofrequency thermocoagulation not effective	7
Urrutia, 2007[99]	Qualitative	2 (2)	0	8 weeks and 6 months	28 and 39	Percutaneous intradiscal radiofrequency thermocoagulation (2)	PIRFT vs. sham for presumed discogenic LBP (one higher-quality RCT): No differences in pain, disability, quality of life, global effect, therapeutic success, and analgesic intake at 8 weeks PIRFT at 80 ºC for 120 seconds versus 360 seconds for presumed discogenic LBP (one higher-quality RCT): No differences in pain and disability at 6 months. Improvement in both groups at 1 month, but not at month 2 and beyond. PIRFT vs. IDET (one non-randomized study): IDET superior for pain at disability at 1 year	6

Table 92. Systematic reviews on efficacy of interventional therapies for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample sizes in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Prolotherapy (5 RCTs in 1 systematic review)								
Dagenais, 2007[76]	Qualitative	5 (5)	Not applicable	6 months (6 to 24 months)	80 (22 to 110)	Prolotherapy (5)	Prolotherapy vs. control injections: >50% pain relief: RR 1.88 (95% CI 0.57 to 6.19) at 3 months (1 RCT); RR 1.10 (95% CI 0.75 to 1.61) at 6 months (1 RCT); RR 0.94 (95% CI 0.47 to 1.85) at 12 months (1 RCT) >50% improvement in disability at 5 months (1 RCT): RR 1.50 (95% CI 0.94 to 2.40) Prolotherapy with co-interventions vs. control injection with co-interventions >50% improvement in pain or disability after 6 months (1 RCT with similar co-interventions): RR 1.47 (95% CI 1.04 to 2.06) at 6 months >50% improvement in disability (1 RCT with different co-interventions): RR 2.24 (95% CI 1.50 to 3.35)	7
Radiofrequency denervation (4 unique RCTs in 5 systematic reviews)								
Boswell, 2007[75]	Qualitative	1 (1)	0	12 months	31	Radio-frequency denervation of lumbar medial branch nerve (1)	Radiofrequency denervation vs. sham for presumed facet joint pain (1 higher-quality RCT + 10 observational studies): Moderate evidence (1 positive RCT and 10 observational studies) for short- and long-term improvement in pain	3
Geurts, 2001[78]	Qualitative	3 (1)	1	3 to 12 months	Range 31 to 41	Radio-frequency denervation of lumbar medial branch nerve (3)	Radiofrequency denervation vs. sham for presumed facet joint pain (2 RCTs, 1 higher-quality): 2 of 2 RCTs found radiofrequency superior to sham	7

Table 92. Systematic reviews on efficacy of interventional therapies for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample sizes in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Niemisto, 2003[90, 91]	Qualitative	3 (2)	0	Range 3 to 12 months	Range 31 to 70	Radio-frequency denervation of lumbar medial branch nerve (3)	Radiofrequency deneveration vs. sham for presumed facet joint pain (3 RCTs, 2 higher-quality): Conflicting evidence of short-term effects (1 RCT positive, 1 neutral, 1 unclear)	7
Resnick, 2005[92]	Qualitative	3 (2)	0	Range 3 to 12 months	Range 31 to 70	Radio-frequency denervation of lumbar medial branch nerve (3)	Radiofrequency denervation vs. sham for presumed facet joint pain (3 RCTs, two higher-quality): Mixed results, with radiofrequency denervation superior to sham in 2 of 3 RCTs	2
Slipman, 2003[93]	Qualitative	3 (not rated)	0	Range 3 to 12 months	Range 31 to 70	Radio-frequency denervation of lumbar medial branch nerve (3)	Radiofrequency denervation vs. sham for presumed facet joint pain (3 RCTs): 3 RCTs reported a 'positive' response to radiofrequency denervation, but in 1 RCT there was no longer a significant difference at 12 weeks	3
Sacroiliac joint injection (0 RCTs in 1 systematic review)								
Hansen, 2007[83]	Qualitative	No RCTs or sacroiliac joint injections for sacroiliac pain not related to spondylo-arthropathy	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	5

Table 92. Systematic reviews on efficacy of interventional therapies for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample sizes in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Spinal cord stimulation (0 RCTs in 1 systematic review)								
Taylor, 2005 and 2006[95, 891]	Quantitative	No RCTs of spinal cord stimulation in patients without failed back surgery syndrome	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	5

*Trials adequately meeting at least half of the quality rating criteria or rated as good or higher-quality if the number of criteria met was not reported
**Trials adequately meeting criteria for adequate allocation concealment
CI=confidence interval, ODI=Oswestry Disability Index, LBP=low back pain, OR=odds ratio, RCT=randomized controlled trial, RDQ=Roland-Morris Disability Questionnaire, RR=relative risk, WMD=weighted mean difference

Table 93. Summary of evidence on interventional therapies for low back pain

Intervention	Population	Number of placebo-controlled trials (number rated higher-quality)	Placebo-controlled trials with ≥100 patients	Total number of trials	Net benefit vs. placebo*	Inconsistency†	Directness of evidence	Overall quality of evidence	Comments
Non-spinal injections									
Botulinum toxin injection	Non-specific low back pain	1 (1)	0	1	Moderate (short-term only, one small trial)	Not applicable	Direct	Poor	
Local injections	Non-specific low back pain	3 (1)	0	5	Unable to determine	No	Direct	Poor	Interventions and populations varied substantially between trials. No higher-quality trials, all trials had small sample sizes
Prolotherapy	Non-specific low back pain	5 (4)	1	5	No effect	No	Direct	Good	
Intraspinal steroid injections and chemonucleolysis									
Chemonucleolysis	Radicul-opathy with prolapsed lumbar disc	6 (5) ‡	2	22	Moderate	No	Direct	Good	Chemonucleolysis with chymopapain superior to placebo injection, but inferior to surgery
Epidural steroid injection	Radicul-opathy with prolapsed lumbar disc	21 (9)	5	34	Moderate (short-term only)	Yes	Direct	Fair	Inconsistency between higher-quality trials could be due to use of epidural or non-epidural placebo injection
	Spinal stenosis	3 (1)	0	3	Unable to determine	No	Direct	Poor	In two of three trials, only a subgroup of patients had spinal stenosis
	Non-specific low back pain	0	Not applicable	1	No evidence	Not applicable	Direct	Poor	No difference between epidural steroid and intrathecal midazolam injection in one small trial
Epidural steroid injection	Failed back surgery syndrome	0	Not applicable	4	No evidence	No	Direct	Poor	

Table 93. Summary of evidence on interventional therapies for low back pain

Intervention	Population	Number of placebo-controlled trials (number rated higher-quality)	Placebo-controlled trials with ≥100 patients	Total number of trials	Net benefit vs. placebo*	Inconsistency†	Directness of evidence	Overall quality of evidence	Comments
Facet joint steroid injection	Presumed facet joint pain	2 (1)	2	7	No effect	No	Direct	Fair	
Intradiscal steroid injection	Radicul-opathy with prolapsed lumbar disc	0	Not applicable	3	No evidence	No	Direct	Fair	No effect versus chemonucleolysis
	Presumed discogenic low back pain	3 (1)	2	3	No effect	No	Direct	Good	
Medial branch block (therapeutic)	Presumed facet joint pain	0	Not applicable	3	No evidence	No	Direct	Poor	
Sacroiliac joint steroid injection	Presumed sacroiliac joint pain	1 (1)	0	1	Substantial (one small trial)	Not applicable	Direct	Poor	The only available trial evaluated a periarticular corticosteroid injection
Radiofrequency denervation, intradiscal electrothermal therapy (IDET), and related procedures									
Coblation® nucleoplasty	Radiculopathy with prolapsed lumbar disc	0	Not applicable	0	No evidence	Not applicable	Not applicable	Not applicable	
	Presumed discogenic low back pain	0	Not applicable	0	No evidence	Not applicable	Not applicable	Not applicable	
Intradiscal electrothermal therapy (IDET)	Presumed discogenic low back pain	2 (2)	0	2	Unable to determine (two trials with inconsistent results)	Yes	Direct	Poor	
Percutaneous intradiscal radiofrequency thermocoagulation (PIRFT)	Presumed discogenic low back pain	1 (1)	0	2	No benefit (one trial)	Not applicable	Direct	Poor	

Table 93. Summary of evidence on interventional therapies for low back pain

Intervention	Population	Number of placebo-controlled trials (number rated higher-quality)	Placebo-controlled trials with ≥100 patients	Total number of trials	Net benefit vs. placebo*	Inconsistency†	Directness of evidence	Overall quality of evidence	Comments
Radiofrequency denervation	Radiculopathy with prolapsed lumbar disc	1 (1)	0	1	No benefit (one trial)	Not applicable	Direct	Poor	
	Presumed facet joint pain	6 (4)	0	6	Unable to determine	Yes	Direct	Poor	1 higher-quality trial used an inadequate technique, another had large baseline differences in pain scores
	Presumed discogenic low back pain	1 (0)	0	1	Unable to determine (one trial)	Not applicable	Direct	Poor	
Spinal cord stimulation	Failed back surgery syndrome with persistent radiculopathy	1 (1)	0	2	Moderate (see comments)	No	Direct	Fair	Spinal cord stimulation superior to repeat surgery in one trial and superior to conventional medical management in a second trial
	Non-specific low back pain, or radiculopathy with prolapsed lumbar disc	0	Not applicable	No trials	No evidence	Not applicable	Not applicable	Not applicable	

* Based on evidence showing intervention is more effective than placebo or sham therapy for one or more of the following outcomes: pain, functional status, overall improvement, or work status. Versus placebo, small benefit defined as 5-10 points on a 100-point Visual Analogue Scale (VAS) for pain (or equivalent), 1-2 points on the Roland Morris Disability Questionnaire (RDQ), 5-10 points on the Oswestry Disability Index (ODI), or a standardized mean difference (SMD) of 0.2-0.5. Moderate benefit defined as10-20 points on a VAS for pain, 2-5 points on the RDQ, 10-20 points on the ODI, or a SMD of 0.5-0.8. Large benefit defined as >20 points on a 100 point VAS for pain; >5 points on the RDQ, >20 points on the ODI, or a SMD of >0.8.
† Inconsistency defined as <75% of trials reaching consistent conclusions on efficacy (no effect vs. positive effect considered inconsistent).
‡ Quality of one small French-language trial not assessed.

Key Question 9

How effective is surgery (and different surgical interventions) for non-radicular low back pain, radicular low back pain, or spinal stenosis, and under what circumstances?

Surgery for non-radicular low back pain with common degenerative changes

The most common surgery for chronic, non-specific low back pain or degenerative disc disease is fusion, a surgical procedure that unites (fuses) two or more vertebra together. The goal of fusion surgery is to relieve symptoms by restricting motion at the source of spinal pain (usually presumed to be a degenerated intervertebral disc) after removing the disc. A variety of spinal fusion techniques are practiced. All involve placement of a bone graft between the vertebrae. fusion can be performed with or without the use of supplemental hardware (instrumentation) such as plates, screws, or cages that serve as an internal splint while the bone graft heals.

Total disc replacement is a recently introduced alternative to fusion. A theoretical advantage of total disc replacement over fusion is that a prosthetic disc could help preserve normal range of motion and mechanics of the spine. This could reduce long-term degenerative changes in adjacent vertebral segments, which may be observed following fusion. Prosthetic discs approved by the Food and Drug Administration as of January 2007 are the Charite® and ProDisc®-L artificial discs.

Results of search: systematic reviews
We identified a total of 13 systematic reviews on efficacy of surgery for chronic, non-specific degenerative low back pain or degenerative disc disease with presumed discogenic low back pain: one higher-quality Cochrane review[79, 80], three other higher-quality systematic reviews[212, 215, 218] and nine lower-quality systematic reviews[72, 210, 213, 214, 221, 224-226, 230]. Four systematic reviews focused on efficacy or safety of vertebral disc replacement for degenerative disc disease with presumed discogenic low back pain[212-214, 221], one systematic review evaluated both fusion and artificial disc replacement[79, 80], and the remainder focused only on fusion. One other lower-quality systematic review of fusion focused only on harms[230]. We excluded two previous versions of the Cochrane review[176, 255] and one other outdated systematic review[260].

Results of search: trials
Twenty randomized trials evaluated surgery for non-radicular low back pain with common degenerative changes (usually degenerative disc disease with presumed discogenic low back pain)[244-247, 252, 253, 892-905]. All of the trials were included in at least one of 12 systematic reviews[72, 79, 80, 210, 212, 214, 215, 218, 221, 224-226, 230]. Four trials[244-247] compared surgery to non-surgical therapy and two trials[252, 253] compared artificial disc replacement to fusion. We excluded one trial[263] that evaluated surgery for foraminal stenosis due to degenerative disc disease and one trial[265] that reported interim, single center results from a multicenter trial.

Efficacy of fusion versus non-surgical management for non-radicular low back pain with common degenerative changes

Four higher-quality trials of fusion surgery versus non-surgical therapy enrolled patients with moderately severe pain (mean score 63 to 65 on a 0 to 100 scale[244, 245, 247]) or disability (mean ODI score=45[246]) for at least one year, unresponsive to standard non-surgical therapy. Positive results on provocative discography were not required for entry in any trial. Exclusion criteria included significant psychiatric or somatic illness, ongoing compensation issues or presence of other chronic pain conditions. Surgical techniques involved some type of fusion procedure, though specific methods varied (Table 94).

Table 94. Trials of fusion versus non-surgical therapy for non-radicular low back pain with common degenerative changes

Author, year Population evaluated	Surgical intervention	Number of patients Duration of follow-up	Main results	Quality score*
Brox, 2003[245] Chronic low back pain with degenerative disc disease at L4/L5 or L5/S1 (no prior discectomy)	Instrumented posterolateral fusion	n=64 1 year	**Surgery versus intensive rehabilitation with a cognitive-behavioral component** ODI score, mean difference in change from baseline: 2.3 (-6.8 to 11.4) Back pain, mean difference in change from baseline: 8.6 (-3.0 to 20.1) Overall rating 'success': 71% vs. 63%, p=0.59	8/9
Brox, 2006[244] Chronic low back pain with degenerative disc disease at L4/L5 or L5/S1 following discectomy	Instrumented posterolateral fusion	n=60 1 year	**Surgery versus intensive rehabilitation with a cognitive-behavioral component** ODI score, mean difference in change from baseline: -7.3 (-17.3 to 2.7) Back pain, mean difference in change from baseline: -5.2 (-18.0 to 7.6) Overall rating 'success': 50% vs. 48%, p=0.91	8/9
Fairbank, 2005[246] MRC Spine Stabilization Trial Chronic low back pain and considered a candidate for spinal fusion	Graf ligamentoplasty (15%) or fusion with technique left to discretion of surgeon (85%)	n=349 2 years	**Surgery versus intensive rehabilitation with a cognitive-behavioral component** ODI, mean difference in change from baseline: -4.1 (-8.1 to -0.1), p=0.045 SF-36 physical component score, mean difference in change from baseline: 2.0 (-1.2 to 5.3) SF-36 mental component score, mean difference in change from baseline: -0.2 (-2.9 to 2.6)	6/9
Fritzell, 2001[247] Swedish Lumbar Spine study Chronic low back pain with degenerative disc disease at L4/L5 or L5/S1	Non-instrumented posterolateral fusion (1/3), instrumented posterolateral fusion (1/3), or instrumented circumferential fusion (1/3)	n=294 2 years	**Surgery versus non-intensive physical therapy** Back pain VAS score, mean change from baseline (0 to 100 scale): 21.0 vs. 4.3, p=0.0002 ODI score, mean change from baseline: 11.6 vs. 2.8, p=0.015 Overall rating 'better' or 'much better': 63% vs. 29%, p<0.0001	7/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9
(VAS): Visual Analogue, (RDQ): Roland Morris Disability Questionnaire, (ODI): Oswestry Disability Index, (SF-36):Short-form 36

The trials reported inconsistent results[244-247]. In the Swedish Lumbar Spine Study (n=294), independent assessors rated outcomes as 'excellent' or 'good' (no more than sporadic pain, slight restriction of function, and occasional analgesics) in 46% of those randomized to surgery versus 18% randomized to non-surgical therapy after 2 years (p<0.0001)[247]. More of the surgical patients rated results as 'better' or 'much better' (63% vs. 29%, p<0.0001). Patients randomized to surgery also experienced moderately greater improvements in pain (mean change from baseline on 0 to 100 VAS pain score 21.0 vs. 4.3, p=0.0002) and slightly greater improvements in ODI scores (mean change from baseline 11.6 vs. 2.8, p=0.015), and a higher proportion returned to work (36% vs. 13%, p=0.002). Two smaller (n=60 and 64) trials conducted by the same Norwegian investigators found no statistically significant differences between surgery versus non-surgical therapy on any of the main outcomes after one year among patients either with[244] or without[245] prior discectomy. In the latter trial surgery was associated with a trend towards slightly superior outcomes on the ODI (mean difference=-7.3, 95% CI -17.3 to +2.7) and back pain scores (mean difference=-5.2, 95% CI -18.0 to +7.6)[244]. The Medical Research Council (MRC) Spine Stabilization Trial (n=349) found surgery associated with statistically significant improvements in ODI scores after 24 months compared to non-surgical therapy, but the difference did not reach clinical significance (mean difference -4.1, 95% CI -9.1 to -0.1, p=0.045)[246]. There were no differences in other outcomes, including SF-36 scores and the shuttle walking test.

The inconsistent results between trials could be related to differences in non-surgical comparator treatments. In the three trials that found clinically or statistically insignificant benefits following surgery, non-surgical treatment consisted of intensive rehabilitation incorporating cognitive behavioral therapy (75 hours over three weeks, with subsequent follow-up visits)[244-246]. In the one trial that showed surgery associated with clinically and statistically significant benefits, the non-surgical treatment intervention was less intensive (70 hours of supervised physical therapy over a 2 year period) and more heterogeneous (could be supplemented by other interventions such as transcutaneous electrical nerve stimulation [TENS], acupuncture, injections, advice, and cognitive therapy)[247]. In addition, one of the criteria for enrollment in this trial was inadequate response to non-surgical treatment, but patients randomized to the non-surgical arm may have continued to receive previously ineffective interventions.

Two higher-quality systematic reviews also found inconsistent results for surgery versus no surgery that could be explained by the non-surgical comparator intervention[79, 80, 218]. Another higher-quality, quantitative systematic review found no difference between surgery and non-surgical therapy when data from three trials[245-247] were pooled (-4.13, 95% CI -9.08 to 0.82), but heterogeneity was present, in part because trials of intensive and standard rehabilitation were combined[215]. Two lower-quality systematic reviews estimated success rates of 67% to 79% following fusion, but pooled data across primarily uncontrolled observational studies[72, 210]. A third systematic review[224] postulated that lack of efficacy observed in smaller (N<100) trials could have been due to small sample sizes and insufficient power to detect differences. However, even if statistically significant, point estimates from the smaller trials would either

favored non-surgical therapy (2.3 points on the ODI[245]) or would only slightly favor surgery (7.3 points on the ODI[244]).

Efficacy of different fusion techniques

There is insufficient evidence to determine optimal fusion methods. Instrumentation and electrical stimulation appear to enhance fusion rates, but effects on clinical outcomes are not established[79, 80]. Although pooled estimates in a higher-quality Cochrane review found instrumentation superior to no instrumentation (OR=0.49 for poor clinical outcome, 95% CI 0.28 to 0.84), results are sensitive to inclusion of two older, lower-quality outlier trials (one non-randomized[906]) that reported unusually favorable results with surgery (83%[906] and 93%[905] success with instrumented fusion). A re-analysis that was limited to higher-quality trials published since 1997 found marginal and insignificant effects of fusion (74% vs. 68% pooled rates of clinical success). There are conflicting results from head-to-head trials regarding the relative effectiveness of various types of fusion (anterior, posterior, or combined)[79, 80].

Efficacy of artificial disk replacement versus fusion

For chronic non-radicular back pain with single-level degenerative disc disease from L3 or L4 to S1, two trials (each funded by the manufacturer of the relevant artificial disc) found no clear differences between artificial disc replacement versus fusion through two years follow-up (Table 95)[252, 253]. One higher-quality trial[252] (n=304) found the Charité® Artificial Disc non-inferior to anterior lumbar interbody fusion using the BAK® Interbody Fusion System (a technique no longer commonly used because of frequent poor outcomes[907]) on a composite outcome of "clinical success" (≥25% improvement in ODI, no device failure, no major complications, and no neurologic deterioration) at 24 months (57% vs. 46%, p<0.0001 for equivalence test; calculated RR 1.23, 95% CI 0.96 to 1.57)[252]. There were no differences in mean ODI (48.5 vs. 42.4, p=0.27 for difference), VAS pain scores (40.6 vs. 34.1, p=0.11) or rates of employment at 24 months, though disc replacement was slightly superior at earlier evaluations. One lower-quality trial (n=286) that compared Prodisc II artificial disc replacement to instrumented circumferential fusion was also designed as a non-inferiority trial, but results appeared to be reported using standard statistical tests for evaluating a superiority hypothesis[253]. It found the Prodisc II superior to circumferential fusion on a composite outcome of success (ODI improved >15 points, device success, neurologic success, SF-36 improved, and radiographic success) after 24 months (53% vs. 41%, p=0.044). However, there were no statistically significant differences on the ODI (mean scores or proportion with >15 point improvement), pain scores, or SF-36 composite mental and physical component scores.

Table 95. Trials of artificial disc replacement versus fusion

Author, year Population evaluated	Surgical intervention	Number of patients Duration of follow-up	Main results	Quality score*
Blumenthal, 2005[252] Chronic low back pain with single-level degenerative disc disease between L4 and S1	Charité® artificial disc	n=304 24 months	**Total disc replacement with Charité® artificial disc vs. anterior lumbar interbody fusion with BAK® cage** Clinical success: 117/205 (57%) vs. 46/99 (46%), p<0.0001 for equivalence ≥25% improvement in ODI: 131/205 (64%) vs. 50/99 (50%) Length of hospitalization: 3.7 vs. 4.2 days, p=0.0039 ODI, mean improvement from baseline at 24 months: 49% vs. 42%, p<0.05 VAS for pain, mean improvement from baseline at 24 months (0 to 100 scale): 40.6 vs. 34.1, p<0.05 Patient satisfaction rated as 'satisfied': 74% vs. 53%, p=0.0011 'Would have same treatment again': 70% vs. 50%, p=0.0062 Use of opioids: 148/205 (72%) vs. 85/99 (86%), p=0.0083 Employed at 24 months (percent increase): 9.2% vs. 7.4%, NS	7/10
Zigler, 2007[253] Chronic low back pain with single-level degenerative disc disease between L3 and S1	Prodisc-L artificial disc	n=292 24 months	**Total disc replacement with Prodisc-L vs. circumferential fusion** ODI (mean improvement at 24 months): 28.9 (46% improvement) vs. 22.9 (36% improvement) (p=0.055) ODI improved >15 points from baseline: 53% vs. 36% at week 6 (p=0.010), 60% vs. 45% at month 6 (p=0.029), 58% vs. 53% at month 12 (p=0.332), 68% vs. 55% at month 24 (p=0.045) SF-36 composite mental and physical component scores improved from baseline: 87% vs. 70% at month 3 (p=0.004), 81% vs. 77% at month 12 (p=0.302), 79% vs. 70% at month 24 (p=0.094) Overall success (ODI improved >15 points, device success, neurologic success, SF-36 improved, and radiographic success): 53% vs. 41% (p=0.044) VAS Pain (mean improvement at 24 months on 0 to 100 scale): 39 vs. 32 (p=0.08) VAS Patient satisfaction (0 to 100): 77 vs. 67 (p=0.015) Opioid use in persons achieving success: 39% vs. 31% (76% vs. 84% at baseline) Employed: 92% vs. 85% (p=0.048)	5/10

*Excludes criteria involving blinding of care providers, for maximum score of 10

Selection of patients for surgery for non-specific low back pain

Patients enrolled in trials of surgery versus non-surgical treatment all had moderately severe chronic pain (mean pain score=62 to 65 on a 0 to 100 scale) or disability (mean ODI score=45) for at least one year, unresponsive to standard non-surgical therapy. Patients had moderate pain (mean scores 63 to 65[244, 245, 247]) or disability (mean ODI 45[246]). Exclusion criteria generally

included any significant psychiatric or somatic illness and often included ongoing compensation issues or other chronic pain conditions. Uncontrolled observational studies have shown poorer surgical outcomes in such patients[254, 908, 909]. In a recent randomized trial (the Swedish Lumbar Spine Study) of surgery versus non-surgical management of chronic low back pain, personality features and low disc height both predicted functional improvement after surgery, and lower age and short sick leave predicted return to work after surgery[910]. The presence of depressive symptoms predicted functional improvement after non-surgical treatment.

Harms

No operative deaths were reported in any randomized trial of fusion versus non-surgical therapy[244-247]. The pooled rate of early surgical complications from three trials[245-247] was 16% (95% CI 12% to 20%)[215]. Major complications included deep wound infections, major bleeding during surgery, thrombosis, acute respiratory distress syndrome, pulmonary edema, and heart failure. One trial, which evaluated different fusion techniques, found higher risks of complications with more technically difficult procedures[911]. The total complication rate after two years was 12% with non-instrumented posterolateral fusion, 22% with instrumented posterolateral fusion, and 40% with circumferential fusion. A recent, large observational study based on the Nationwide Inpatient Sample reported <1% in-hospital mortality for all fusion procedures[912]. In systematic reviews that included observational studies, complication rates following fusion varied widely and were difficult to interpret due to differences in techniques, study populations, and methodological shortcomings[72, 230]. One systematic review found perioperative complications ranged from 2% to 54% in 31 studies of different fusion methods, with a trend towards higher complications with circumferential fusion[72]. Another systematic review found wide variation in estimates of common adverse events or undesirable outcomes following anterior or posterior lumbar interbody fusion with a stand-alone cage. Rates of non-union ranged from 0% to 83% in 24 studies, rates of major vessel injury ranged from 0 to 12% in 12 studies, rates of neurologic complications ranged from 0 to 44% in 10 studies, and rates of dural injury ranged from 2% to 15% in 8 studies[230]. Higher rates of solid fusion were associated with potential author conflicts of interest, though there was no association between potential conflicts of interest and estimates for other outcomes. One shortcoming of this study is that other factors that could affect reported complication rates (such as study quality) were not assessed.

In two trials of artificial disc replacement, one death was reported among 205 patients randomized to Charité® total disc replacement[252] and none in 161 patients randomized to Prodisc-L artificial disc replacement[253]. There were no major complications in the Prodisc-L trial, and in the Charité® trial there were no differences between artificial disc replacement and fusion in rates of overall (p=0.6769) complications. Major complications occurred in 1% of patients in both groups. The rates of major (4.9% vs. 4%) and minor (9.8% vs. 8.1%) neurologic complications were similar for artificial disc replacement and fusion. Long-term data following artificial disc replacement are limited, but case reports and other uncontrolled observational studies have reported prosthesis migration or subsidence (settling or sinking into bone), adjacent level disc degeneration, and facet joint arthritis, with some patients undergoing

subsequent fusion or artificial disc removal[913-916]. One study found fewer complications and shorter length of hospitalization when Charite® total disc replacement was performed by surgeons more experienced in the procedure[917].

Costs
Two trials of surgery versus non-surgical management of chronic non-specific low back pain conducted cost-effectiveness analyses[918, 919]. One estimated an incremental cost-effectiveness ratio of £48,588/QALY (about $95,232 U.S./QALY) for surgery relative to intensive rehabilitation[919]. Estimates were sensitive to the proportion of patients in the rehabilitation group that required surgery in the future. The other found surgery associated with an incremental cost-effectiveness ratio relative to usual care of about $372 ($86-729) per case of improvement, $744 ($157-1,644) per one point improvement on a 100 point pain scale, $1,616 ($186-6,864) per one point improvement on the ODI score, and $586 ($14-3,060) per patient returned to work (converted from Swedish kroner)[918]. There were no differences in costs associated with three different fusion techniques (posterolateral fusion, instrumented posterolateral fusion, and circumferential fusion with solid autogenous bone grafts).

Summary of evidence

- For chronic non-radicular low back pain with common degenerative changes, three higher-quality trials found spinal fusion surgery no better or only slightly superior to intensive rehabilitation plus a cognitive intervention for improvement in pain or function, but a fourth trial found fusion surgery moderately superior to less intensive physical therapy supplemented by other non-invasive interventions (TENS, acupuncture, injections, advice, and/or cognitive therapy) for pain and slightly superior for functional status (level of evidence: fair).
- For mixed degenerative conditions (including degenerative spondylolisthesis), evidence on efficacy of instrumented versus non-instrumented fusion is inconsistent, though clinical outcomes are similar after excluding two lower-quality outlier trials and pooling data from the remaining six trials (level of evidence: fair).
- Evidence regarding efficacy of anterior, posterior, or combined fusion from four trials is inconsistent and does not permit reliable judgments about relative efficacy (level of evidence: fair).
- Electrical stimulation may improve fusion rates in non-instrumented (but not instrumented) fusion, but did not have a clear effect on clinical outcomes in three trials (level of evidence: fair).
- For degenerative disc disease, artificial disc replacement with the Charite® artificial disc was non-inferior to anterior interbody fusion with a stand-alone cage for a combined measure of success at 24 months in one higher-quality trial, and artificial disc replacement with the ProDisc®-L artificial disc was slightly superior to circumferential fusion for a combined measure of success at 24 months in another higher-quality trial. In both trials, there were no differences in pain relief or functional status at 24 months, though some earlier results favored artificial disc replacement (level of evidence: fair).

- Early complications following fusion occur in up to about 20% of patients. The rate of in-hospital mortality is <1%. Rates of other complications vary widely between studies (level of evidence: fair).
- Complications from spinal fusion were more frequent with more technically difficult methods in one higher-quality trial (level of evidence: fair).
- Rates of complications were similar after artificial disc replacement and fusion in two higher-quality trials that each evaluated a different artificial disc (level of evidence: fair).
- Trials of surgery versus non-surgical management generally included patients with moderate pain who failed to improve after 6 months to 2 years of non-surgical management, and had disease localized to L4-L5 and/or L5-S1.

Recommendations and findings from other guidelines

- The AHCPR guidelines recommend against spinal fusion for the treatment of low back problems during the first 3 months of symptoms (strength of evidence: C).
- The AHCPR guidelines recommend that spinal fusion be considered following decompression at a level of increased motion due to degenerative spondylolisthesis (strength of evidence: C).
- The European COST guidelines found insufficient evidence to recommend fusion surgery for chronic low back pain unless two years of all other recommended conservative treatments have failed and combined programs of cognitive interventions and exercises are not available in the given geographical area. It strongly recommends that only carefully selected patients with severe pain (and with maximum 2 affected levels) should be considered for fusion.

Surgery for isthmic spondylolisthesis

Isthmic spondylolisthesis refers to a condition in which a lytic defect in the pars interarticularis results in anterior subluxation of the affected vertebral body. The subluxation may also place stress on the adjacent intervertebral disc, resulting in degenerative disc disease. The most common site of isthmic spondylolisthesis is at L5, which can cause back pain or radicular symptoms due to tension or compression on the L5 nerve root. The most common surgical procedure for isthmic spondylolisthesis is fusion, with or without decompressive laminectomy.

Results of search: systematic reviews
We identified a higher-quality Cochrane review of surgery for degenerative conditions of the back, including isthmic spondylolisthesis[79, 80]. We identified one other lower-quality systematic review on efficacy of surgery for low-grade isthmic spondylolisthesis[216]. We excluded earlier versions of the Cochrane review[176, 255].

Results of search: trials
Six unique trials (reported in ten publications[233, 235, 920-927]) evaluated surgery for isthmic spondylolisthesis (three in mixed populations of patients with isthmic or degenerative spondylolisthesis[233, 235, 921, 926]). All were included in previously published systematic reviews[79, 80, 216]. Only one trial compared surgery to non-surgical therapy[925]. Long-term (9 years) results of

this trial have been reported[922]. The other trials evaluated different methods of surgery. Three trials met criteria for adequate allocation concealment in the Cochrane review[920, 921, 924-926]. We excluded one non-randomized study that compared different surgical techniques for unstable low-grade isthmic spondyolisthesis[928].

Efficacy of surgery versus non-surgical treatment of isthmic spondylolisthesis

For lumbar isthmic spondylolisthesis of any grade with low back pain for at least one year and no radiologic disc prolapse or central canal stenosis, one lower-quality trial found posterolateral fusion associated with moderately decreased pain (mean score 37 vs. 56 on a 0 to 100 scale, p=0.002) and disability (mean Disability Rating Index 29 vs. 44 on a 0 to 100 scale, p=0.004) and superior patient-reported overall outcomes (74% vs. 43% better or much better) after 2 years compared to an exercise program, though there were no significant difference in work-related outcomes (46% vs. 45% working) (Table 96)[925]. Nearly all patients enrolled in this trial (112 of 114) were categorized as having a Grade I or II slip. After an average of 9 years follow-up, differences were small and no longer significant for pain or function[922]. Relief of sciatica from nerve root compression (the major indication for surgery in patients with isthmic spondyolisthesis) was not reported.

Table 96. Trial of surgery versus non-surgical treatment for isthmic spondylolisthesis

Author, year Population evaluated	Surgical intervention	Number of patients Duration of follow-up	Main results	Quality score*
Moller, 2000 [922, 925] Chronic lumbar isthmic spondylolisthesis (any grade)	Posterolateral fusion with or without instrumentation	n=114 9 years	**Surgery versus exercise therapy** Disability Rating Index, mean score (0 to 100 scale): 29 vs. 44 (p=0.004) at 2 years, 33 vs. 38 (NS) at 9 years Pain, mean score (0 to 100 scale): 37 vs. 56 (p=0.002) at 2 years, 40 vs. 49 at 9 years Proportion working: 46% vs. 45% (NS) at 2 years, 51% vs. 46% at 9 years Overall outcome much better or better: 74% vs. 43% at 2 years, 76% vs. 50% at 9 years	4/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Efficacy of different surgery techniques for isthmic spondylolisthesis

For grade I or II isthmic L5/S1 spondylolisthesis without neurologic deficits, one small (n=42), higher-quality trial found fusion (with or without instrumentation) plus decompressive laminectomy associated with higher rates of pseudoarthrosis (22% vs. 0%, p=0.02) and unsatisfactory results (33% vs. 4%, p=0.01) compared to fusion alone (with or without instrumentation)[920]. Results may be somewhat confounded because only patients who smoked received instrumentation, though no benefits from decompression were observed in either smokers or non-smokers. In two lower-quality trials included in the Cochrane review, there were no differences in fusion rates[923, 924] or clinical outcomes[924] between patients randomized to instrumented posterolateral fusion versus non-instrumented fusion.

A lower-quality systematic review found posterior fusion for isthmic spondyolisthesis associated with poorer success rates compared to anterior or combined approaches (75% versus 90% and 86%)[216]. Instrumented fusion was associated with higher success rates than non-instrumented fusion (85% vs. 64%, p<0.0001). There were no differences in success rates with fusion plus laminectomy versus fusion alone (74% vs. 80%, p=0.11). However, estimates may not be reliable because they are based on simple pooling of success rates across randomized and non-randomized studies, including lower-quality, uncontrolled surgical series.

Results of trials[233, 235, 921, 926, 927] that included mixed populations of patients with isthmic or degenerative spondylolisthesis are summarized in the section on surgery for spinal stenosis or degenerative spondylolisthesis (see below).

Harms
One trial of surgery versus non-surgical therapy for isthmic spondyolisthesis found posterolateral fusion associated with three major operative complications (two cases of permanent L5 root injury during instrumented fusion out of 37 subjects, and one case of permanent blindness)[925]. Another trial (n=42) reported two post-operative complications following fusion (with or without instrumentation and with or without laminectomy) that required operative revision, one case of transient palsy of the sacral nerve, and one dural tear[920]. A trial (n=27) of posterolateral fusion with or without instrumentation reported four wound hematomas, one screw breakage, one damaged nerve root, and one pedicle fracture with subsequent radiculopathy that required surgical exploration[923].

Costs
We found no studies evaluating costs.

Summary of evidence

- For isthmic spondylolisthesis with Grade I or II slip, posterolateral fusion was moderately superior to an exercise program for pain and disability after 2 years in one lower-quality trial, though differences were no longer significant after an average of 9 years (level of evidence: poor).
- For grade I or II isthmic L5/S1 spondylolisthesis without neurologic deficits, one small, higher-quality trial found fusion (with or without instrumentation) plus laminectomy and decompression associated with higher rates of pseudoarthrosis and unsatisfactory results compared to fusion (with or without instrumentation) alone (level of evidence: poor).
- For mild isthmic spondylolisthesis, instrumented fusion was no better than non-instrumented fusion in two lower-quality trials (level of evidence: poor).
- For mild isthmic spondylolisthesis, pooled data from primarily lower-quality observational studies found fusion using the anterior or combined approach superior for success rates compared to fusion using the posterior approach, and instrumented fusion superior to non-instrumented fusion (level of evidence: poor).
- There is insufficient evidence to reliably judge safety of surgery for isthmic spondylolisthesis.

- Evidence on efficacy of different surgical techniques in mixed populations of patients with isthmic or degenerative spondylolisthesis are summarized in the section on surgery for spinal stenosis or degenerative spondylolisthesis.

Recommendations and findings from other guidelines

- The other guidelines do not make specific recommendations for surgery in patients with isthmic spondylolisthesis.

Surgery for spinal stenosis with or without degenerative spondylolisthesis

Common causes of acquired spinal stenosis (narrowing of the spinal canal) include degenerative disc disease, degenerative spondyolisthesis, prolapsed intervertebral disc, and diffuse idiopathic skeletal hyperostosis. The most common surgery for spinal stenosis is decompressive laminectomy, or removal of the vertebral lamina in order to create more space and reduce pressure on the spinal column or nerve roots. Laminectomy can be performed with or without fusion or discectomy. Another surgical treatment for spinal stenosis is placement of a spacer device between the interspinous processes, which could theoretically improve postural symptoms of spinal stenosis by limiting extension or lordosis of the spine (which results in narrowing of the spinal canal) when standing.

Degenerative spondylolisthesis is a condition characterized by degenerative changes at the facet joints, which leads to a loss of normal structural supports and subluxation (slippage) of the affected vertebral body. This can cause pain and neurologic deficits due to tension on nerve roots or spinal stenosis. The most common site for degenerative spondylolisthesis is L4. The most common surgical procedure for degenerative spondylolisthesis is decompressive laminectomy, often with an intertransverse process arthrodesis (fusion) using an autogenous bone graft.

Results of search: systematic reviews
We identified a higher-quality Cochrane review on efficacy of surgery for spinal stenosis, with or without degenerative spondylolisthesis[79, 80], one other higher-quality systematic review[217], and six lower-quality systematic reviews[210, 223, 225, 226, 228, 229]. We also identified one lower-quality systematic review on predictors of postoperative clinical outcomes in spinal stenosis[254]. We excluded earlier versions of the Cochrane review[176, 255] and three other outdated systematic reviews[257-259].

Results of search: trials
Nineteen trials evaluated surgery for spinal stenosis with or without degenerative spondylolisthesis[231-233, 235, 236, 241, 243, 250, 251, 895, 906, 926, 929-935]. Twelve trials were included in at least one of the eight systematic reviews[79, 80, 210, 217, 223, 225, 226, 228, 229] and we identified seven additional trials[231-233, 235, 236, 241, 250]. Of six trials that compared surgery versus non-surgical therapy, four evaluated laminectomy[236, 241, 243, 250] and two evaluated an interspinous spacer device[231, 251]. Previously published systematic reviews included only one trial of laminectomy[243] and one trial of an interspinous spacer device[251] versus non-surgical therapy.

Efficacy of decompressive surgery versus non-surgical treatment for spinal stenosis with or without degenerative spondyolisthesis

Four higher-quality trials compared surgery to non-surgical therapy for spinal stenosis (Table 97)[236, 241, 243, 250]. One trial evaluated surgery for spinal stenosis without degenerative spondylolisthesis[250], one trial evaluated surgery for spinal stenosis with degenerative spondylolisthesis[241], and two trials evaluated surgery for spinal stenosis with or without degenerative spondylolisthesis[236, 243]. In three trials, baseline pain scores averaged 31 to 32 on the SF-36 bodily pain score[241, 250] or 7 on a 0 to 10 pain scale[236]. The fourth trial did not report baseline severity or duration of pain[243]. Although two trials permitted enrollment of patients with as little as 12 weeks of symptoms, the majority of patients in all trials reported at least six months of symptoms at the time of enrollment.

Table 97. Trials of decompressive surgery versus non-surgical treatment for spinal stenosis

Author, year Population evaluated	Surgical intervention	Number of patients Duration of follow-up	Main results	Quality score*
Amundsen, 2000[243] Chronic spinal stenosis with or without degenerative spondylolisthesis	Laminectomy (without fusion)	n=31 10 years	**Laminectomy (without fusion) versus non-surgical treatment** Proportion with 'good' results: 9/13 (69%) vs. 6/18 (33%) at 1 year; 11/12 (92%) vs. 8/17 (47%) at 4 years; 10/11 (91%) vs. 12/17 (71%) at 10 years (p values not reported)	6/9
Malmivaara, 2007[236] Chronic symptomatic spinal stenosis with or without degenerative spondylolisthesis	Laminectomy (with or without fusion)	n=94 2 years	**Laminectomy (with or without fusion) versus non-surgical treatment (difference between groups, negative values favor surgery)** ODI: -7.6 (95% CI -13.9 to -1.3) at 6 months, -11.3 (95% CI -18.4 to -4.3) at 12 months, -7.8 (95% CI -14.9 to -0.8) at 24 months Leg pain during walking (0 to 10 scale): -2.02 (95% CI -3.36 to -0.69) at 6 months, -1.51 (95% CI -2.77 to -0.25) at 24 months Low back pain during walking (0 to 10 scale): -2.64 (95% CI -3.88 to -1.40) at 6 months, -2.13 (95% CI -3.28 to -0.98) at 24 months Self-reported walking ability (m): No significant differences	6/9
Weinstein, 2007[241] Spine Outcomes Research Trials Chronic symptomatic spinal stenosis with degenerative spondylolisthesis	Laminectomy (with or without fusion)	n=304 2 years	**Laminectomy (with or without fusion) versus non-surgical treatment (positive SF-36 and negative ODI scores favor surgery)** **Intention-to-treat results, differences between interventions at 2 years** SF-36 bodily pain: 1.5 (95% CI -4.2 to 7.3) SF-36 physical function: 1.9 (95 5CI -3.7 to +7.5) ODI: 2.2 (95% CI -2.3 to +6.8) As-treated results at 2 years, differences between interventions (randomized cohort only) SF-36 bodily pain: +17.8 (95% CI 12.5 to 23.0) SF-36 physical function: +16.7 (95% CI 11.4 to 22.1) ODI: -15.9 (95% CI -20.2 to -11.7) As-treated results at 2 years, differences between interventions (randomized and observational cohorts) SF-36 bodily pain: 18.1 (95% CI 14.5 to 21.7) SF-36 physical function: 18.3 (95% CI 14.6 to 21.9) ODI: -16.7 (95% CI -19.5 to -13.9) Very or somewhat satisfied with symptoms (%): 36.6 (95% CI 28.0 to 45.1) Self-rated major improvement in progress (%): 50.0 (955 CI 42.2 to 57.9)	5/9

Table 97. Trials of decompressive surgery versus non-surgical treatment for spinal stenosis

Author, year Population evaluated	Surgical intervention	Number of patients Duration of follow-up	Main results	Quality score*
Weinstein, 2008[250] Spine Outcomes Research Trials Chronic symptomatic spinal stenosis without degenerative spondylolisthesis	Laminectomy (with or without fusion)	n=289 2 years	**Laminectomy versus non-surgical therapy (positive SF-36 and negative ODI scores favor surgery). Intention-to-treat results, differences between interventions** SF-36 bodily pain: 2.4 (95% CI -4.2 to 9.1) at 3 months, 7.8 (95% CI 1.5 to 14.1) at 2 years SF-36 physical function: -4.2 (95% CI -10.9 to 2.6) at 3 months, 0.1 (95% CI -6.4 to +6.5) at 2 years ODI: 0.5 (95% CI -5.0 to 6.0) at 3 months, -3.5 (95% CI -8.7 to +1.7) at 2 years As-treated results at 2 years, differences between interventions (randomized cohort only) SF-36 bodily pain: 11.7 (95% CI 6.2 to 17.2) SF-36 physical function: 8.1 (95% CI 2.8 to 13.5) ODI: -8.7 (95% CI -13.3 to -4.0) As-treated results at 2 years, differences between interventions (randomized and observational cohorts) SF-36 bodily pain: 13.6 (95% CI 10.0 to 17.2) SF-36 physical function: 11.1 (955 CI 7.6 to 14.7) ODI: -11.2 (95% CI -14.1 to -8.3) Very or somewhat satisfied with symptoms (%): 38.7 (95% CI 30.0 to 47.3) Self-rated major improvement in condition (%): 34.1 (95% CI 25.6 to 42.6)	5/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9
(ODI):Oswestry Disability Index

For spinal stenosis either with or without degenerative spondylolisthesis, two trials found initial decompressive surgery superior to initial non-surgical therapy[236, 243]. One small (n=31) trial found initial decompressive surgery (without fusion) superior to non-surgical treatment (lumbar support and back school) for likelihood of experiencing an overall 'good' outcome, though differences were somewhat decreased at longer follow-up (69% vs. 33% at 1 year, 92% vs. 47% at 4 years, 91% vs. 71% at 10 years)[243]. Interpretation of results is complicated by crossover from non-surgical therapy to surgery in10 of 18 patients. The second trial (n=94) found laminectomy with or without fusion moderately superior to non-surgical therapy on the ODI (mean difference 11.3 points) and for leg pain (mean difference 1.7 points on a 10 point scale) and substantially superior for low back pain (mean difference 2.3 points on a 10 point scale) at 1 year, but differences were diminished after 2 years (7.8 points on the ODI, 1.5 for leg pain, 2.1 for back pain)[236].

Two large multicenter trials (the Spine Outcomes Research Trials, or SPORT[936]) evaluated laminectomy with or without fusion versus non-surgical therapy for spinal stenosis specifically with[241] or without[250] degenerative spondylolisthesis. Although both trials found few differences between surgical versus non-surgical therapy through two years based on intention-to-treat analyses, results are difficult to interpret because nearly half of patients did not adhere to treatment assignments. In an on-treatment analysis of randomized patients adjusted for potential confounders, surgery was moderately superior (16 to 18 points on 100 point scales) to non-surgical therapy on the ODI and SF-36 bodily pain and functional scores after two years for spinal stenosis with degenerative spondylolisthesis[241], and slightly to moderately superior (8 to 12 points) to non-surgical therapy for spinal stenosis without degenerative spondylolisthesis[250]. Analyses that combined on-treatment results of randomized patients with data from concurrent observational cohorts resulted in slightly higher estimates in favor of surgery[241, 250]. In both trials, average improvements from baseline on the ODI and SF-36 in patients who did not undergo surgery averaged about ten points.

Results of a higher-quality, long-term (8 to 10 years) prospective observational study (n=148) of surgery versus non-surgical therapy for spinal stenosis (the Maine Lumbar Spine Study) are consistent with the randomized trials[937]. In general, benefits associated with surgery were statistically significant through 4 years, but attenuated or no longer present after 8 to10 years[937-939]. The proportion of patients with improvement in their predominant symptom was significantly greater with initial surgery compared to non-surgical therapy after 1 and 4 years (55% vs. 28%, p=0.003 and 70% vs. 52%, p=0.05, respectively), but not after 8 to 10 years (54% vs. 42%, p=0.3)[937-939]. Satisfaction with current status was also similar after 10 years (55% vs. 49%, p=0.5). Back-related functional status persistently moderately favored initial surgical treatment (mean change after 8 to 10 years -7.3 vs. -1.2 on modified RDQ scale, p=0.02). Among patients who initially had surgery, 23% underwent reoperation, and among patients who initially received nonsurgical treatment, 39% subsequently underwent surgery.

Interspinous spacer device versus non-surgical therapy for spinal stenosis or degenerative spondylolisthesis

For chronic (>6 months) one or two level spinal stenosis with pain relieved with flexion, one higher-quality[231] (n=75) and one lower-quality trial[251, 940, 941] (n=200) both found the X STOP® interspinous spacer device substantially superior to non-surgical treatment (epidural injection, NSAIDs, analgesics, physical therapy) for achieving an overall treatment success through two years based on the Zurich Claudication Questionnaire criteria (48% vs. 5% at 2 years[940, 941]) or a composite outcome for overall treatment success (63% vs. 13%[231]). At two years, the interspinous spacer device was superior to non-surgical therapy on the SF-36 bodily pain subscale in one trial reporting this outcome (mean difference in change from baseline about 19 points)[941], but in both trials differences on the SF-36 mental and physical component subscales were small or not statistically significant. Effects on rates of subsequent laminectomy were mixed One trial[941] found the interspinous spacer associated with lower rates of subsequent laminectomy compared to initial non-surgical therapy (6% vs. 22%), but the other trial[231] found no difference in rates of laminectomy (12% vs. 12%). The device manufacturer funded both trials. No trial has compared an interspinous spacer device to standard decompressive surgery.

Table 98. Trials of interspinous spacer device versus non-surgical treatment for spinal stenosis

Author, year Population evaluated	Surgical intervention	Number of patients Duration of follow-up	Main results	Quality score*
Anderson, 2006[231] Chronic symptomatic one- or two-level spinal stenosis with symptoms relieved by forward flexion	X-Stop® interspinous spacer	n=75 2 years	**Interspinous spacer device versus non-surgical treatment (results at 2 years)** Zurich Claudication Questionnaire (0 to 100), mean improvement: -27.35 vs. -3.86 SF-36 Physical component subscale: +9.66 vs. -0.05 SF-36 Mental component subscale: +4.23 vs. -0.26 Patient satisfaction (0 to 5), mean score: 1.55 vs. 2.80 Clinical 'success' (>15 point improvement in Zurich Claudication Questionnaire score, <2.5 patient satisfaction score, and no further surgery): 63% vs. 13% Additional surgery: 12% (5/42) vs. 12% (4/33)	5/9
Zucherman, 2004[251, 940, 941] Chronic symptomatic one- or two-level spinal stenosis with symptoms relieved by forward flexion	X-Stop® interspinous spacer	n=200 2 years	**Interspinous spacer device versus non-surgical treatment** Treatment success (improvement in all three subscales of the Zurich Claudication Questionnaire): 59% vs. 12% at 1 year (p<0.05), 48% vs. 5% at 2 years SF-36 bodily pain, mean score: 56.1 vs. 36.9 at 1 year (p<0.05), 53.8 vs. 34.5 at 2 years (p<0.05) SF-36 physical function, mean score: 62.2 vs. 42.7 at 1 year (p<0.05), 59.3 vs. 41.1 at 2 years (p<0.05) SF-36 physical component subscale: 38.4 vs. 31.2 at 2 years (p<0.05) SF-36 mental component subscale: 54.3 vs. 52.5 (p>0.05) Underwent laminectomy by 2 years: 6% vs. 22%	2/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9
(ODI):Oswestry Disability Index

Efficacy of different surgical techniques for spinal stenosis or degenerative spondylolisthesis

There is insufficient evidence to determine optimal surgical methods for spinal stenosis with or without degenerative spondylolisthesis. Systematic reviews of randomized trials found inconsistent results or no clear differences between laminectomy plus posterolateral fusion versus laminectomy alone[79, 80, 217, 228, 229]. The Cochrane review included three small (total n=139) trials[906, 931, 932] of patients with spinal stenosis or degenerative spondylolisthesis that found no significant differences between laminectomy and posterolateral fusion (with or without instrumentation) versus laminectomy alone for likelihood of experiencing a "poor" surgeon-rated outcome, though the trend favored laminectomy plus fusion (OR=0.44, 95% CI 0.13 to 1.48). A second higher-quality systematic review found laminectomy plus fusion superior to laminectomy alone for overall clinical success (RR 1.40, 95% CI 1.04 to 1.89, 7 studies)[217]. However, these results include data from 5 comparative observational studies and only 2 small (n=50 and n=43) randomized trials (RR 2.15, 95% CI 1.43 to 3.23)[906, 932]. One of these trials (rated lower-quality) may have skewed results because it reported an unusually high rate of successful clinical outcomes with fusion plus decompressive laminectomy (96%)[932].

Three systematic reviews evaluated evidence for instrumented versus non-instrumented fusion for mixed degenerative conditions, but did not report results separately for degenerative spondyolisthesis (see section on surgery for non-radicular low back pain)[79, 80, 210, 226]. A fourth (higher-quality) systematic review found no significant difference between instrumented versus non-instrumented fusion for degenerative spondyolisthesis (RR=1.19, 95% CI 0.92 to 1.54 based on 3 trials and 2 observational studies)[217].

For a mixed population of patients with degenerative or isthmic spondylolisthesis, one higher-quality trial found instrumented circumferential fusion moderately to substantially superior to instrumented posterolateral fusion at long-term (5 to 9 years) follow-up on all four areas of the Dallas Pain Questionnaire, moderately superior on the ODI (mean score 28 vs. 40, p=0.004), and substantially superior on current back pain scores (mean score 3 vs. 6 on a 0 to 10 scale, p=0.021)[927, 929]. Differences on the SF-36 physical component and mental component summaries were small (5 to 6 points) but statistically significant.

One small (n=25), lower-quality trial[935] included in one lower-quality systematic review found no differences in clinical outcomes after 2 years between use of 1 versus 2 stand-alone posterolateral interbody fusion BAK cages for L4-5 degenerative spondyolisthesis, though use of 1 cage was associated with less operative blood loss and operation time[225].

The Cochrane review included one trial[934] of laminectomy versus multiple laminotomy (partial laminectomy) for spinal stenosis that found no differences in clinical outcomes or spondylolisthesis progression, though confounding factors (including inconsistent surgical techniques and crossovers) may have affected results[79, 80].

Predictors of postoperative outcomes in lumbar spinal stenosis

For patients who underwent surgery for lumbar spinal stenosis, one lower-quality systematic review (21 studies, 8 higher-quality) found reported walking capacity (better preoperative walking capacity predicted better postoperative capacity) and depression (baseline depression predicted worse postoperative outcomes) to be significant predictors of postoperative outcomes[254]. Age and gender, the most frequently evaluated factors, only predicted outcomes in one of twelve studies.

Harms

No operative deaths were reported in four randomized trials of decompressive surgery versus non-surgical therapy for spinal stenosis[236, 241, 243, 250]. Dural tears were the most common operative complication, occurring in 7% to 11% of patients[236, 241, 250]. In two trials, neural injuries, vascular injury, and misplaced transpedicular screw were each reported in 1 patient undergoing surgery (total n=466)[236, 241]. In the observational Maine Lumbar Spine Study, neural injury occurred in 2.5% and dural tear in 10% of 81 operated patients[938].

Among 142 patients randomized to the X STOP® interspinous spacer device, there was one case each of an incision complication requiring antibiotics, respiratory distress, pulmonary edema, and an ischemic coronary episode[231, 251]. Two malpositioned spacer devices, one implant dislodgement/migration, and one spinous process fracture were also reported.

Costs

A higher-quality decision analysis estimated incremental cost-effectiveness of $56,500/QALY for laminectomy with noninstrumented fusion versus laminectomy without fusion in patients with degenerative spondylolisthesis and spinal stenosis[942]. The cost-effectiveness ratio of instrumented fusion compared with noninstrumented fusion was $3,112,800/QALY. However, this estimate was sensitive to the proportion of patients experiencing symptom relief after surgery, and could be as low as $82,400/QALY if the proportion of patients experiencing symptom relief was 90% with instrumented fusion and 80% with noninstrumented fusion. For spinal stenosis, estimated costs of laminectomy alone and laminectomy plus noninstrumented or instrumented fusion were $12,615, $18,495, and $25,914 in a study published in 1997[943].

Summary of evidence

- For spinal stenosis with or without degenerative spondylisthesis, two small, higher-quality trials found standard decompressive surgery moderately to substantially superior to initial non-surgical therapy for pain, function, or improved overall outcome at 1 year, but differences are attenuated with longer term follow-up. A well-designed, large observational study reported similar results, though surgery remained moderately superior for back-specific functional status through 10 years (level of evidence: fair).
- For spinal stenosis with degenerative spondylisthesis, a large, higher-quality trial found no differences between decompressive surgery and non-surgical therapy based on an intention-to-treat analysis, but results are difficult to interpret because of high rates of crossover in both

intervention groups. On-treatment analyses found decompressive surgery moderately superior to non-surgical therapy for both pain and function (level of evidence: fair).

- For spinal stenosis without degenerative spondylisthesis, a large, higher-quality trial found no differences between decompressive surgery and non-surgical therapy based on an intention-to-treat analysis, but results are difficult to interpret because of high rates of crossover in both intervention groups. On-treatment analyses found decompressive surgery slightly to moderately superior to non-surgical therapy for both pain and function (level of evidence: fair).
- For one- or two-level spinal stenosis relieved by flexion or sitting, two trials (one higher-quality) found an interspinous spacer device moderately superior to non-surgical therapy for pain and function through two years (level of evidence: fair).
- For degenerative spondylolisthesis, there was a trend towards superior clinical outcomes following decompressive laminectomy plus posterolateral fusion compared to decompression alone in three small, lower-quality trials, but results may be skewed by a trial that reported unusually good results with laminectomy plus fusion (level of evidence: poor to fair).
- For degenerative spondylolisthesis, there was no difference between instrumented and non-instrumented fusion in three trials (level of evidence: fair).
- For mixed degenerative or isthmic spondyolisthesis, one higher-quality trial found circumferential instrumented fusion moderately superior to instrumented posterolateral fusion for function and substantially superior for pain through 5 to 9 years follow-up (level of evidence: fair).
- For spinal stenosis, one lower-quality trial found no differences between laminectomy versus multiple laminotomy (level of evidence: poor).
- For spinal stenosis with or without degenerative spondylolisthesis, decompressive surgery for spinal stenosis (with or without degenerative spondylolisthesis) was associated with no operative mortality four randomized trials. Neural injuries occur in up to 2.5% of operations and dural tear in about 10% (level of evidence: fair).
- For spinal stenosis with or without degenerative spondylolisthesis, placement of an interspinous spacer device was associated with a malpositioned spacer device in 1.4% of 142 cases, with other complications occurring in less than 1% of cases (level of evidence: fair).

Recommendations and findings from other guidelines

- The AHCPR guidelines found that elderly patients with spinal stenosis who can adequately function can be managed without surgery, and surgery should normally not be considered in the first three months of symptoms. Decisions on treatment should take into account patient preferences, lifestyle, surgical risk, and co-morbid medical problems, and should not be based solely on imaging tests, but take into account degree of neurogenic claudication symptoms, associated limitations, and detectable neurologic compromise (strength of evidence: D).

Surgery for radiculopathy with herniated lumbar disc

The purpose of surgery for symptomatic lumbar disc prolapse is to relieve pressure on affected nerve roots by removing part of, or the entire, disc. Standard open discectomy involves removal of the disc via a standard surgical incision and surgery performed with direct visualization. It is often performed with laminectomy (removal of the vertebral lamina). Microdiscectomy, which is often also considered an "open" procedure, involves a small incision made in the back and use of an operating microscope to perform hemilaminotomy (removal of part of the lamina in order to adequately visualize the disc) and removal of the disk fragment compressing the affected nerves. It can be performed on an outpatient basis. A variety of "minimally invasive" techniques for performing discectomy are also available, including discectomy performed with endoscopic guidance and minimally invasive surgery with lasers to vaporize parts of the disc, automated percutaneous discectomy (using a pneumatically driven, suction-cutting probe), Coblation® nucleoplasty (using a catheter emitting low-frequency radio waves to vaporize and heat parts of the nucleus), and the disc Dekompressor™, a device for disc nucleus extraction that involves a rapidly rotating probe and autosuction.

Results of search: systematic reviews
We identified a higher-quality Cochrane review on efficacy of different surgical techniques for lumbar disc prolapse[81, 82]. We also identified five lower-quality systematic reviews that focused on efficacy of laser lumbar discectomy[211, 219], endoscopic laser foraminoplasty[220], automated percutaneous mechanical discectomy[222], or fusion[227] for treatment of symptomatic lumbar disc prolapse. We also identified one systematic review of Coblation® nucleoplasty, but it identified no trials and is discussed in Key Question 8 because it focused on efficacy for degenerative disc disease[88]. We excluded earlier versions of the Cochrane review[176, 177] and three other outdated systematic reviews[190, 191, 256].

Results of search: trials
35 trials evaluated surgery for radiculopathy with herniated lumbar disc[110, 234, 237-240, 248, 249, 842, 869, 870, 873-878, 944-962]. Thirty of the trials were included in at least one of the six systematic reviews[81, 82, 211, 219, 220, 222, 227] and we identified five additional trials (reported in six articles[110, 234, 237-240]). Four trials compared discectomy versus non-surgical therapy[237-239, 248, 249]; the remainder compared different surgical techniques. We excluded two trials published only as conference abstracts[262, 264].

Efficacy of discectomy versus non-surgical treatment for radiculopathy with herniated lumbar disc

Four trials compared surgery to non-surgical therapy (Table 99)[237-239, 248, 249]. We rated three trials higher-quality[237-239, 249]. Each trial enrolled patients with sciatica present for at least six weeks. Baseline pain scores averaged about 20 points on the 0 to 100 SF-36 bodily pain score (lower scores indicate worse pain) in two trials[238, 239, 249] and 60 on a 0 to 100 pain scale (higher scores indicate worse pain) in the third[237]. The fourth and oldest trial was rated lower-quality[248]. It enrolled patients unresponsive to two weeks of inpatient non-surgical treatment and did not report severity of baseline pain.

Table 99. Trials of discectomy versus non-surgical therapy for radiculopathy with prolapsed lumbar disc

Author, year Population evaluated	Surgical intervention	Number of patients Duration of follow-up	Main results	Quality*
Osterman, 2006[237] Radiculopathy for 6 to 12 weeks with imaging-confirmed lumbar disc prolapse	Micro-discectomy	n=58 2 years	**Microdiscectomy vs. non-operative treatment** (intention-to-treat, mean differences at 2 years, positive values favor microdiscectomy) Leg pain (0 to 100 scale): 9 (95% CI -1 to 20) Back pain (0 to 100 scale): 7 (95% CI -3 to 17) ODI (0 to 100 scale): 3 (95% CI -4 to 10) 15D Health-related quality of life (0 to 1.0 scale): 0.03 (-0.01 to 0.07) Subjective work ability (0 to 100 scale): 5 (95% CI -7 to 18) At 6 weeks, only leg pain superior in microdiscectomy group: mean score 12 vs. 25 On-treatment analyses (including 11 patients who crossed over to surgery): No differences for any outcomes	6/9
Peul, 2007[238, 239] Radiculopathy for 6 to 12 weeks with imaging-confirmed lumbar disc prolapse	Micro-discectomy	n=283 2 years	**Microdiscectomy vs. non-operative treatment (mean difference, negative values favor surgery except for SF-36 where positive values favor surgery)** RDQ: -3.1 (95% CI -4.3 to -1.7) at 8 weeks, -0.8 (95% CI -2.1 to +0.5) at 26 weeks, -0.4 (95% CI -1.7 to +0.9) at 1 year, and -0.5 at 2 years (95% CI -1.8 to +0.8) VAS score for leg pain (0 to 100): -17.7 (95% CI -23.1 to -12.3) at 8 weeks, -6.1 (95% CI -10.0 to -2.2) at 26 weeks, 0 (95% CI -4.0 to +4.0) at 1 year, and +2 at 2 years (95% CI -2.0 to +6.0) VAS score for back pain (0 to 100): -11.3 (95% CI -17.4 to -5.6) at 8 weeks, -2.3 (95% CI -8.2 to +3.6) at 26 weeks, -2.3 (95% CI -8.2 to +3.6) at 1 year, and -1.4 (95% CI -6.3 to +4.5) at 2 years SF-36 Bodily Pain: +8.4 (95% CI 3.2 to 13.5) at 8 weeks, +3.3 (-1.8 to +8.4) at 26 weeks, +2.7 (95% CI -2.6 to +7.9) at 1 year, SF-36 Physical Functioning: +9.3 (95% CI +4.4 to +14.2) at 8 weeks, +1.5 (95% CI -3.4 to +6.4) at 26 weeks, +2.2 (95% CI -2.8 to +7.2) at 1 year, -1.3 (95% CI -6.3 to +3.7) at 2 years Recovery (defined as complete or nearly complete disappearance of symptoms as measured on a 7-point Likert scale): 81% vs. 36% at 8 weeks, 77% vs. 71% at 26 weeks, 86% vs. 82% at 1 year, 81% vs. 79% at 2 years (hazards ratio 1.97, 95% CI 1.7 to 2.2, at 1 year)	7/9

Table 99. Trials of discectomy versus non-surgical therapy for radiculopathy with prolapsed lumbar disc

Author, year Population evaluated	Surgical intervention	Number of patients Duration of follow-up	Main results	Quality*
Weber, 1983[248] Radiculopathy unresponsive to two weeks of non-surgical inpatient treatment and with imaging-confirmed lumbar disc prolapse	Open discectomy	n=126 10 years	**Discectomy versus initial non-surgical treatment** 'Good' result (patient completely satisfied): 65% (39/60) vs. 36% (24/66) at 1 year, 67% (40/60) vs. 52% (34/66) after 4 years, 58% (35/60) vs. 56% (37/66) after ten years 'Poor' or 'bad' results: 8% (5/60) vs. 21% (14/66) at 1 year (OR=0.34, 95% CI 0.12 to 1.02), 14% (8/57) vs. 12% (8/66) after 4 years (OR=1.21, 95% CI 0.42 to 3.46), and 7% (4/55) vs. 6% (4/66) after 10 years (OR=1.22, 95% CI 0.29 to 5.10) Proportion with no low back pain: 60% (36/57) vs. 58% (38/66) at 4 years, 84% (43/51) vs. 79% (52/66) at 10 years Proportion with no radiating pain: 79% (45/57) vs. 68% (45/66) at 4 years, 98% (54/55) vs. 98% (65/66) at 10 years	4/9
Weinstein, 2006[249] Spine Outcomes Research Trials Radiculopathy for >6 weeks with imaging-confirmed lumbar disc prolapse	Open discectomy	n=501 2 years	**Standard open discectomy vs. non-operative treatment, intention-to-treat analyses (mean difference, negative values favor surgery)** SF-36 bodily pain (0 to 100): -2.9 (95% CI -8.0 to 2.2) at 3 months; -3.2 (-8.4 to 2.0) at 2 years SF-36 physical function (0 to 100): -2.8 (95% CI -8.1 to 2.5) at 3 months; 0 (95% CI -5.5 to 5.4) at 2 years ODI: -4.7 (95% CI -9.3 to -0.2) at 3 months; -2.7 (95% CI -7.4 to 1.9) at 2 years Sciatica Bothersomeness Index (0 to 24): -2.1 (95% CI -3.4 to -0.9) at 3 months; -1.6 (95% CI -2.9 to -0.3) at 2 years Work status, satisfaction with symptoms, satisfaction with care: No significant differences SF-36 bodily pain scale: -15.0 (95% CI -19.2 to -10.9) at 1 year SF-36 physical function scale: -17.5 (95% CI -21.5 to -13.6) at year ODI: -15.0 (95% CI -18.3 to -11.7) Sciatica Bothersomeness Index: -3.2 (95% CI -3.2 to -2.1)	6/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9
VAS: Visual Analogue; RDQ: Roland Morris Disability Questionnaire; ODI: Oswestry Disability Index; SMD: standardized mean difference; SF-36:Short-form 36

For radiculopathy with concordant herniated lumbar disc on imaging, the first trial (n=128) to compare surgery to non-surgical treatment was published in 1983. It found standard open discectomy associated with a lower likelihood of poor results compared to non-surgical therapy after one year (OR 0.38, 95% CI 0.14 to 0.99), but not after four or ten years (OR 1.21, 95% CI 0.42 to 3.45 and OR 1.21, 95% CI 0.29 to 5.10, respectively)[248]. One quarter of patients randomized to initial non-surgical therapy eventually underwent surgery. This trial was rated lower-quality, in part because standards for reporting and design of randomized trials have become more stringent.

Two higher-quality trials evaluated microdiscectomy versus non-surgical therapy[237-239]. The larger of the trials (n=283) found initial microdiscectomy moderately superior to initial non-operative treatment on the RDQ (3 points) and leg and back pain scores (18 and 11 points, respectively, on 0 to 100 VAS scales) at 8 weeks. By 26 weeks, differences in pain scores were small (6 points for leg pain) or no longer present (back pain), and there were no differences in pain scores after 1 or 2 years[238, 239]. Early differences in SF-36 bodily pain and physical functioning scores were small (8 to 9 points) and did not reach statistical significance. By 26 weeks, both groups had improved by 40 to 50 points on both scores. Patients assigned to initial surgery reported a faster rate of perceived recovery at 1 year (hazard ratio 1.97, 95% CI 1.72 to 2.22), but differences in the proportion of patients who experienced recovery were only present at 8-week follow-up (81% vs. 36%). By 26 weeks, recovery rates were similar (79% vs. 78%). A smaller (n=58) trial found microdiscectomy moderately superior to non-surgical treatment (isometric exercises) for leg pain (but not back pain, the ODI, or other outcomes) at six weeks, but no difference on any outcome assessed at 3 months to 2 years[237]. In both trials, approximately 40% of patients assigned to initial non-surgical therapy underwent surgery, which could have attenuated benefits associated with surgery in intention-to-treat analyses.

The large (n=501), multicenter, higher-quality Spine Outcomes Research Trial (SPORT)[936] found no differences between standard open discectomy or microdiscectomy (technique left to discretion of the surgeon) versus non-surgical therapy based on an intention-to-treat analysis (the exception being a five point different in improvement in ODI scores at 3 months), but interpretation of these findings is complicated by low rates of adherence to treatment assignments[249]. At the end of the trial, only 60% of patients randomized to surgery had undergone discectomy, and 45% randomized to non-operative treatment had undergone surgery. In on-treatment analyses adjusted for potential confounders, surgery was moderately superior by about 15 points on ODI scores and SF-36 bodily pain and physical function scales after one year, and differences remained statistically significant through two years. Some significant baseline differences were present between those who crossed over and those who remained on their original treatment assignment. Regardless of treatment allocation, improvement averaged 30 to 40 points on the ODI and SF-36 bodily pain and physical function scales after 2 years. Results of a concurrent prospective cohort study were consistent with on-treatment analyses from the randomized trial[963] and a combined analysis of the cohort study plus combined on-treatment results from the randomized trial found that benefits persisted through 4 years[242].

A higher-quality Cochrane review[81, 82] also found discectomy superior to non-surgical therapy for short-term outcomes, but only included two[248, 249] trials of surgery versus non-surgical therapy and one other trial[262] only available as a conference abstract.

The Maine Lumbar Spine Study, a well-designed, long-term (10 years follow-up) prospective cohort study (n=507) also found initial treatment with surgery associated with greater likelihood for improvement in the predominant symptom (either back or leg pain) at 1 year compared to initial non-surgical treatment (71% vs. 43%, p<0.001) for lumbar disc prolapse with radiculopathy, though differences were attenuated after 5 years (70% vs. 56%, p<0.001) and no longer significant after 10 years (69% and 61%, p=0.20)[964-966]. Patients initially treated surgically were also more likely to report long-term resolution of low back and leg pain (56% vs. 40%, p=0.006) and greater improvements in RDQ scores. Work and disability status were comparable between groups at all follow-up evaluations. About one-quarter of patients in either group underwent additional or subsequent back surgery. Another, lower-quality observational study (did not adjust for baseline differences or confounders) found that fewer patients (n=342) who initially underwent surgery reported their low back condition as unchanged or worse after 13 years compared to those who received initial non-surgical treatment (19% vs. 41%), though similar proportions reported sciatica (67% vs. 68%) and being disabled due to a back problem (20% vs. 20%)[967]. There were also no differences in long-term functional status.

Efficacy of discectomy versus chemonucleolysis for lumbar disc prolapse

Evidence on discectomy versus chemonucleolysis for lumbar disc prolapse is discussed in more detail in the section on chemonucleolysis (Key Question 8). Briefly, discectomy was generally superior to chemonucleolysis for patient-reported outcomes, surgeon-reported outcomes, and rates of additional or subsequent surgery in all trials included in the Cochrane review[81, 82]. However, differences were not always statistically significant.

Efficacy of discectomy versus epidural steroid injection for lumbar disc prolapse

Evidence on discectomy versus epidural steroid injection for lumbar disc prolapse is discussed in more detail in the section on epidural steroid injections (Key Question 8). Briefly, one higher-quality trial[842] included in the Cochrane review[81, 82] found discectomy superior for short-term (one to three month) outcomes related to pain relief, functional status, motor deficits, and use of medications, though differences were no longer significant after 2-3 years of follow-up. Results are difficult to interpret because about one-third of the patients assigned to epidural steroids crossed over to surgery, and intention-to-treat results were not reported.

Efficacy of laser-assisted discectomy

The Cochrane review[81, 82] included two trials of laser discectomy, neither of which compared laser discectomy versus non-surgical therapy, standard open discectomy, or microdiscectomy. One trial only reported in conference abstracts found chemonucleolysis superior to laser discectomy[877, 968]. The other trial only compared two type of lasers[959]. Three lower-quality systematic reviews of laser discectomy (with[211] or without endoscopy[219]) and endoscopic laser foraminoplasty[220] identified one additional trial[264] that compared laser lumbar discectomy versus

epidural steroids, but it is also only published as a conference abstract. It found no differences between interventions on any outcome, and the trial was aborted before completion.

Efficacy of Coblation® nucleoplasty or disc Dekompressor™

We found no trials on efficacy of nucleopasty or the disc Dekompressor™ for lumbar disc prolapse with radiculopathy.

Efficacy of different surgical techniques for lumbar disc prolapse

There is insufficient evidence to determine optimal surgical methods for radiculopathy with prolapsed disc. Four trials found no clear differences between microdiscectomy and standard open discectomy[234, 950, 956, 962].

There are no published trials of Coblation® nucleoplasty, disc Dekompressor™, or laser-assisted methods[219, 220], and insufficient evidence from sparse, lower-quality, and primarily small (N<100) trials[945, 949, 958, 961, 969, 970] to reliably evaluate sequestrectomy, automated percutaneous discectomy or percutaneous endoscopic discectomy[211, 222]. One larger trial (n=178) found endoscopic (interlaminar or transforaminal) discectomy superior to microdiscectomy for days of postoperative work disability (25 vs. 49, p<0.01) and postoperative pain (data not reported), with no differences in pain and ODI scores through 12 months, but it had a number of methodological shortcomings, including inadequate randomization method (alternate allocation) and lack of intention-to-treat analysis[240].

The Cochrane review also found that an inter-position gel covering the dura (five trials) and of fat (four trials) appear to reduce scar formation, but insufficient evidence to draw conclusions about effects on clinical outcomes[81, 82].

Harms

No operative deaths were observed in randomized trials and large observational studies of standard open discectomy or microdiscectomy versus non-surgical therapy (total number of patients undergoing surgery about 1400)[237, 238, 249, 963, 964]. The most common complication associated with surgery for lumbar disc herniation was dural tear, which occurred in 1% to 4% of operations[238, 249, 963, 964]. Reoperation occurred in 3% to 7% of patients within 1 year[238, 249, 963] of initial surgery and 9% within 2 years.[249, 963] In the SPORT randomized trial and observational cohort, no complications were reported in 95% of open discectomies.[249, 963] No cases of cauda equina syndrome occurred in patients randomized to non-operative treatment.

Costs

One study estimated a cost-effectiveness ratio of $12,000 to $33,900/QALY (depending on the cost of discectomy) for surgery for prolapsed disc relative to continued non-surgical management[971]. Another trial found similar costs for automated percutaneous lumbar discectomy and microdiscectomy for contained lumbar disc herniation (automated percutaneous lumbar discectomy associated with poorer outcomes)[972].

Summary of evidence

- For lumbar disc prolapse with radiculopathy, two higher-quality RCTs and two well-designed observational studies found standard open discectomy associated with small to moderately improved outcomes at 3 months to 4 years compared to initial non-surgical therapy (or delayed surgery). Patients who received either initial surgery or non-surgical treatment both experienced moderate improvements in pain and functional status. In some studies, benefits of surgery were attenuated or no longer present at longer-term follow-up. Interpretation of results is complicated by high rates of nonadherence to assigned therapies in some trials (level of evidence: good).
- For lumbar disc prolapse with radiculopathy, two higher-quality trials found microdiscectomy moderately superior to initial non-surgical therapy for pain relief (2 trials) and function (1 trial) after 6 to 8 weeks, though differences were no longer present after 1 to 2 years (level of evidence: good).
- For lumbar disc prolapse with radiculopathy, chemonucleolysis was consistently associated with trends towards worse outcomes compared to standard discectomy in five lower-quality trials, and was associated with subsequent surgery in about 30% of cases (level of evidence: fair).
- For lumbar disc prolapse with radiculopathy, two lower-quality trials found inconsistent evidence on efficacy of automated percutaneous discectomy versus chymopapain chemonucleolysis, with one trial finding chemonucleolysis superior and the other finding no differences in functional status or rates of neurologic deficits (level of evidence: poor).
- One lower-quality trial found low-dose chymopapain chemonucleolysis plus transforaminal posterolateral endoscopic discectomy associated with a slightly lower rate of recurrent herniation compared to endoscopic discectomy alone, but there were no differences on other outcomes (level of evidence: poor).
- One trial found epidural steroids superior to discectomy for short-term but not longer-term outcomes, but results are difficult to interpret because crossover rates were high and intention-to-treat results not reported (level of evidence: poor).
- Four trials (three lower-quality) found no clear differences between standard open discectomy and microdiscectomy (level of evidence: fair).
- One lower-quality trial found no clear differences between percutaneous endoscopic discectomy (used modified forceps and an automated cutter with suction) versus microdiscectomy (level of evidence: poor).
- There is mixed evidence from two lower-quality trials on efficacy of automated percutaneous discectomy versus microdiscectomy, with one trial reporting similar outcomes and the other poorer outcomes with automated percutaneous discectomy (level of evidence: poor).
- There is insufficient evidence to judge efficacy of laser discectomy or foraminoplasty (level of evidence: poor).
- There are no randomized trials of Coblation® nucleoplasty or disc Dekompressor™.

- Use of inter-position membranes may reduce scar formation, but there is insufficient evidence from eight trials to determine whether they improve clinical outcomes (level of evidence: poor).
- In randomized trials and well-designed observational studies, open discectomy was associated with no operative mortality in over 1400 cases and no complications in 95% of operations. Dural tear was the most common complication. No cases of cauda equina syndrome were observed in patients that received initial non-surgical treatment (level of evidence: fair).

Recommendations and findings from other guidelines

- The AHCPR guidelines found that patients with acute low back pain who do not have findings suggestive of nerve root compression or positive red flags do not need surgical consultation for possible herniated lumbar disc (strength of evidence: D).
- The AHCPR guidelines recommend discussing further treatment options after 1 month of conservative therapy in patients with sciatica, and consider referral to a specialist when all of the following are met: 1) sciatica is both severe and disabling, 2) symptoms of sciatica persist without improvement or with progression, 3) there is clinical evidence of nerve root compromise (strength of evidence: B).
- The AHCPR guidelines found standard discectomy or microdiscectomy appropriate for selected patients with herniated discs and nerve root dysfunction (strength of evidence: B).
- The AHCPR guidelines recommend against percutaneous discectomy in patients with lumbar disc herniation because of poor efficacy relative to chymopapain (strength of evidence: C).

Table 100. Systematic reviews on efficacy of surgery for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample size in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Surgery for non-radicular low back pain with common degenerative changes (20 unique RCTs in 11 systematic reviews)								
Andersson, 2006[72]	Quantitative	9 (3)	4	2 years (1 to 6 years)	69 (11 to 279)	Fusion (9)	Lumbar fusion for presumed degenerative disc disease: Median=67% (range 17% to 100%) for proportion reporting 'good' or 'excellent' results after fusion (16 studies, including observational data) Lumbar fusion versus non-operative treatment for non-specific LBP (2 RCTs): conflicting results (no difference in one RCT and fusion superior in the other)	2
Bono, 2004[210]	Quantitative	3 (not rated)	0	Range 1 to 2 years	Range 11 to 179	Fusion (3)	Instrumented versus noninstrumented fusion for non-radicular low back pain with common degenerative findings (3 RCTs) or degenerative spondylolisthesis (3 RCTs) Proportion with good or excellent results: 75% vs. 79% (all studies, including observational data); instrumentation improved outcomes in one of three RCTs.	3
de Kleuver, 2003[212]	Qualitative	No RCTs	Not applicable	Not applicable	Not applicable	Not applicable	Vertebral disc replacement for degenerative disc disease: Range 50% to 81% for good or excellent results (7 observational studies), range 7% to 46% for secondary surgery (3 observational studies)	6
Freeman, 2006[213]	Quantitative	2 (not rated)	0	2 years	78 and 309	Fusion (2), prosthetic disc (2)	Vertebral disc replacement with Charite® prosthetic disc vs. anterior interbody lumbar fusion with BAK cage for single level degenerative disc disease (1 completed RCT): 57% vs. 46% met all criteria for surgical success ($p<0.0001$ for equivalence test)	4

Table 100. Systematic reviews on efficacy of surgery for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample size in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Geisler, 2004[214]	Quantitative	4 (not rated)	0	Range 2 to 4 years	Range 46 to 304	Fusion (4), prosthetic disc (1)	360 degree lumbar fusion via ALIF, PLIF, or TLIF vs. stand-alone ALIF or PLIF for non-specific LBP or degenerative disc disease Weighted mean change in VAS: -49.1% (13 studies) vs. -45.5% (7 studies). Weighted mean change in mean ODI: -20.6% (5 studies) vs. -27.9%(13 studies)	2

Table 100. Systematic reviews on efficacy of surgery for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample size in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Gibson, 2005[79, 80]	Qualitative and quantitative	14 (7)	4	14 months (6 to 48 months)	72 (53 to 264)	Fusion (14), prosthetic disc (2)	Fusion vs. non-surgical treatment for non-specific LBP (2 RCTs): Surgery superior for back to work and patient rating at 2 years in 1 RCT (vs. physical therapy), but no differences for 1 year outcomes in other RCT (vs. multidisciplinary rehab) Prosthetic vertebral disc vs. fusion (2 RCTs): Small numbers, but no statistically significant differences between interventions Fusion with instrumentation vs. fusion without instrumentation (8 RCTs): OR 0.43 (95% CI 0.21 to 0.91) for no fusion (8 RCTs), OR 0.64 (95% CI 0.35 to 1.17) for poor clinical outcome (8 RCTs). Comparisons of anterior, posterior, and combined fusion (4 RCTs): Conflicting results; unable to draw conclusions about comparative effectiveness of anterior, posterior, or circumferential fusion Electrical stimulation vs. no electrical stimulation: OR 0.38 (95% CI 0.22 to 0.64) for no fusion after non-instrumented fusion (3 RCTs); OR 0.59 (95% CI 0.15 to 2.30) for no fusion after instrumented fusion. No significant effect on clinical outcomes in 2 RCTs	6
Ibrahim, 2008[215]	Quantitative	3 (3)	0	Range 1 to 2 years	Range 60 to 349	Fusion (3)	Lumbar fusion vs. non-operative treatment for non-specific LBP ODI (mean difference between interventions in improvement from baseline, negative values favor fusion, 3 RCTs): -4.13 (95% CI -9.08 to 0.82)	5

Table 100. Systematic reviews on efficacy of surgery for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample size in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Mirza, 2007[218]	Qualitative	4 (not rated)	0	Range 1 to 2 years	Range 60 to 349	Fusion (4)	Lumbar fusion vs. non-operative treatment for non-specific LBP: Range -8.8 to +3.9 for mean difference in improvement on ODI (4 RCTs); range -2.3 to +3.9 for fusion vs. intensive rehabilitation (3 RCTs)	5
NICE, 2004[221]	Qualitative	1 (not rated)	0	2 years	304	Fusion (1), prosthetic disc (1)	Vertebral disc replacement vs. anterior interbody lumbar fusion with BAK cage for single-level degenerative disc disease (1 RCT): Total disc replacement superior for proportion of patients with improvement in ODI (at least 25% improvement): 62% vs. 49%, p=0.04	3
Resnick, 2005[224]	Qualitative	2 (1)	0	1 and 2 years	61 and 264	Fusion (2)	Lumbar fusion vs. non-operative-treatment for non-specific LBP (2 RCTs): Fusion superior to standard non-operative treatments in 1 RCT (n=294), fusion no better than intensive rehabilitation in 1 RCT (n=64)	2
Resnick, 2005[225]	Qualitative	2 (2)	0	2 years and 35 months	53 and 264	Fusion (2)	Interbody fusion associated with higher fusion rates compared with posterolateral fusion for back pain due to degenerative disc disease limited to 1 or 2 levels Conflicting evidence on effects of interbody fusion on functional outcomes. No clear differences between different interbody fusion techniques	2

Table 100. Systematic reviews on efficacy of surgery for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample size in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Resnick, 2005[226]	Qualitative	4 (2)	1	2 years (16 to 26 months)	Range 68 to 264	Fusion (4)	Lumbar fusion with pedicle screw fixation to PLF for non-specific low back pain or degenerative disc disease (5 RCTs) or degenerative spondylolisthesis (3 RCTs) increases radiologic fusion success when assessed by plain x-ray with dynamic imaging (supported by all Class I and the majority of Class II and Class III evidence). No convincing clinical correlation between radiographic fusion and clinical outcome. Lumbar fusion with pedicle screw fixation: conflicting evidence on clinical outcomes (primarily Class II and III evidence). The largest contemporary RCT did not show a benefit with pedicle screw fixation	2

Table 100. Systematic reviews on efficacy of surgery for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample size in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Surgery for isthmic spondylo-listhesis (4 unique RCTs in 2 systematic reviews)								
Gibson, 2005[79, 80]	Quantitative and qualitative	4 (3)	0	Range 2 to 5 years	Range 27 to 111	Fusion (4), laminectomy (1)	Posterolateral fusion vs. non-surgical treatment for isthmic spondylolisthesis (1 higher-quality RCT): Surgery superior for pain and disability though not occupational outcomes at 2 years (no data on relief of sciatica) Fusion (with or without instrumentation) + laminectomy vs. fusion alone (with or without instrumentation) for isthmic spondylolisthesis (1 higher-quality RCT): Fusion + laminectomy inferior for rates of pseudoarthrosis (22% vs. 0%, p=0.02) and unsatisfactory results (33% vs. 4%, p=0.01) Instrumented vs. non-instrumented posterolateral fusion for isthmic spondylolisthesis (1 higher-quality RCT): No differences	6
Kwon, 2005[216]	Quantitative	4 (not rated)	0	Range 2 to 5 years	Range 27 to 111	Fusion (4), laminectomy (1)	Combined vs. posterior fusion for isthmic spondylolisthesis: 86% vs. 75% (p=0.0045) for 'successful' clinical results (includes observational data) Combined vs. anterior fusion for isthmic spondylolisthesis: 86% vs. 90% (p=0.65) for 'successful' clinical results (includes observational data) Posterior vs. anterior fusion for isthmic spondylolisthesis: 75% vs. 90% (p=0.0047) for 'successful' clinical results (includes observational data)	1

Table 100. Systematic reviews on efficacy of surgery for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample size in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Bono, 2004[210]	Quantitative	3 (0)	0	Range 2 to 3 years	Range 50 to 130	Fusion (3), laminectomy (1)	Instrumented versus noninstrumented fusion for non-radicular low back pain with common degenerative findings (3 RCTs) or degenerative spondylolisthesis (3 RCTs) Proportion with good or excellent results: 75% vs. 79% (all studies, including observational data); instrumentation improved outcomes in one of three RCTs	3
Surgery for spinal stenosis with or without degenerative spondylo-listhesis (12 unique RCTs in 8 systematic reviews)								
Gibson, 2005[79, 80]	Qualitative and quantitative	10 (4)	2	2 years (1 to 10 years)	66 (31 to 200)	Fusion (7), laminectomy (5), interspinous spacer (1)	Surgical decompression vs. non-surgical therapy for spinal stenosis (1 RCT): OR 0.09 (95% CI 0.01 to 0.89) for secondary surgery by 4 years; OR 2.43 (95% CI 0.09 to 57.58) for 'bad result' after 10 years. Laminectomy vs. multiple laminotomy for spinal stenosis (1 RCT): no differences. Interspinous spacer device vs. non-surgical therapy (including epidural steroid) for spinal stenosis (1 RCT): 1 year pain and claudication results superior with spacer device Laminectomy plus fusion vs. laminectomy alone for spinal stenosis with or without degenerative spondylolisthesis: OR 0.44 (95% CI 0.13 to 1.48) for poor result (surgeon rated) at 18 to 24 months (3 RCTs); OR 4.69 (95% CI 0.51 to 42.83) for re-operation after 2-4 years (2 RCTs)	6

Table 100. Systematic reviews on efficacy of surgery for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample size in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Martin, 2007[217]	Quantitative	4 (1)	1	Range 2 to 3 years	Range 44 to 83	Fusion (4), laminectomy (2)	Fusion versus decompression alone for degenerative lumbar spondylolisthesis: RR 2.15 (95% CI 1.43 to 3.23) for satisfactory clinical outcome (2 lower-quality RCTs); RR 1.40 (95% CI 1.04 to 1.89) when pooled with observational studies Instrumented fusion versus non-instrumented fusion for degenerative lumbar spondylolisthesis: RR 1.58 (95% CI 0.60 to 4.12) for satisfactory clinical outcome (3 RCTs, 1 higher-quality); RR 1.19 (95% CI 0.92 to 1.54) when pooled with observational studies; RR 1.96 (95% CI 1.35 to 2.84) for achieving solid fusion (2 RCTs, 1 higher-quality); RR 1.37 (95% CI 1.07 to 1.75) when pooled with observational studies	5
NICE, 2005[223]	Qualitative	1 (not rated)	0	2 years	200	Interspinous spacer device (1)	Interspinous spacer implant vs. non-surgical therapy for lumbar spinal stenosis with neurogenic claudication exacerbated in extension and relieved with flexion (1 RCT): 45% vs. 7% ($p<0.001$) improvement in symptom severity from baseline at 1 year, 44% vs. 0.4% ($p<0.001$) improvement in physical function scores at 1 year, 48% vs. 5% fulfilled all Zurich Claudication Questionnaire criteria at 2 years	4

Table 100. Systematic reviews on efficacy of surgery for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample size in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Resnick, 2005[228]	Qualitative	4 (1)	0	Range 2 to 3 years	Range 44 to 130	Fusion (4), laminectomy (2)	Laminectomy + fusion versus laminectomy alone for spinal stenosis with degenerative spondylolisthesis (1 RCT): Fusion superior for excellent or good outcome at 3 years (96% vs. 44%), also for leg and back pain	2
Resnick, 2005[229]	Qualitative	3 (0)	0	Range 2 to 3 years	Range 44 to 50	Fusion (3), laminectomy (3)	Laminectomy + fusion versus laminectomy alone for spinal stenosis with or without degenerative spondylolisthesis (3 RCTs): No evidence that fusion (with or without instrumentation) provides any benefit over laminectomy alone for lumbar stenosis without evidence of preoperative deformity or instability	2
Resnick, 2005[225]	Qualitative	2 (0)	1	2 years	25 and 147	Fusion (2)	Circumferential instrumented fusion versus posterolateral fusion (1 lower-quality RCT): Lower re-operation rate through 2 years (7% vs. 22%), leg pain at 1 year ($p<0.03$), and peak back pain at 2 years ($p<0.04$); no difference in functional status (2 years) One stand-alone posterolateral interbody fusion BAK cage versus two stand-alone posterolateral interbody BAK cages for L4-L5 degenerative Grade I spondylolisthesis (1 lower-quality RCT): No differences	2

Table 100. Systematic reviews on efficacy of surgery for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample size in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Resnick, 2005[226]	Qualitative	3 (2)	0	2 years	Range 44 to 130	Fusion (3), laminectomy (1)	Lumbar fusion with pedicle screw fixation to PLF for non-specific low back pain or degenerative disc disease (5 RCTs) or degenerative spondylolisthesis (3 RCTs) increases radiologic fusion success when assessed by plain x-ray with dynamic imaging (supported by all Class I and the majority of Class II and Class III evidence) No convincing clinical correlation between radiographic fusion and clinical outcome Lumbar fusion with pedicle screw fixation: conflicting evidence on clinical outcomes (primarily Class II and III). The largest contemporary RCT did not show a benefit with pedicle screw fixation	2
Surgery for radiculopathy with herniated lumbar disc (30 unique RCTs in 6 systematic reviews)								
Boult, 2000[211]	Qualitative	No RCTs	Not applicable	Not applicable	Not applicable	Not applicable	Information about percutaneous endoscopic laser discectomy is very limited and the information available is of poor quality The safety and/or efficacy of the procedure cannot be determined due to an incomplete and/or poor quality evidence base	4

Table 100. Systematic reviews on efficacy of surgery for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample size in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
Gibson, 2007[81, 82]	Qualitative and quantitative	30 (8)**	30	1 year (6 weeks to 10 years)	79 (18 to 501)	Standard discectomy or not specified (12), microdiscect-omy (10), laminotomy (2), minimally invasive, laser, or automated percutaneous mechanical discectomy (9)	Discectomy (standard or micro-) versus initial non-surgical therapy Poor/bad result (surgeon-rated): OR 0.38 (95% CI 0.14 to 0.99) at 1 year, OR 1.21 (95% CI 0.42 to 3.45) at 4 years, OR 1.21 (95% CI 0.29 to 5.10) at 10 years (1 RCT); qualitatively, discectomy superior for short-term outcomes in all 3 RCTs, but differences attenuated at longer follow-up in 2 of the RCTs Microdiscectomy versus standard open discectomy for lumbar disc prolapse (4 RCTs): Outcomes broadly similar (data couldn't be pooled) Automated percutaneous discectomy vs. microdiscectomy (2 RCTs) or chemonucleolysis (2 RCTs) for lumbar disc prolapse: Automated percutaneous discectomy similar to microdiscectomy in 1 trial, inferior for satisfactory results in another (29% vs. 80%); and inferior to chemonucleolysis in 1 trial Percutaneous endoscopic discectomy (cannula inserted into the central disc) vs. microdiscectomy for lumbar disc prolapse (1 RCT): No differences Use of interposition membranes (8 RCTs): Effects on clinical outcomes inconsistent.	6

Table 100. Systematic reviews on efficacy of surgery for low back pain

Author, year	Type of systematic review	Number of included RCTs (number rated higher-quality) *	Number of RCTs not included in any other relevant systematic review	Median duration of follow-up (range)	Median sample size in included RCTs (range)	Interventions evaluated (number of RCTs)	Main conclusions	Overall quality using Oxman scale (1 to 7)
NICE, 2005[222]	Qualitative	3 (not rated)	0	Range 6 months to 1 year	Range 35 to 141	Automated perctuaneous mechanical lumbar discectomy (3)	Automated percutaneous lumbar discectomy vs. standard open discectomy for lumbar disc prolapse (1 RCT): 41% (7/17) vs. 40% (4/10) for excellent or good outcome Automated percutaneous lumbar discectomy vs. microdiscectomy for lumbar disc prolapse (1 RCT): 29% (9/31) vs. 80% (32/40) for successful outcome (p<0.001) Automated percutaneous lumbar discectomy vs. chemonucleolysis for lumbar disc prolapse (1 RCT): 44% (30/69) vs. 61% (44/72) for successful outcome (p<0.05)	4
NICE, 2003[219]	Qualitative	1 abstract (not rated)	1	1 to 26 months	29	Laser discectomy (1)	Laser lumbar discectomy vs. epidural corticosteroid injection for lumbar disc prolapse (1 RCT): No difference between groups on ODI or modified MacNab score	3
NICE, 2003[220]	Qualitative	No RCTs	Not applicable	Not applicable	Not applicable	Not applicable	3 comparative observational studies only compared results of endoscopic laser foraminoplasty in different populations, or complications only (no efficacy data) of endoscopic laser foraminoplasty vs. historical controls	3
Resnick, 2005[227]	Qualitative	No RCTs	Not applicable	Not applicable	Not applicable	Not applicable	Lumbar fusion for lumbar disc prolapse with radiculopathy: No convincing evidence to support routine use of lumbar fusion at the time of primary lumbar disc excision	3

*Trials adequately meeting at least half of the quality rating criteria or rated as good or higher-quality if the number of criteria met was not reported
**Trials adequately meeting criteria for adequate allocation concealment

Table 101. Summary of evidence on surgery for low back pain

Population	Number of trials of surgery versus non-surgical therapy (number rated higher-quality)	Number of trials of surgery vs. non-surgical therapy with >100 patients	Total number of trials	Net benefit*	Effective vs. non-surgical therapy	Inconsistency†	Directness of evidence	Overall quality of evidence	Comments
Lumbar interbody fusion									
Non-radicular low back pain with common degenerative changes	4 (4)	2	18	Small to moderate versus standard physical therapy supplemented by other non-surgical therapies, no benefit versus intensive rehab-ilitation	Yes versus standard physical therapy (1 trial), no versus intensive rehabilit-ation (3 trials)	Some inconsistency (see comments)	Direct	Fair	Inconsistency between trials may be related to use of different comparator interventions
Artificial disc replacement									
Non-radicular low back pain with single-level degenerative disc disease	2 (1)‡	2‡	2	No difference versus fusion	No trials	No	Direct	Fair	One trial of the Prodisc II and one trial of the Charité® Artificial Disc
Posterolateral fusion									
Isthmic spondylolisthesis	1 (0)	1	6	Moderate	Yes (1 trial)	Not applicable	Direct	Poor	
Standard open discectomy or micro-discectomy									
Lumbar disc prolapse with radiculopathy	4 (4)	3	35	Moderate	Yes (4 trials)	No	Direct	Good	Benefits associated with surgery diminish or no longer present after 3 months follow-up

Table 101. Summary of evidence on surgery for low back pain

Population	Number of trials of surgery versus non-surgical therapy (number rated higher-quality)	Number of trials of surgery vs. non-surgical therapy with >100 patients	Total number of trials	Net benefit*	Effective vs. non-surgical therapy	Inconsistency†	Directness of evidence	Overall quality of evidence	Comments
Laminectomy (with or without fusion)									
Spinal stenosis with or without degenerative spondylo-listhesis	4 (4)	2	17	Moderate	Yes (4 trials)	No	Direct	Good	Benefits associated with surgery present through 1 to 2 years follow-up
Interspinous spacer device									
One- or two-level spinal stenosis with symptoms relieved by forward flexion	2 (1)	1	2	Moderate to substantial (pain relief) slight to moderate (function)	Yes (2 trials)	No	Direct	Fair	Two trials of the X STOP® interspinous spacer device

* Based on evidence showing intervention is more effective than placebo or sham therapy for one or more of the following outcomes: pain, functional status, overall improvement, or work status. Versus placebo, small benefit defined as 5-10 points on a 100-point Visual Analogue Scale (VAS) for pain (or equivalent), 1-2 points on the Roland Morris Disability Questionnaire (RDQ), 5-10 points on the Oswestry Disability Index (ODI), or a standardized mean difference (SMD) of 0.2-0.5. Moderate benefit defined as10-20 points on a VAS for pain, 2-5 points on the RDQ, 10-20 points on the ODI, or a SMD of 0.5-0.8. Large benefit defined as >20 points on a 100 point VAS for pain; >5 points on the RDQ, >20 points on the ODI, or a SMD of >0.8.
† Inconsistency defined as <75% of trials reaching consistent conclusions on efficacy (no effect vs. positive effect considered inconsistent).
‡Trials of artificial disc replacement versus fusion.

Key Question 10

How effective are combinations of therapies for acute and chronic low back pain?

This section focuses on studies that compared dual therapy with two non-invasive interventions to monotherapy with one of the interventions. Most of the systematic reviews and trials included in this section are described in more detail in the relevant sections of Key Questions 3 and 4. We did not include invasive interventions in this section because they are generally only considered after failure of non-invasive therapies.

Combinations of medications

Results of search: systematic reviews
A Cochrane review included five trials (four higher-quality) on efficacy of skeletal muscle relaxants plus an NSAID or acetaminophen versus an NSAID or acetaminophen alone[488, 489]. We found no other systematic reviews on efficacy of one drug added to another relative to one of the drugs alone.

Results of search: trials
We identified one additional lower-quality trial on efficacy of opioids plus an NSAID versus an NSAID alone[517].

Efficacy of a muscle relaxant plus an analgesic versus an analgesic alone

For acute low back pain, the Cochrane review of muscle relaxants[488, 489] included three higher-quality trials[449, 973, 974] that consistently found tizanidine plus acetaminophen or NSAIDs superior to placebo plus acetaminophen or NSAIDs for short-term (up to one week) pain relief and decrease of muscle spasm. Another higher-quality trial included in the Cochrane review found no differences in global efficacy between orphenadrine plus acetaminophen compared to placebo plus acetaminophen, but the combination was associated with significantly fewer disability days[975]. One lower-quality trial found no differences in pain intensity or global efficacy between cyclobenzaprine plus an NSAID versus an NSAID alone, though effects on muscle spasm were superior[976].

Efficacy of an opioid plus an NSAID versus an NSAID alone

Naproxen was inferior to set-dose or titrated-dose opioid plus naproxen in one small n=36) lower-quality trial (Table 102)[517]. However, results are difficult to interpret because the naproxen dose was not specified and average doses not reported.

Table 102. Trials of an opioid versus an NSAID or acetaminophen

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Jamison, 1998[517]	n=36 16 weeks	**Sustained-release morphine + immediate-release oxycodone (titrated dose) + naproxen versus immediate-release oxycodone (set dose) + naproxen versus naproxen alone (mean scores over 16 weeks, all outcomes on 0 to 100 scales)** Average pain: 54.9 vs. 59.8 vs. 65.5 Anxiety: 11.2 vs. 15.0 vs. 31.6 Depression: 10.8 vs. 16.4 vs. 26.9 Level of activity: 49.3 vs. 49.3 vs. 51.5 Hours of sleep (means): 5.9 vs. 5.9 vs. 6.1	3/11

Harms
The Cochrane review found a higher risk of central nervous system adverse effects with the combination of a muscle relaxant plus an analgesic (4 trials, RR=2.44, 95% CI 1.05 to 5.63)[488, 489]. For overall adverse effects, there was no significant difference (RR=1.34, 95% CI 0.67 to 2.67).

Costs
We found no studies evaluating costs.

Summary of evidence

- For acute low back pain, there is consistent evidence from three higher-quality trials that tizanidine combined with acetaminophen or an NSAID is associated with greater short-term pain relief and decrease of muscle spasm compared to acetaminophen or an NSAID alone (level of evidence: good).
- For acute low back pain, one higher-quality trial found no benefits from adding orphenadrine to acetaminophen, though the combination was associated with fewer disability days (level of evidence: fair).
- For acute low back pain, one lower-quality trial found no benefits from adding cyclobenzaprine to an NSAID (level of evidence: poor).
- There is insufficient evidence from one trial (doses unclear) to judge efficacy of opioids plus an NSAID versus an NSAID alone (level of evidence: poor).
- Adding a muscle relaxant to acetaminophen or an NSAID is associated with an increased risk of central nervous system adverse effects (level of evidence: good).

Recommendations and findings from other guidelines

- The AHCPR guidelines found no additional benefit from using muscle relaxants plus NSAIDs over using NSAIDs alone.

- The European COST guidelines recommend adding a short course of muscle relaxants on its own or added to NSAIDs in patients with acute low back pain, if acetaminophen or NSAIDs failed to reduce pain.

Self-care advice combined with other interventions

Results of search: systematic reviews
We found no relevant systematic reviews.

Results of search: trials
We identified five trials (three rated higher-quality[368, 661, 977] that compared a self-care book plus another intervention to a self-care book alone[363, 978].

Efficacy of a self-care book combined with other interventions

For low back pain of less than 6 weeks' duration, one higher-quality trial found a self-care book plus advice and immediate exercise therapy using a biopsychosocial approach associated with more rapid improvements in function than a self-care book plus advice and waiting for 6 weeks to initiate exercise therapy (Table 103)[977]. For patients off work for less than one year due to low back pain, a lower-quality trial found addition of a brief exercise intervention to a self-care book and advice associated with quicker return to work (20 versus 13 days, p=0.034) and greater improvement in pain scores through two months compared to a self-care book and advice without the exercise intervention[978].

Table 103. Trials of a self-care book + exercise versus a self-care book alone

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Wright, 2005[978]]	n=111 2 months	**Self-care book plus advice plus usual care vs. self-care book plus advice plus brief exercise therapy** McGill Pain Questionnaire, VAS (0 to 100): 34.9 vs. 23.6 at 1 month (p=0.047), 30.9 vs. 18.4 at 2 months (p=0.023) McGill Pain Questionnaire, PPI (0 to 10): 1.75 vs. 1.13 at 1 month (p=0.039), 1.53 vs. 1.09 at 2 months (p=0.087) SF-12, physical subscale: 14.6 vs. 16.4 at 2 months (NS) SF-12, mental subscale: 20.8 vs. 22.1 at 2 months (NS) Return to work, median number of days: 20 vs. 13, (p=0.034)	3/9
Wand, 2004[977]	n=102 6 months	**Self-care book + advice + immediate exercise therapy with biopsychosocial assessment vs. self-care book + advice + delayed therapy** Roland Disability score (0 to 24), mean: 4.5 vs. 6.3 at 6 weeks (p=0.02), 3.9 vs. 4.4 at 6 months (p=0.94)Pain (0 to 10): 2.4 vs. 3.3 at 6 weeks (p=0.22), 2.1 vs. 2.4 at 6 months (p=0.61) SF-36 bodily pain (0 to 100): 65 vs. 54 at 6 weeks (p=0.06), 73 vs. 65 at 6 months (p=0.32) No differences on other SF-36 subscales at 3 or 6 months, though immediate therapy superior at 6 weeks on vitality, social functioning, and mental health	6/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

A higher-quality trial found addition of interferential therapy to a self-care book associated with greater improvement in functional status at three months compared to the self-care book alone, but baseline differences may invalidate results (Table 104)[661].

Table 104. Trials of a self-care book + exercise versus a self-care book alone

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Hurley, 2001[661]	n=60 3 months	**Interferential therapy applied to painful area + self-care book versus interferential therapy applied to area of spinal nerve + self-care book versus self-care book alone** (difference in median scores from baseline to 3 months) McGill Pain Questionnaire Pain Rating Index (0 to 78): +2.2 vs. -2.5 vs. -9.7 RDQ Score (0 to 24): -3.5 vs. -8.0 vs. -4.0 EQ-5D: No difference RDQ Score, median score at 3 months: 2.0 vs. 1.0 vs. 1.0	5/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Two other trials evaluated efficacy of a self-care book plus face-to-face advice with a self-care book alone. One higher-quality trial found a brief nurse-led educational intervention plus a self-care book associated with a higher proportion of patients exercising and greater patient satisfaction than a self-care book alone (Table 105)[368]. However, there were no differences in pain or functional status. A lower-quality trial found outcomes no better with the combination of a self-care book and advice to exercise compared to the self-care book alone[363].

Table 105. Trials of a self-care book + another intervention versus a self-care book alone

Author, year Duration of LBP	Number of patients Duration of follow-up	Main results	Quality score*
Little, 2001[363] Acute or subacute (<3 months)	n=311 3 weeks	**Self-care book vs. exercise advice vs. both vs. neither (control) (mean changes versus control)** Pain/function scale (0 to 100): -8.7 vs. -7.9 vs. -0.1 at 1 week, -6.3 vs. -1.4 vs. -4.0 at 3 weeks (NS) Aberdeen pain and function scale (0 to 100): -3.8 vs. -5.3 vs. -1.9 at 1 week (NS)	4/9
Cherkin, 1996[368] Not specified	n=300 1 year	**Self-care book vs. nurse education + self-care book vs. usual care (mean change from baseline)** RDQ score (0 to 24 scale): -5.4 vs. -5.2 vs. -5.3 (NS) at 1 week Symptom bothersomeness score (0 to 10 scale): -3.3 vs. -3.3 vs. -3.6 (NS) at 1 week Health care visits for low back pain: 45% vs. 46% vs. 47% in first 7 weeks after intervention (NS) Work loss days: 24% vs. 36% vs. 29% in first 7 weeks after intervention (NS)	6/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Harms

No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- Two trials (one higher-quality) found a self-care book plus advice plus exercise therapy superior to the self-care book and advice alone. One trial evaluated patients with back pain for less than 6 weeks and the other evaluated patients off work less than one year due to back pain (level of evidence: fair).
- Two trials (one higher-quality) found the addition of face-to-face advice to a self-care book did not improve clinical outcomes, though one of the trials found self-reported exercise and patient satisfaction higher (level of evidence: fair).
- For subacute low back pain, one higher-quality trial compared interferential therapy plus a self-care book to a self-care book alone and found the combined intervention improved functional status at 3 months, but differences could be due to baseline differences between groups (level of evidence: fair).

Recommendations and findings from other guidelines

- The other guidelines do not address self-care.

Exercise combined with other interventions

Results of search: systematic reviews
We identified one higher-quality Cochrane review[613, 614] and an associated meta-regression[615] that evaluated efficacy of exercise therapy plus other non-invasive interventions relative to exercise therapy alone for chronic low back pain.

Results of search: trials
One recent, large, lower-quality trial (UK BEAM) not included in the Cochrane review evaluated effects of exercise plus spinal manipulation versus spinal manipulation alone for subacute or chronic low back pain[629]. A higher-quality trial not included in the Cochrane review evaluated exercise plus self-care advice versus exercise alone[362].

Efficacy of exercise therapy plus other non-invasive treatments versus exercise alone

The meta-regression performed in conjunction with the Cochrane review analyzed 36 groups that received exercise plus another intervention and 36 groups that received exercise alone[615]. In multivariate analyses, adding other non-invasive interventions had a small average additional effect compared to exercise therapy alone of 5.1 points (95% CI 3.6 to 7.1) for pain and 2.1 points (95% CI 0.7 to 3.7) for function (each on 100 point scales).

Results of the recent, large (n=1334) UK BEAM trial were consistent with these findings (Table 106)[629]. At 12 months, the combination of exercise and manipulation was associated with small net improvements in RDQ scores compared to manipulation alone (net improvement relative to usual care 1.30 points on a 0 to 24 scale, 95% CI 0.54 to 2.07 and 1.01 points, 95% CI 0.22 to

1.81, respectively). The difference between combination therapy and manipulation was similar at three months. There were also no significant differences on the modified Von Korff scale or SF-36, though results on the back beliefs and fear avoidance questionnaires favored combination therapy.

A higher-quality trial found exercise plus advice to remain active slightly more effective than exercise alone for subacute (6 to 12 weeks) low back pain[362]. However, statistical significance was not reported for this comparison. Differences averaged about 0.3 points on a 0 to 10 pain scale and 0.6 points on the RDQ.

Table 106. Trials of exercise therapy plus other non-invasive interventions versus exercise therapy alone not included in published systematic reviews

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Pengel, 2007[362] (nonspecific low back pain)	n=259 12 months	**Exercise plus advice versus sham advice, sham ultrasound and sham diathermy (mean change reported for all results)** Pain: -1.5 (95% CI -2.2 to -0.7) at 6 weeks, -0.8(95% CI -1.7 to +0.1) at 12 months Patient-specific functional scale: +1.1 (95% CI +0.3 to +1.9) at 6 weeks, +1.1 (95% CI +0.3 to +1.8) at 12 months Global perceived effect: +1.3 (95% CI +0.7 to +1.9) at 6 weeks, +0.8 (95% CI 0.0 to +1.6) at 12 months RDQ: -1.3 (95% CI -2.7 to +0.2) at 6 weeks, -0.9 (95% CI -2.7 to +0.8) at 12 months Depression Anxiety Stress Scale: +0.2 (95% CI -2.5 to +2.8) at 6 weeks, -0.4 (95% CI -3.1 to +2.3) at 12 months **Exercise versus sham ultrasound plus sham diathermy (mean change reported for all results)** Pain: -0.8 (95% CI -1.3 to -0.3) at 6 weeks, -0.5 (95% CI -1.1 to +0.2) at 12 months Patient-specific functional scale: +0.4 (95% CI -0.2 to +1.0) at 6 weeks, +0.5 (95% CI -0.1 to +1.0) at 12 months Global perceived effect: +0.5 (95% CI +0.1 to +1.0) at 6 weeks, +0.4 (95% CI -0.1 to +1.0) at 12 months RDQ: -0.8 (95% CI -1.8 to +0.3) at 6 weeks, -0.3 (95% CI -1.6 to +0.9) at 12 months Depression Anxiety Stress Scale: -0.7 (95% CI -2.5 to +1.2) at 6 weeks, -0.6 (95% CI -2.6 to +1.3) at 12 months	8/9
UK BEAM Trial, 2004[629]	n=1334 12 months	**Manipulation + exercise versus manipulation versus exercise versus usual care (all results are net benefit relative to usual care at 12 months)** RDQ Questionnaire (0 to 24 scale): 1.30 (95% CI 0.54 to 2.07) vs. 1.01 (95% CI 0.22 to 1.81) vs. 0.39 (95% CI -0.41 to 1.19) Modified Von Korff pain score (0 to 100 scale): 6.71 (95% CI 2.47 to 10.95) vs. 5.87 (95% CI 1.58 to 10.17) vs. 4.90 (95% CI 0.30 to 9.50) Modified Von Korff disability score (0 to 100 scale): 6.71 (95% CI 2.62 to 10.80) vs. 5.65 (95% CI 1.57 to 9.72) vs. 4.56 (95% CI 0.34 to 8.78)	2/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- The addition of other non-invasive interventions to exercise was associated with small improvements in pain (about 5 points on a 100 point scale) and no clinically significant improvement in function (about 2 points on a 100 point scale) in a meta-regression of 36 comparison groups. Results of two additional trials not included in the meta-regression are consistent with these findings (level of evidence: good).

Recommendations and findings from other guidelines

- The other guidelines do not address exercise combined with other interventions.

Acupuncture combined with other non-invasive interventions

Results of search: systematic reviews
We identified one higher-quality Cochrane review of acupuncture for low back pain that evaluated efficacy of acupuncture added to other non-invasive interventions for acute (one lower-quality trial) or chronic (four higher-quality trials) low back pain[69, 70].

Results of search: trials
We did not search for additional trials

Efficacy of acupuncture plus other non-invasive treatments versus the other treatment alone

For acute low back pain, the Cochrane review included one lower-quality trial (n=100) that found the combination of acupuncture and moxibustion plus Chinese herbal medicine superior to Chinese herbal medicine alone for pain and function at long-term follow-up[979].

For chronic low back pain, the Cochrane review also included four higher-quality trials (n=289) that found addition of acupuncture to another intervention more effective than the other intervention alone (co-interventions included exercises, NSAIDs, aspirin, non-opioid analgesics, mud packs, infrared heat therapy, back care education, ergonomics, or behavioral modifications). In pooled analyses, the addition of acupuncture was associated with moderate improvements in pain (two trials, SMD -0.76, 95% CI -1.14 to -0.38) and function (three trials, SMD -0.55, 955 CI -0.92 to -0.18) that persisted through 3 to 12 months of follow-up[69, 70]. Despite the evaluation of different co-interventions, there was no between-study heterogeneity in the pooled analyses.

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- For acute low back pain, there is insufficient evidence to judge effects of acupuncture added to other interventions (one lower-quality trial) (level of evidence: poor).
- For chronic low back pain, the addition of acupuncture to a variety of other non-invasive interventions was associated with consistent, moderate beneficial effects compared to the other intervention alone on pain and function through 3 to12 months (four higher-quality trials) (level of evidence: good).

Recommendations and findings from other guidelines

- The other guidelines do not address acupuncture combined with other non-invasive interventions.

Spinal manipulation combined with other interventions

Results of search: systematic reviews
A higher-quality Cochrane review of spinal manipulation did not evaluate additive benefits of spinal manipulation to other non-invasive interventions[66, 67].

Results of search: trials
One recent, large trial evaluated exercise therapy plus manipulation versus manipulation alone and exercise therapy alone[629].

Efficacy of spinal manipulation plus exercise versus exercise alone

For acute or subacute low back pain, the UK BEAM trial found RDQ scores improved an average of 1.30 points (95% CI 0.54 to 2.07) with manipulation plus exercise compared to 0.39 (-0.41 to 1.19) with exercise alone (Table 106)[629]. The small difference in average effect (about one point) was not statistically significant. There were also no significant differences on other outcome measures including the Von Korff scale, the back beliefs questionnaire, the fear avoidance beliefs questionnaire, or SF-36. Another higher-quality trial found the combination of manipulation and exercise and a brief educational intervention (physician consultation) slightly superior to physician consultation alone for long-term pain scores (average 6.3 point difference on a 100 point pain scale at 12 months and 2.4 point difference after 24 months) compared to physician consultation alone in patients with chronic low back pain (Table 41)[612]. There were no differences on the ODI score or health-related quality of life.

Efficacy of chiropractic care plus physical modalities versus chiropractic care alone

The higher-quality UCLA Low Back Pain Study found chiropractic care plus physical modalities (heat or cold, ultrasound, or electrical muscular stimulation) no better than chiropractic care alone for pain or functional status (Table 107)[780, 781].

Table 107. Results of the UCLA Low Back Pain Study

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Hurwitz, 2002[780, 781] UCLA Low Back Pain Study	n=681 6 months	**Chiropractic care + physical modalities vs. chiropractic care alone** Most severe pain (0 to 10 scale): -0.15 (95% CI -0.85 to 0.55) at 6 months, +0.25 (-0.49 to 0.98) at 18 months Average pain (0 to 10 scale): -0.26 (95% CI -0.81 to 0.29) at 6 months, +0.12 (-0.46 to 0.71) at 18 months RDQ score (0 to 24 scale): +0.12 (95% CI -1.15 to +1.38) at 6 months, -0.01 (95% CI -1.35 to +1.32) at 18 months	7/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Harms
No trial reported adverse events.

Costs
The UK BEAM Trial estimated a cost-effectiveness ratio of £3800/QALY (about $7,448 U.S./QALY) for manipulation plus exercise relative to best care alone[629]. The cost-effectiveness of the combined treatment was superior to either manipulation or exercise alone (£4,800/QALY or about $9,408 U.S./QALY and £8,300/QALY or about $16,268 U.S./QALY respectively, each relative to best care alone).

Although the UCLA Low Back Pain Study found the addition of physical modalities to chiropractic care associated with negligible additional average cost ($579 vs. $560), there were also no differences in outcomes[787].

Summary of evidence

- For subacute or chronic low back pain, spinal manipulation plus exercise was not associated with significant benefits compared to exercise alone in a recent, large, lower-quality trial (level of evidence: poor).
- For back pain of unspecified duration, adding physical modalities to chiropractic care did not improve outcomes compared to chiropractic care alone in one higher-quality trial (level of evidence: fair).
- For chronic low back pain, the combination of spinal manipulation plus exercise and a brief educational intervention (physician consultation) was slightly superior for long-term pain but not function compared to physician consultation alone in one higher-quality trial (level of evidence: fair).

Recommendations and findings from other guidelines

- The other guidelines do not address spinal intervention combined with other interventions.

Massage combined with other interventions

Results of search: systematic reviews
We identified one recent, higher-quality Cochrane review of massage therapy[700, 701] that included one higher-quality trial[736] of massage plus exercise and education versus exercise and education without massage.

Results of search: trials
We did not search for additional trials.

Efficacy of massage plus exercise and education versus exercise and education without massage

For subacute low back pain, one trial found combined treatment with massage, exercise and education moderately superior to exercise and education without massage for pain (McGill Present Pain Intensity) and disability (RDQ score) at one-month follow-up[736]. Mean Present Pain Intensity scores (0 to 5 scale) were 0.42 (95% CI 0.17 to 0.66) for the combination versus 1.33 (0.97 to 1.7) for exercise and education alone, and mean RDQ scores (0 to 24 scale) 1.54 (95% CI 0.69 to 2.4) versus 5.71 (95% CI 3.5 to 7.9).

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- For subacute low back pain, the addition of massage therapy to exercise and education was moderately superior to exercise and education alone for short-term pain and disability in one higher-quality trial (level of evidence: fair).

Recommendations and findings from other guidelines

- The other guidelines do not address massage combined with other interventions.

Psychological therapies combined with other interventions

Results of search: systematic reviews
We identified one recent, higher-quality Cochrane review that included six lower-quality trials comparing psychological therapies in addition to another treatment versus the other treatment alone for chronic low back pain[301]. We considered combination therapy including psychological therapy separately from interdisciplinary rehabilitation, which we defined as a more integrated (and usually more intensive) intervention that often involves three or more different interventions (see Key Question 4).

Results of search: trials
We did not search for additional trials

Efficacy of psychological therapies in addition to another intervention versus the other intervention alone

The Cochrane review included six trials that compared psychological therapies combined with exercise and back education, multidisciplinary treatment, inpatient pain management, various forms of medical treatment (pain medication, nerve blocks, or physical therapy), and exercise therapy[301]. In pooled analyses, adding psychological therapies to other interventions was not associated with beneficial effects on long-term pain intensity (SMD=-0.24, 95% CI -0.64 to 0.16), functional status (SMD=0.26, 95% CI -0.06 to 0.57), or behavioral outcomes (SMD=0.32, 95% CI -0.06 to 0.71). Despite the evaluation of different co-interventions, little between-study heterogeneity was present.

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- For chronic low back pain, psychological therapies did not improve outcomes when added to a variety of other interventions in six lower-quality trials. Diversity in both the psychological and non-psychological interventions may limit generalizability of these findings (level of evidence: fair).

Recommendations and findings from other guidelines

- The other guidelines do not address psychological therapy combined with other interventions.

Traction combined with other interventions

Results of search: systematic reviews
We identified a recent, higher-quality Cochrane review[676, 677] that included one lower-quality trial[980] comparing traction plus physical therapy to physical therapy alone.

Results of search: trials
We did not search for additional trials

Efficacy of traction plus physical therapy versus physical therapy alone

For chronic low back pain with or without sciatica, one small (n=42) trial included in the Cochrane review found no statistically significant differences between traction plus physical therapy (exercise, hot packs, and ultrasound) and physical therapy alone for pain, functional status, global recovery, or satisfaction[980].

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- For chronic low back pain with or without sciatica, traction plus physical therapy was no better than physical therapy alone in one small, lower-quality trial (level of evidence: poor).

Recommendations and findings from other guidelines

- The other guidelines do not address traction combined with other interventions.

Combination therapy for spinal stenosis

Results of search: systematic reviews
We found no relevant systematic reviews.

Results of search: trials
We identified one higher-quality trial on efficacy of two different physical therapy-based interventions for spinal stenosis[630].

Efficacy of combined physical therapy interventions for spinal stenosis

For chronic spinal stenosis, one higher-quality trial found the combination of manual therapy (manipulation and mobilization), tailored exercises, and body-weight supported treadmill ambulation associated with a higher likelihood of perceived recovery compared to lumbar flexion exercises, standard treadmill walking, and subtherapeutic ultrasound (79% vs. 41% at 6 weeks, 38% vs. 21% at 29 months), though there were no differences on other outcomes including pain scores and the ODI[630].

Table 108. Trial of physical therapy-based interventions for spinal stenosis

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Whitman, 2006[630]	n=60 Mean 29 months	**Manual therapy, tailored exercises, and body-weight supported treadmill ambulation program vs. lumbar flexion exercises, standard treadmill walking, and subtherapeutic ultrasound** Perceived recovery (global rating of change +3 or higher): 79% vs. 41% at 6 weeks, 62% vs. 41% at 1 year, 38% vs. 21% at mean 29 months ODI, between group differences (positive values favor manipulation/mobilization group): 3.93 (95% CI -2.07 to 9.93) at 6 weeks, 2.10 (95% CI -8.50 to 4.32) at 1 year Spinal Stenosis Scale Satisfaction Subscale (1 to 4), between group differences: 0.26 (95% CI -0.09 to 0.62) at 1 year Numeric Pain Rating Scale for lower extremity symptoms (0 to 10), between group differences: 0.47 (95% CI -1.23 to 2.18) at 1 year Treadmill walking distance: No differences	8/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- For chronic spinal stenosis, one higher-quality trial found manual therapy, tailored exercises, and body-weight supported treadmill ambulation moderately superior for perceived recovery compared to standardized lumbar flexion exercises, standard treadmill walking, and subtherapeutic ultrasound through two years, but found no differences on other outcomes (level of evidence: fair).

Recommendations and findings from other guidelines

- The other guidelines do not address combination therapy for spinal stenosis.

Key Question 11
How effective are different treatment strategies for failed back surgery syndrome?

The term failed back surgery syndrome is commonly used to refer to a heterogeneous group of conditions characterized by chronic disabling low back pain with or without leg pain following one or more spinal surgeries. Because success rates of a second spinal operation are substantially lower than with initial surgery (and continue to decline with subsequent operations)[981], effective non-surgical treatment alternatives have been sought for patients with failed back surgery syndrome.

Adhesiolysis and forceful epidural injection

Adhesiolysis (also referred to as lysis of epidural adhesions, epidural neurolysis, and epidural neuroplasty) is a relatively new procedure. The goal of adhesiolysis is to facilitate application of drugs to target nerves and other tissues by removing scars and adhesions in the epidural space. Adhesiolysis can be performed percutaneously or with endoscopic guidance and involves the injection of isotonic saline, hypertonic saline, or hyaluronidase (intended to facilitate lysis of adhesions). It is typically reserved for patients with back pain refractory to other treatments, often in the post-surgical setting.

The purpose of forceful epidural injections is also to disrupt epidural adhesions or fibrosis following lumbar surgery by injecting large volumes (20 ml's or more) of saline, with or without a corticosteroid. In published trials of forceful epidural injections, the epidural space has been accessed via the sacroccygeal hiatus, which may help avoid areas of fibrosis that can impede placement of medications using other approaches.

Results of search: systematic reviews
We identified one lower-quality systematic review on efficacy of adhesiolysis[982]. We excluded an earlier version of this review[983]. We also included one lower-quality systematic review of endoscopic division of epidural adhesions[984].

Results of search: trials
The systematic review of adhesiolysis included four randomized trials[115, 985-987]. However, one trial classified as a randomized trial was clearly not randomized (patients were allocated to the no adhesiolysis group if the insurer or patient refused the treatment)[986]. In addition, the systematic review did not report quality ratings for included trials.

We independently abstracted and analyzed the three randomized trials included in the systematic review[115, 985, 987]. One was rated higher-quality[115]. It compared adhesiolysis to epidural steroid injection without adhesiolysis. Another trial compared adhesiolysis to a poorly defined physical therapy intervention[987]. The third trial compared different adhesiolysis methods (hypertonic versus normal saline, with or without hyaluronidase)[985]. We also identified two lower-quality trials evaluating forceful epidural injections for persistent post-operative back pain or sciatica[848, 850].

The systematic review of endoscopic division of epidural adhesions identified no trials that met inclusion criteria[984]. From 472 potentially relevant citations, we identified one higher-quality trial on efficacy of targeted steroid placement with epidural endoscopy with adhesiolysis if adhesions were observed at the target nerve, versus caudal epidural steroid without endoscopy[843].

Efficacy of adhesiolysis with or without hypertonic saline versus other interventions
The systematic review of adhesiolysis had important methodological limitations, including mis-classification of a non-randomized trial as randomized[986], failure to report quality ratings for included trials, and classification of trials as 'positive' (showing efficacy for adhesiolysis) if patients improved compared to baseline, regardless of whether any differences were observed versus a control group.

We independently rated the quality of adhesiolysis trials (Table 109). For chronic low back pain that failed to respond to standard treatments (including epidural steroids) and had negative facet joint block testing (about 70% with previous back surgery), one higher quality trial (n=75) found adhesiolysis with or without hypertonic saline associated with significantly greater likelihood for >50% pain relief compared to epidural steroid alone (72% and 60% vs. 0%, $p<0.001$) after 12 months[115]. However, even though patients enrolled in this trial had failed a previous epidural injection, the 0% response rate with epidural steroids is much lower than in other trials. For example, in a higher-quality trial of epidural steroids versus saline placebo, rates of improvement in pain were approximately 70% in both groups[130].

For chronic low back pain with sciatica (about 15% with previous back surgery), a second, lower-quality randomized trial found adhesiolysis substantially superior to physical therapy for leg and

back pain and moderately superior on the ODI at 6 months, though differences were no longer significant at 6 or 12 months[987]. The physical therapy intervention was not described in this trial, there was high loss to follow-up in the physical therapy arm, and intention-to-treat results were not reported. The third study reported itself as a randomized trial but was actually a non-randomized comparative study[986]. Adhesiolysis was superior to usual care on most measured outcomes including pain, measures of functional status, and opioid intake.

Table 109. Studies of adhesiolysis versus other interventions

Author, year	Number of patients Duration of follow-up	Main results	Quality
Veihelmann, 2006[987] (randomized controlled trial)	n=99 12 months	**Adhesiolysis vs. physiotherapy (improvement from baseline)** VAS leg pain (0 to 10): -4.8 vs. -1.1 at 3 months (p<0.05), -4.4 vs. -0.8 (NS) VAS back pain (0 to 10): -4.7 vs. -0.6 at 3 months (p<0.05), -4.2 vs. -0.3 (NS) ODI (0 to 100):-12.5 vs. +0.2 at 3 months (p<0.05), -11.5 vs. +0.2 (NS)	2/9*
Manchikanti, 2004[115] (randomized controlled trial)	n=75 12 months	**Adhesiolysis with hypertonic saline vs. adhesiolysis with isotonic saline vs. epidural steroid** Proportion with >50% pain relief at 12 months: 72% vs. 60% vs. 0% (p<0.001) ODI disability index score at 12 months: 23 vs. 24 vs. 32 (p<0.001) VAS pain score (0 to 10) at 12 months: 4.6 vs. 5.2 vs. 7.7 Taking opioids: 52% vs. 16% vs. 16% vs. 52% (p<0.001)	8/11
Manchikanti, 2001[986] (non-randomized comparative study)	n=45 18 months to 3 years	**Adhesiolysis vs. usual care** Average pain (0 to 10): 3.9 vs. 6.9 (p<0.06) Functional status (0 to 10): 5.3 vs. 4.3 (p<0.05) Opioid intake moderate or heavy: 74% vs. 80% Employed: 17% vs. 20%	3/11

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Efficacy of adhesiolysis with hypertonic saline versus hyaluronidase versus isotonic saline

One higher-quality trial found no significant differences in pain relief between patients randomized to adhesiolysis with hypertonic saline compared to adhesiolysis with isotonic saline (Table 110)[115]. One lower-quality trial found no significant differences between patients who underwent adhesiolysis with hypertonic saline alone versus adhesiolysis with hyaluronidase, hyaluronidase alone, or isotonic saline for pain relief or in the proportion of patients requiring additional treatments (Table 110)[985].

Table 110. Trials of adhesiolysis with hypertonic saline versus hyaluronidase versus isotonic saline

Author, year	Number of patients Duration of follow-up	Main results	Quality
Manchikanti, 2004[115] (randomized controlled trial)	n=75 12 months	**Adhesiolysis with hypertonic saline vs. adhesiolysis with isotonic saline vs. epidural steroid** Proportion with >50% pain relief at 12 months: 72% vs. 60% vs. 0% (p<0.001) ODI disability index score at 12 months: 23 vs. 24 vs. 32 (p<0.001) VAS pain score (0 to 10) at 12 months: 4.6 vs. 5.2 vs. 7.7 Taking opioids: 52% vs. 16% vs. 16% vs. 52% (p<0.001)	8/11
Heavner, 1999[985] (randomized controlled trial)	n=83 12 months	**Adhesiolysis with hypertonic saline vs. hypertonic saline + hyaluronidase vs. isotonic saline vs. isotonic saline + hyaluronidase** No significant differences on McGill Questionnaire, VAS pain score, and percentage requiring additional treatments through 1 year (data only reported in graphs, raw data not provided)	2/11

Efficacy of forceful epidural injection

For persistent post-operative low back pain with sciatica and epidural fibrosis by CT, one lower-quality trial evaluated efficacy of repeated (two injections in first 48 hours, then once a month for four months) forceful epidural injection via the sacrococcygeal hiatus with a total of 40 ml of saline plus 125 mg of prednisolone (5 ml) versus standard epidural injection with 125 mg of prednisone alone (Table 111)[850]. It found greater rates of treatment success at 6 months with forceful epidural injection with corticosteroid for sciatica (45% vs. 19%, p=0.025) and for low back pain (24% vs. 6%, p=0.002), though differences were only significant for low back pain at 18 months (31% vs. 19%, p<0.05). Forceful epidural steroid injection was slightly superior on low back pain scores (average difference about 6 points on a 100 point scale) but not on sciatica pain scores. There were no differences in functional status or work status.

For persistent post-discectomy sciatica, a second lower-quality trial found repeated (once a month for three months) forceful epidural injection with 20 ml of saline (with or without 125 mg prednisolone) inferior to standard epidural injection with 125 mg prednisolone alone on VAS pain scores through the first thirty days (p=0.01)[848]. However, there were no significant differences between the three groups one month after the third injection. There was also no difference in the proportion of patients achieving >15% improvement in pain score (p=0.30).

Table 111. Trials of forceful epidural steroid injection

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Meadeb, 2001[848] (randomized controlled trial)	n=47 4 months	**Forceful saline + corticosteroid vs. forceful saline alone vs. epidural corticosteroid alone (all via sacrococcygeal hiatus)** Improvement in pain (0 to 100 VAS): -1.9 vs. -10.7 vs. -10.1 (p=0.08 for B vs. A or C) Proportion with >15% improvement in pain score: 20% vs. 44% vs. 25% (p=0.30 for B vs. A or C) Dallas activity of daily living score: No differences	3/11
Revel, 1996[850] (randomized controlled trial)	n=60 18 months	**Forceful epidural saline + corticosteroid injection vs. epidural corticosteroids alone (via sacrococcygeal hiatus)** Treatment 'success' for sciatica (improved or considerably improved on global efficacy evaluation): 45% vs. 19% at 6 months (p=0.025) and 34% vs. 29% at mean 18 months (p>0.05) Treatment 'success' for low back pain: 24% vs. 6% at 6 months (p=0.002) and 31% vs. 19% at 18 months (p<0.05) Change in low back pain score (0 to 100): 7 vs. 1 (p=0.015) Change in sciatica pain score (0 to 100): 3 vs. -10 (p=0.08) No differences in medication use, functional index, return to work or return to leisure activities	5/11

Efficacy of endoscopic lysis of epidural adhesions

A systematic review found no trials of endoscopic lysis of epidural adhesions[984]. The only non-randomized comparative study evaluated endoscopic lysis of epidural adhesions in pregnant women not necessarily with low back pain.

For patients with persistent (>6 months) sciatica without previous spinal surgery, one trial not included in the systematic review found no differences in pain, anxiety, or depression scores between targeted steroid placement during spinal endoscopy with adhesiolysis performed if scar tissue was observed, versus caudal epidural steroid injection[843]. However, only 3 of 27 patients randomized to spinal endoscopy required endoscopic lysis of epidural adhesions.

Harms

One higher-quality trial of adhesiolysis reported one subarachnoid block among 50 patients[115]. One lower-quality trial reported no adverse effects among 59 patients undergoing adhesiolysis[985], but another lower-quality trial reported transient sensory deficits in about one-third of patients and catheter problems in about 9%[987]. A non-randomized comparative study reported one suspected infection and minor complications (such as rash and itching) in 10% of patients[986]. In other observational studies, subarachnoid puncture was reported in up to 9% of procedures[988], suspected infection in up to 10%[988], and post dural headache in 14%[989].

Two trials both found greater rates of pain (73% vs. 52%)[848] or drop-outs due to pain (14% vs. 3.2%)[850] associated with forceful epidural injection compared to standard epidural injection (Table 112).

Table 112. Trials of forceful epidural injection vs. standard epidural injection

Author, year	Number of patients Duration of follow-up	Main results	Quality score
Meadeb, 2001[848]	n=47 120 days	**Forceful saline + corticosteroid vs. forceful saline alone vs. epidural corticosteroid alone (all via sacrococcygeal hiatus)** Improvement in pain (0 to 100 VAS): -1.9 vs. -10.7 vs. -10.1 (p=0.08 for B vs. A or C) Proportion with >15% improvement in pain score: 20% vs. 44% vs. 25% (p=0.30 for B vs. A or C) Dallas activity of daily living score: No differences	3/11
Revel, 1996[850]	n=60 18 months	**Forceful saline + corticosteroid vs. epidural corticosteroids alone (via sacrococcygeal hiatus)** Treatment 'success' for sciatica (improved or considerably improved on global efficacy evaluation): 45% vs. 19% at 6 months (p=0.025) and 34% vs. 29% at mean 18 months (p>0.05) Treatment 'success' for low back pain: 24% vs. 6% at 6 months (p=0.002) and 31% vs. 19% at 18 months (p<0.05) Change in low back pain score (0 to 100): 7 vs. 1 (p=0.015) Change in sciatica pain score (0 to 100): 3 vs. -10 (p=0.08) No differences in medication use, functional index, return to work or return to leisure activities	5/11

Costs
We found no studies evaluating costs.

Summary of evidence

- For primarily post-surgical patients with refractory back pain who failed a previous epidural steroid injection, one small, higher-quality trial found adhesiolysis markedly superior to epidural steroid injection for pain relief. However, confirmation of results by other trials is necessary because of the extremely low (0%) response rate in the epidural steroid group (level of evidence: poor).
- For patients with chronic back pain and sciatica (with or without prior surgery), one lower-quality trial found adhesiolysis substantially superior to physical therapy for pain and functional status at 3 months, but the physical therapy intervention was not described, loss to follow-up was high in the physical therapy arm, differences were no longer significant after 6 months, and intention-to-treat results were not reported (level of evidence: poor).
- There is no clear evidence that adhesiolysis with hypertonic saline or hyaluronidase improves outcomes compared to adhesiolysis with isotonic saline alone (level of evidence: fair).
- Adverse events other than transient sensory deficits were infrequent and usually minor in trials of adhesiolysis, but were more common in observational studies and included suspected infection, subarachnoid puncture, and post-dural headache in up to 9-14% of patients (level of evidence: fair).
- For persistent post-surgical sciatica, one of two lower-quality trials found forceful epidural steroid injection superior to non-forceful epidural steroid injection (level of evidence: poor).

- For persistent sciatica without previous spinal surgery, one small, higher-quality trial found no difference between targeted placement of epidural steroids during spinal endoscopy compared to caudal epidural steroid injection without endoscopy, but few patients randomized to endoscopy required lysis of epidural adhesions (level of evidence: poor).

Recommendations and findings from other guidelines

- The other guidelines do not address adhesiolysis and forceful epidural injections.

Intrathecal therapy

Intrathecal therapy involves the delivery of pain medication (usually an opioid) via a catheter directly into the intrathecal space. It is reserved for patients who do not respond to less invasive interventions[990], including patients with failed back surgery syndrome. Before placing patients on long-term intrathecal therapy, a short-term trial is performed to determine responsiveness of pain and tolerability to treatment. For long-term, continuous use, intrathecal therapy is usually delivered using an implanted pump.

Ziconotide is a non-opioid analgesic that acts by blocking neuron-specific calcium channels. It is the synthetic equivalent of venom from the marine snail *Conus magus*. It approved in December 2004 by the FDA for treatment of chronic severe pain in patients in whom intrathecal therapy is indicated.

Results of search: systematic reviews
We found no systematic reviews evaluating efficacy of intrathecal delivery of opioids or other drugs in patients with low back pain.

Results of search: trials
From 207 potentially relevant citations, we found no randomized trials meeting inclusion criteria. Two recent trials of ziconotide did not include[991] or did not report results separately for patients with low back pain[992].

Efficacy of intrathecal therapy

For failed back surgery syndrome, the only comparative observational study (n=67) found implantation with an intrathecal pump and administration of opioids associated with improvement in the ODI in 27% of patients after 5 years, compared to 12% of patients receiving usual care[993]. For chronic low back pain, one prospective study (n=136, 76% with prior back surgery) found pain scores had dropped by more than 47% at 12-month follow-up[994]. In addition, more than 65% of implanted patients had improvements in ODI scores. Other data on efficacy of intrathecal opioid therapy primarily comes from small case series of patients with cancer or non-cancer pain, with the proportion of patients with ‘good or excellent’ results ranging from 50% to close to 100%[995].

A recent trial of ziconotide for refractory pain due to various conditions found greater short-term (three-week) improvements in pain scores with ziconotide (14.7% improvement) compared to

placebo (7.2% improvement, p=0.036)[990]. Results specifically in patients with chronic low back pain were not reported.

Harms
Complications following intrathecal pump implantation are common. In one study, there was an average of 0.77 mean complications per implant (n=23)[993]. The most common complication was catheter-related and occurred in 26% (6/23) of patients. Other complications include pump flipping (22%) and infection (22%). One patient required pump explanation, and another developed late-onset meningitis after catheter replacement. In another study, adverse events occurred in 23 of 136 (17%) patients after intrathecal pump implantation, with 21 (15%) requiring surgical correction[994]. Adverse events included infection (12%), dislodgement or migration (1.5%), and cerebrospinal fluid leak (0.7%). Recently, a number of inflammatory masses of the catheter tip (granulomas) in patients receiving intrathecal opioids have also been reported[990]. These masses appear associated with high doses of certain opioids (such as hydromorphone), and can become large enough to cause neurological injury.

Ziconotide was associated with significantly greater incidences of dizziness (47% vs. 13%), confusion (18% vs. 5%), ataxia (16% vs. 1.9%), abnormal gait (15% vs. 1.9%), and memory impairment (11.6% vs. 0.9%) compared to placebo in a recent trial of patients with chronic pain due to a variety of underlying conditions[990]. A trial of patients with refractory cancer of AIDs-related pain also reported increased fever, postural hypotension, nausea and vomiting, somnolence, and urinary retention with ziconotide compared to placebo[991]. Most adverse events with ziconotide resolve upon discontinuation of the medication.

Costs
We identified two cost studies[996, 997]. Both estimated fewer costs with intrathecal morphine relative to medical management, but used poor-quality observational data for key parameters.

Summary of evidence

- In patients with failed back surgery syndrome, there is insufficient evidence to judge efficacy of intrathecal opioid therapy (data from generally lower-quality observational studies only) (level of evidence: poor).
- Adverse events with intrathecal opioid therapy appear frequently and often require surgery (level of evidence: poor).
- There is insufficient data to judge efficacy of intrathecal ziconotide for low back pain (no trials).
- Intrathecal ziconotide is associated with a number of side effects including ataxia, dizziness, somnolence, confusion, nausea and vomiting, postural hypotension, and urinary retention (level of evidence: fair).

Recommendations and findings from other guidelines

- The other guidelines do not address intrathecal therapy.

Non-invasive interventions

Results of search: systematic reviews
We found no systematic reviews of non-invasive interventions for failed back surgery syndrome.

Results of search: trials
From 472 potentially relevant citations, we identified one lower-quality trial that compared low-tech exercise, high-tech exercise, physical agents, manipulation, and no treatment for chronic low back pain following L5 laminectomy[998].

Efficacy of non-invasive interventions for failed back surgery syndrome

The trial (n=250) found no significant differences in ODI scores at the end of an 8-week course of treatment of high-tech exercise (using specialized exercise equipment), low-tech exercise (using McKenzie and spinal stabilization training exercises), physical agents (hot packs, ultrasound, TENS), joint manipulation, or control, though trends favored the two exercise groups (Table 113)[998].

Table 113. Trial of efficacy of non-invasive interventions for failed back surgery syndrome

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Timm, 1994[998]	n=250 At end of 8 week course of treatment	**Low-tech exercise vs. high-tech exercise vs. physical agents vs. manipulation vs. no treatment (at end of 8 week treatment session)** ODI (0 to 100), mean improvement: -20.5 vs. -18.1 vs. -0.14 vs. -3.8 vs. -0.18	2/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

One comparative observational study found interdisciplinary rehabilitation to be moderately more effective at reducing self-reported pain and slightly more effective at improving ODI scores in patients with failed back surgery syndrome than in patients with chronic low back pain without previous back surgery[999].

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- For chronic low back pain following L5 laminectomy, one lower-quality trial found no significant differences in immediate post-treatment ODI scores between exercise, physical agents, manipulation, and no treatment (level of evidence: poor).
- Interdisciplinary rehabilitation was moderately more effective for reducing pain and slightly more effective for improving functional status in patients with failed back surgery syndrome compared to those without previous surgery in one comparative observational study (level of evidence: poor).

Recommendations and findings from other guidelines

- The other guidelines do not address non-invasive interventions.

Spinal cord stimulation

Results of search: systematic reviews
We identified three systematic reviews (all rated higher-quality) on efficacy of spinal cord stimulation for failed back surgery syndrome[85, 95, 96, 98]. We excluded one outdated systematic review[192] and one review that did not use systematic methods[195].

Results of search: trials
Two randomized trials evaluated spinal cord stimulation for failed back surgery syndrome[113, 153]. Interim or final results of one trial[153] were included in three higher-quality systematic reviews[85, 95, 96, 98] and we identified one additional trial[113].

The systematic reviews also included one lower-quality, controlled observational study[1000]. Seventy-two other case series of spinal cord stimulation for chronic back and leg pain or failed back surgery syndrome were included in one of the reviews[95] and are reviewed in Key Question 9.

Efficacy of spinal cord stimulation

For failed back surgery syndrome with persistent radiculopathy, one higher-quality trial (n=50) found spinal cord stimulation associated with a greater likelihood for >50% pain relief compared to re-operation after a mean of 2.9 years (38% or 9/24 vs. 12% or 3/26, p=0.048) (Table 114)[153]. Spinal cord stimulation was also associated with a lower rate of increased use of opioids (13% vs. 42%), and fewer patients allocated to spinal cord stimulation subsequently underwent surgery (21% or 5/24) compared to those allocated to surgery who later received spinal cord stimulation (54% or 14/26). Three-year results were similar. A second, higher-quality trial (n=100) of patients with persistent radicular pain following anatomically successful surgery for herniated disc found spinal cord stimulation associated with greater likelihood of experiencing >50% pain relief after six months compared to conventional medical management (48% versus 9%, $p<0.001$)[113]. Spinal cord stimulation was also moderately superior (by 10 to 20 points) on 7 of 8 SF-36 subscales and the ODI. The trial was designed so that patients randomized to spinal cord stimulation would undergo device implantation only if they experienced greater than 50% pain relief or 80% paresthesia coverage following a screening trial. 92% (48/52) of patients randomized to spinal cord stimulation underwent implantation, including five patients who did not meet criteria for a positive trial.

Table 114. Randomized trials of spinal cord stimulation for failed back surgery syndrome

Author, year	Sample size Type of LBP Duration of symptoms	Duration of follow-up	Main results	Quality score
Kumar, 2007[113]	n=100 Failed back surgery syndrome with persistent radiculopathy Chronic	12 months	**Spinal cord stimulation vs. conventional medical management** ≥50% pain relief at 6 months: 48% (24/50) vs. 9% (4/44) (p<0.001) >50% pain relief at 6 months: 34% vs. 7% (crossover at 6 months considered failures) (p=0.005) SF-36 Physical function: 38.1 vs. 21.8 (p<0.001) SF-36 Role physical: 17.5 vs. 8.0 (p=0.12) SF-36 Bodily pain: 33.0 vs. 19.5 (p<0.001) SF-36 General health: 52.8 vs. 41.3 (p<0.001) SF-36 Vitality: 41.3 vs. 31.1 (p=0.01) SF-36 Social functioning: 49.3 vs. 33.5 (p=0.002) SF-36 Role-emotional: 51.3 vs. 29.5 (p=0.02) SF-36 Mental health: 62.6 vs. 50.1 (p=0.002) ODI: 44.9 vs. 56.1 (p<0.001) Opioids use: 56% vs. 70% (p=0.20) Satisfied with pain relief: 66% vs. 18% (p<0.001) Return to work: 11% vs. 3% (p=0.36)	6/11
North, 2005[153]	n=60 Failed back surgery syndrome with persistent radiculopathy Chronic	2 years	**Spinal cord stimulation vs. recurrent lumbosacral spine surgery** >50% pain relief and satisfied with treatment: 38% (9/24) vs. 12% (3/26) (p=0.04) Crossed over: 21% (5/24) vs. 54% (14/26) (p=0.02) Opioid use stable or decreased: 87% (20/23) vs. 58% (15/26) (p=NS) Opioid use increased: 13% (3/23/) vs. 42% (11/26) Activities of daily living, neurologic status, ability to work: Differences not significant	6/11

Harms

In the randomized trials, 26% to 32% of patients experienced a complication following spinal cord stimulator implantation, including electrode migration, infection or wound breakdown, generator pocket-related complications, and lead problems[113, 153]. Long-term complications included one infection, two implantation generator pocket-related complications, and one defective lead. Evidence on harms from non-randomized studies of spinal cord stimulation is discussed in Key Question 8.

Costs

One of the randomized trials[153] that evaluated clinical outcomes also collected economic data[1001]. It estimated a 78% likelihood that the additional cost of spinal cord stimulation is less than $40,000/QALY compared to repeat surgery, based on data from 40 of the 50 patients originally enrolled in this trial. A decision analysis found that spinal cord stimulation dominated continued medical management over the lifetime of a patient with failed back surgery syndrome[891]. This study is difficult to interpret because it used potentially unreliable cost data from an observational study[993]. In addition, it assumed that the rate of pain relief in the nonspinal cord stimulator group could be estimated from a trial of patients with non-radicular low back pain randomized to surgery versus nonsurgical therapy[247], even though 80% of enrollees in that trial had never

previously undergone back surgery. No sensitivity analyses were performed on key costs, utilities, or rates of pain relief.

Summary of evidence

- For failed back surgery syndrome, one small, higher-quality trial found spinal cord stimulation associated with a higher likelihood of pain relief, lower likelihood of increase in opioid use, and lower likelihood of crossing over to reoperation (versus crossing over to spinal cord stimulation) compared to initial reoperation through 3 years and one small, higher-quality trial found spinal cord stimulation associated with moderately superior pain and functional outcomes compared to conventional medical management through 6 months (level of evidence: fair).
- About one-quarter of patients experience complications that usually not serious following spinal cord stimulator implantation. Most complications are related to infection and generator or lead-associated problems (level of evidence: fair).

Recommendations and findings of other guidelines

- The European COST guidelines found insufficient evidence to recommend spinal cord stimulation for patients with chronic low back pain.

Key Question 12

How effective are different methods of integrating or coordinating low back pain care?

Integration or coordination of care usually refers to a broad intervention that aims to help meet patient health care needs by enhancing information sharing across providers; encouraging use of evidence-based testing and interventions; insuring appropriate follow-up of referrals, testing, and interventions; and promoting goal-setting and patient self-management. Although interdisciplinary rehabilitation (see Key Question 4) may be considered a type of coordinated care intervention, it does not necessarily address the same broad framework as a formal coordination of care intervention.

Results of search: systematic reviews
We identified no systematic reviews on efficacy of different methods for integrating or coordinating care in patients with low back pain.

Results of search: trials
From 79 potentially relevant citations, we identified one lower-quality trial on efficacy of coordination of care relative to usual care in patients with back-pain associated disability[1002]. One other lower-quality trial evaluated efficacy of integrated care between primary care and neurology via a psychiatrist liaison versus usual care in patients with back pain of unspecified duration[1003].

Efficacy of coordinated or integrated care versus usual care

For workers receiving compensation for low back pain for 4 to 8 weeks, one trial found coordination of primary health care slightly superior to usual care for functional status after 6

months on the ODI scale (average 9 point difference, p=0.02) and moderately superior on the Quebec Back Pain Disability Scale (average twelve point difference on a 100 point scale, p=0.01) (Table 115)[1002]. Coordination of care was also associated with slightly quicker return to work (6.6 days, not significant). Patients randomized to coordinated care used three times fewer specialized imaging tests (p<0.01) and exercised twice as much (p<0.05) as controls. Two primary care physicians and a nurse performed the coordination of care intervention, which involved a complete examination, recommendations to the treating physician for clinical management consistent with guidelines, and support to carry out the recommendations.

For low back pain of unspecified duration, another lower-quality trial found integration of care between a neurologist and primary care physician via a psychiatrist did not improve patient outcomes, satisfaction of general practitioners, or affect utilization of healthcare services compared to usual care[1003]. The protocol called for the psychiatrist, who did not see the patient, to facilitate communication between the primary care physician and neurologist through structured telephone communication, weekly information sharing, and development of a treatment plan of care. However, the protocol was only fully implemented in about one-quarter of the 50 patients randomized to the intervention group.

Table 115. Trials of integration or coordination of care

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Rossignol, 2000[1002]	n=110 6 months	**Coordination of care versus usual care** Return to work by 6 months: 78% vs. 73% Time to return to work: average difference 6.6 days (NS) Pain, mean difference from baseline to 6 months: 22.9 vs. 12.8, p=0.1 Quebec Back Pain Disability Scale, mean difference from baseline to 6 months (0 to 100 scale): 20.9 vs. 9.1, p=0.01 ODI, mean difference from baseline to 6 months: 17.2 vs. 7.8, p=0.02 Dallas Pain Questionnaire, mean difference from baseline to 6 months: 25.9 vs. 11.7 (p=0.01)	4/9
Meeuwesen, 1996[1003]	n=104 6 months	**Coordination of care versus usual care** SCL-90 subscales, DSM-III-R somatoform disorders (DSM-SOM) scale: No differences between interventions Functional impairment scale (FBI), mean difference from baseline to 6 months: 1.6 vs. 0.9 (NS) General Health Questionnaire-28, mean difference from baseline to 6 months: 2.0 vs. 1.7 (NS) Satisfaction of general practitioners: no differences between interventions Medication use: no differences between interventions Diagnostic imaging: no differences between interventions	2/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Harms
No trial reported adverse events.

Costs
We found no studies evaluating costs.

Summary of evidence

- In workers receiving short-term (4 to 8 weeks) compensation for low back pain, coordination of low back pain care was superior to usual care for improving functional status and pain after 6 months and reduced use of specialized imaging tests in one lower-quality trial (level of evidence: poor).
- There is insufficient evidence to judge efficacy of coordination or integration of low back pain care in other (primary care) settings (one low quality trial) (level of evidence: poor).
- Interdisciplinary rehabilitation is reviewed in Key Question 4.

Recommendations and findings of other guidelines

- The other guidelines do not address integrating or coordinating care in improving outcomes.

Key Question 13

How effective are interventions for secondary prevention of low back pain in patients who have had an episode of acute low back pain, or for prevention of flares of low back pain in patients with chronic low back pain?

Back schools

Results of search: systematic reviews
A recent, higher-quality Cochrane review of back schools (19 trials) included five trials (three higher-quality[600, 604, 605]) that reported recurrent low back pain episodes (or sick leave due to low back pain) as an outcome[586, 587]. Another recent, lower-quality systematic review of back schools did not include any additional trials[1004].

Results of search: trials
We did not search for additional trials.

Efficacy of back schools versus no back school, usual care, or placebo for preventing recurrent episodes of low back pain

The Cochrane review included five trials that compared back schools to no treatment or usual care[586, 587]. Four trials were conducted in occupational settings and the fifth[600] in a mixed setting. Longer-term follow-up[603, 1005] is available from two higher-quality trials[600, 604].

For subacute low back pain, one trial found no difference between “mini” back school and usual care in the proportion of patients with one or more sick-leave recurrences randomized through five years of follow-up (72% or 142/198 versus 74% or 118/160), though the proportion with two or more recurrences was lower in the back school group (35% or 69/198 vs. 46% or 74/160)[603, 604]. In patients no longer on sick leave, the other longer-term trial found that the mean number of low back pain recurrences decreased more with an intensive back school program than with no back school through three years (mean decrease 0.9 vs. 0.3 episodes/year, $p<0.05$)[600, 1005]. On

the other hand, three trials (one higher-quality) with shorter duration of follow-up (one year) reported no difference in low back pain recurrences with back school relative to usual care, placebo treatment, or wait-list control[149, 598, 601]. Two of the trials enrolled patients with back pain for less than three months, and the third[601] enrolled patients with at least three episodes of low back pain annually.

Efficacy of back schools versus exercise for preventing recurrent episodes of low back pain

In workers with frequent (at least three annually) low back pain episodes, the Cochrane review included one lower-quality trial[601] that found back school associated with a higher incidence of low back pain episodes than biweekly calisthenics through 12 months in workers with frequent (mean number of painful months 7.3 vs. 4.5, $p<0.05$).

Summary of evidence

- Evidence on efficacy of back schools for preventing recurrent episodes of low back pain is mixed, which may be due in part to diversity among populations and interventions evaluated. One higher-quality trial found that an intensive back school intervention decreased recurrent episodes of low back pain more than no back school through three years of follow-up, but another trial that evaluated "mini" back school found no clear effect. Three shorter-term (1 year) trials (one higher-quality) also found no effect on recurrences (level of evidence: fair).
- One lower-quality trial found back school inferior to callisthenic exercises for reducing low back pain episodes through 12 months (level of evidence: poor).

Recommendations and findings from other guidelines

- The VA/DoD guidelines found inconclusive evidence on the long term benefit of back schools (strength of evidence: A to B).
- The UK RCGP guidelines found that group education based on the Swedish back school approach may be effective in occupational settings (strength of evidence: **).
- The UK RCGP guidelines found that the efficacy of back schools in non-occupational settings has not been demonstrated (strength of evidence: *).
- The European COST guidelines recommend against back schools for acute low back pain.
- The European COST guidelines recommend consideration of back schools where information is consistent with evidence-based recommendations for short-term (<6 weeks) pain relief and improvements in functional status, but recommend against back schools for chronic low back pain when aiming for long-term effects (>12 months).

Exercise

Results of search: systematic reviews

A recent, higher-quality Cochrane review of exercise for low back pain did not include recurrences as an outcome[613, 614]. Only one systematic review reported low back pain recurrences, but was rated lower-quality[1004].

Results of search: trials
We identified four lower-quality trials that reported effects of exercise on recurrences of low back pain[364, 1006-1008].

Efficacy of exercise versus no exercise for preventing recurrent episodes of low back pain

One trial found that a weekly, ongoing exercise program reduced the average number of low back pain episodes over a 1 ½ year period by 0.27, compared to an average increase of 0.19 episodes in the no exercise group (Table 116)[1007]. However, this study had numerous methodologic shortcomings including unclear randomization and allocation concealment methods, unclear use of blinded outcomes assessment, and lack of intention-to-treat analysis with high loss to follow-up. Another small (n=39), lower-quality trial found medical management (advice and medications) plus an exercise program aimed at strengthening the multifidus muscle associated with a lower number of low back pain recurrences after 1 year (30% vs. 84%) and 2-3 years (35% vs. 70%) compared to medical management alone[1006].

Table 116. Trial of exercise versus no exercise for preventing recurrent episodes of low back pain

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Kellett, 1991[1007]	n=125 1.5 years	**Exercise versus no exercise** Mean episodes of low back pain in 1.5 years prior to intervention minus episodes during 1.5 years during intervention: 0.27 vs. -0.19 (p<0.05) Mean sick days in 1.5 years prior to intervention minus episodes during 1.5 years during intervention: 2.86 vs. -1.63 (p<0.02)	1/9
Hides, 2001[1006]	n=39 3 years	**Exercise (strengthening of multifidus) plus advice and medications versus advice and medications alone** Rate of low back pain recurrences in 1st year: 6/20 (30%) vs. 16/19 (84%) in year 1 (p<0.05) Rate of continuing recurrences in years 2 and 3: 7/20 (35%) vs. 12/16 (75%) (p<0.05)	4/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Efficacy of exercise versus education only for preventing recurrent episodes of low back pain

Two lower-quality trials both found that exercise reduced the number of back pain recurrences (Table 117)[364, 1008]. In one trial of patients with a back pain episode who had completed treatment and sick leave, a course of McKenzie extension exercises was associated with fewer low back pain recurrences than back education only through one year follow-up (44% vs. 74%)[364]. The benefit persisted from one to five years follow-up (proportion of patients with recurrences 64% vs. 88%, p<0.01). In the other trial, a 13-week course of a Mensendieck exercise program (incorporating exercises and education) was associated with fewer recurrences compared to information about the exercise program only during 12 months of follow-up (32% versus 57%, p<0.05)[1008].

Table 117. Trials of exercise versus education for preventing recurrent episodes of low back pain

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Soukup, 1999[1008]	n=77 12 months	**Mensendieck exercise program versus education only** Low back pain recurrences during 12 month follow-up: 32% (11/34) vs. 57% (20/35) (p<0.05) Sick leave (mean days): 30 vs. 38 (NS) Pain, 0 to 100 scale: 26 vs. 32 (p=0.22)	3/9
Stankovic, 1995[364]	n=100 5 years	**McKenzie exercise versus back education** Recurrences: 44% (22/50) vs. 74% (37/50) after 1 year; 64% (30/47) vs. 88% (37/42) between 1 and 5 years (p<0.01) Sick leave between 1 and 5 years: 51% (24/47) vs. 74% (31/42) (p<0.03)	3/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Efficacy of exercise versus other interventions for preventing recurrences of low back pain

One higher-quality trial (reviewed in detail in the section on self-care books) found that approximately 50% of subjects randomized to exercise, manipulation, or a self-care book experienced a recurrence of low back pain during the first year after the intervention, and 70% during the second year[367]. There were no differences in the proportion of patients who sought care for back pain in the second year (20% vs. 29% vs. 24%, p=0.29).

Summary of evidence

- There is consistent evidence from two lower-quality trials that an exercise program is superior to education only for reducing long-term low back pain recurrences (level of evidence: fair).
- There is insufficient evidence (single lower-quality trials) to judge efficacy of an ongoing exercise program or an exercise program aimed at strengthening the multifidus muscles for reducing future episodes of low back pain (level of evidence: poor).

Recommendations and findings from other guidelines

- The other guidelines do not address exercise.

Lumbar supports

Results of search: systematic reviews
One recent, higher-quality Cochrane review included no trials evaluating efficacy of lumbar supports for secondary prevention of low back pain[385].

Results of search: trials
We found no additional trials.

Efficacy of lumbar supports for preventing recurrent episodes of low back pain

There are no trials on efficacy of lumbar supports for prevention of low back pain recurrences. The Cochrane review found moderate evidence that lumbar supports are not more effective than other interventions or no treatment for primary prevention of low back pain[385].

Summary of evidence

- No trials have evaluated the efficacy of lumbar supports for secondary prevention.

Recommendations and findings from other guidelines

- The European COST guidelines recommend against lumbar supports for prevention of low back pain.

Advice to stay active

Results of search: systematic reviews
One recent, higher-quality Cochrane review of advice to stay active included no trials reporting low back pain recurrences as an outcome[360].

Results of search: trials
We identified one lower-quality trial on effects of a multidisciplinary examination and advice to stay active on recurrent sick leave due to low back pain (Table 118)[608]. It was excluded from the Cochrane review[360] because it didn't evaluate advice to stay active as a single intervention.

Efficacy of advice to stay active for preventing recurrent episodes of low back pain

One trial of patients on sick leave for 8 to 12 weeks due to low back pain found that a single visit to a spine clinic with examination by a physiatrist and physical therapist and advice on remaining active was associated with similar rates of recurrent episodes of low back pain compared to usual care through three years (62% vs. 61%, NS)[360]. There were also no differences in the proportion off sick leave at 3 years, though the intervention group was superior at 1 year follow-up (OR=1.60, 95% CI 1.08 to 2.39).

Table 118. Trial of spine clinic exam and advice to stay active versus usual care for preventing recurrent episodes of low back pain

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Molde Hagen, 2003[608]	n=510 3 years	**Spine clinic exam and advice to stay active versus usual care** New episodes of sick leave due to LBP (through 3 years): 62% (147/237) vs. 61% (135/220) (NS) LBP still present at 1 year: 47% vs. 52% (NS) On sick leave at 3 years: 64% vs. 62% (NS)	4/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Summary of evidence

- In patients on sick leave for low back pain for 8 to 12 weeks, one lower-quality trial found no difference in long-term (through 3 years) low back pain recurrences following randomization to a single spine clinic exam and advice to stay active versus usual care (level of evidence: poor).

Recommendations and findings from other guidelines

- Recommendations from other guidelines for advice are summarized in Key Question 3.

Early occupational medicine intervention

Results of search: systematic reviews
We identified no systematic reviews evaluating the effects of an early occupational medicine intervention for preventing future episodes of low back pain.

Results of search: trials
We identified one lower-quality trial evaluating early evaluation by an occupational physician in workers with low back pain[1009].

Efficacy of an early occupational medicine intervention versus usual care for preventing recurrent episodes of low back pain

One trial of hospital workers on sick leave for at least 10 days due to low back pain found that early, routine management by occupational physicians trained in recent guidelines was associated with a greater likelihood of recurrent sick leave due to low back pain than usual management by the worker's supervisor for the first three months (52% vs. 25%, hazard ratio=2.4, 95% CI 1.2 to 4.7) (Table 119)[1009]. However, there were no differences in the amount of time until return to work (hazard ratio=1.3, 95% CI 0.90 to 1.90) or other outcomes. A high rate of crossovers (24%) in the usual care group and some deviation from the guidelines by the occupational medicine physicians could have affected results.

Table 119. Trial of early occupational medicine intervention versus usual care for preventing recurrent episodes of low back pain

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Verbeek, 2002[1009]	n=120 12 months	**Early intervention by an occupational physician versus no early intervention** Time to return to work: 51 vs. 62 days (NS) Recurrence of sick leave in 1 year: 51% (26/51) vs. 25% (12/48) (p<0.05) Pain intensity (mean at 12 months, VAS 0 to 100): 24 vs. 30 (p=0.18) RDQ score (0 to 100): 20 vs. 21 (p=0.57)	4/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Summary of evidence

- In workers on sick leave for at least 10 days, an early occupational medicine intervention was associated with a greater likelihood of lower back pain recurrences than no early intervention in one lower-quality trial (level of evidence: poor).

Recommendations and findings from other guidelines

- The other guidelines do not address early occupational medicine intervention.

Psychological therapies, interdisciplinary rehabilitation, spinal manipulation, acupuncture, patient information or education

Results of search: systematic reviews
Recent, higher-quality Cochrane reviews of psychological therapies[301], interdisciplinary rehabilitation[299, 300, 643, 644], and acupuncture[69, 70] included no trials that reported rates of low back pain recurrences. One trial of spinal manipulation was discussed in the section on exercise therapy[367]. We found no systematic reviews on effects of patient information or education on recurrent low back pain.

Results of search: trials
We found no additional relevant trials for any of these interventions.

Summary of evidence

- There is no evidence on effects of psychological therapies, interdisciplinary rehabilitation, and acupuncture on recurrent back pain episodes.

Recommendations and findings from other guidelines

- The other guidelines do not address psychological therapies, interdisciplinary rehabilitation, spinal manipulation, acupuncture, patient information or education.

Key Question 14

How effective are interventions for managing low back pain during pregnancy and post-partum?

We considered low back pain during pregnancy as separate from pelvic girdle pain (defined as pain experienced between the posterior iliac crest and the gluteal fold, particularly in the vicinity of the sacroiliac joints). The AHCPR, VA/DoD, UK RCGP, and European COST guidelines do not address low back pain in pregnancy, though the latter has developed a guideline on diagnosis and treatment of pelvic girdle pain[1010]. We excluded trials on management of back pain during labor.

Acupuncture during pregnancy

Results of search: systematic reviews
A recent, higher-quality Cochrane review[69, 70] of acupuncture (reviewed earlier in this report) included one lower-quality trial[1011] of acupuncture versus exercise in pregnant women. This trial was also included in a systematic review of physical therapy for pregnancy-related back pain[1012].

Results of search: trials
From 373 potentially relevant citations, we identified two lower-quality trials[1013, 1014 5] of acupuncture during pregnancy that were not included in the Cochrane review. Both compared acupuncture to usual care.

Efficacy of acupuncture versus usual care

Acupuncture was superior to usual care for pain relief in pregnant women in two lower-quality trials (Table 120)[1013, 1014]. One found a higher proportion of women reported >50% decrease in average pain intensity in the acupuncture group relative to usual care (78% vs. 15%, p<0.0001)[1013]. The other found decreased pain intensity in 60% of patients with acupuncture versus 14% with usual care (p<0.01)[1014]. Both trials also found acupuncture associated with increased capacity to perform general activities (p=0.01)[1013] or decreased pain with activity (p<0.05)[1014]. One trial reported less use of other therapies with acupuncture compared to usual care (p<0.01)[1014]

Table 120. Trials of acupuncture versus usual care for low back pain during pregnancy

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Guerreiro da Silva, 2004[1013]	n=61 8 weeks	**Acupuncture vs. usual care** Average pain (0 to 10), mean difference relative to baseline: -4.8 vs. +0.3 (p<0.0001) Average pain intensity decrease by > 50%: 78% (21/27) vs. 15% (5/34) (p<0.0001) Medication use, median number of daily doses between initial and final interviews: 0.0 vs. 2.0 (p=0.005) General activities functional status (0 to 10), median difference relative to baseline: -1.0 vs. 0.0 (p=0.01) Ability to perform work (0 to 10): 0.0 vs. +1.0 (p<0.001) Ability to walk (0 to 10): 0.0 vs. +2.0 (p<0.001).	4/10
Kvorning, 2004[1014]	n=72 From third trimester to birth	**Acupuncture vs. usual care** Pain intensity decreased: 60% vs. 14% (p<0.01) Decreased pain with activity: 43% vs. 9% (p<0.01) Analgesic drug use: 0% (0/37) vs. 15% (5/34) (p<0.05)	5/10

*Excludes criteria involving blinding of care providers, for maximum score of 10

Efficacy of acupuncture versus exercise

Both systematic reviews included one lower-quality trial that found acupuncture moderately to substantially superior to exercise for mean pain scores after treatment (difference of about 1.5 to 3 points on a 10 point VAS pain scale)[1011]. Acupuncture was also more effective than exercise for improving functional status for various activities as measured by the Disability Rating Index, and a higher proportion of patients reported 'excellent' or 'good' pain relief with acupuncture (96% or 27/28 versus 78% or 14/18). However, there was a high drop-out rate in the exercise group (12/30), and drop-outs did not appear to be included in the data analysis.

Harms
None of the trials reported serious adverse effects in mothers or their infants following acupuncture[1011, 1013, 1014]. In one trial, two women had small bruises, three reported ecchymosis at

one or two points and one experienced a higher level of pain for a few hours after the first session[1013]. In another trial, symptoms were reported in 38% of 37 patients including local pain (n=6), heat or sweating (n=5), local hematoma (n=2), tiredness (n=2), nausea (n=2) and weakness (n=1)[1014].

Costs
We found no studies evaluating costs

Summary of evidence

- For low back pain during pregnancy, three lower-quality trials found acupuncture more effective than usual care (2 trials) or exercise (1 trial) for improving pain and function (level of evidence: fair).

Recommendations and findings from other guidelines

- The other guidelines do not address acupuncture during pregnancy

Physical therapy during pregnancy

Results of search: systematic reviews
We identified one higher-quality systematic review of exercise or other physical therapy interventions for back pain during pregnancy that included five trials[1012]. Only one, a trial comparing water gymnastics to usual care, was rated higher-quality[1015].

Results of search: trials
From 373 potentially relevant citations, we identified one additional trial (lower-quality) of a sitting pelvic tilt intervention[1016]

Efficacy of physical therapy versus usual care

The systematic review included five trials of physical therapy (exercise, education, advice, or combination of these interventions) for back pain compared to usual care[1012]. It did not attempt to pool trials because of diversity in the populations and interventions studied.

In the only higher-quality trial, water gymnastics was associated with decreased pain relative to usual care[1015]. Pain intensity was lower in the water gymnastics group relative to the usual care group in the first postpartum week (p=0.034, data not reported). In addition, the water gymnastics group reported less absence from work after 32 weeks of pregnancy (OR 0.38, 95% CI 0.16-0.88).

Two trials[1017, 1018] included in the systematic review[1012] found individualized exercise superior to usual care on measures of pain intensity. Group education or therapy, however, was superior to usual care in only one[1019] of three[1018, 1020] trials. All of these trials were rated lower-quality. The only trial with long-term (six years) follow-up found back pain during pregnancy appeared to return to baseline levels soon after pregnancy[1021].

One lower-quality trial not included in the systematic review compared a sitting pelvic tilt exercise to no exercise (Table 121)[1016]. Those in the pelvic tilt intervention group had less pain at day 56 versus usual care (2.03 vs. 7.49 on a 10 point VAS, p<0.001).

Table 121. Trial of a sitting pelvic tilt interventions versus usual care for low back pain during pregnancy

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Suputtitada, 2002[1016]	n=67 56 days	**Sitting pelvic tilt exercise versus no exercise** Pain (0 to 10), mean on day 56: 2.03 vs. 7.49 (p<0.05) Labor onset at 37-38 weeks: 56% vs. 20% (p<0.05) Birth weight, mean: 3009g vs. 3192g (p=0.018)	3/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Efficacy of physical therapy versus other interventions

One systematic review included a trial that compared exercise therapy and acupuncture[1011]. We reviewed this trial in the section on efficacy of acupuncture versus other interventions.

Harms

In the trial of a sitting pelvic tilt exercise, labor onset was slightly earlier and birth weight slightly lower for those randomized to the pelvic tilt intervention, although there were no cases of preterm labor or low birth weight in either group[1016]. Other trials did not report adverse events associated with exercise in pregnancy.

Costs

We found no studies evaluating costs.

Summary of evidence

- For back pain during pregnancy, water gymnastics was superior to usual care in one higher-quality trial (level of evidence: fair).
- For back pain during pregnancy, individualized physiotherapy was superior to usual care in two lower-quality trials (level of evidence: fair).
- For back pain during pregnancy, evidence on efficacy of group education and exercise was mixed, with group education and exercise superior to usual care in one of three lower-quality trials (level of evidence: poor).
- For back pain during pregnancy, a pelvic tilt exercise was associated with decreased pain in one lower-quality trial, but also with lower birth weight and earlier (though full-term) onset of labor (level of evidence: poor)

Recommendations and findings from other guidelines

- The other guidelines do not address physical therapy during pregnancy

Massage during pregnancy

Results of search: systematic reviews
One higher-quality systematic review of physical therapy interventions[1012] included one lower-quality trial of massage therapy versus progressive relaxation therapy[1022].

Results of search: trials
From 373 potentially relevant citations, we identified one lower-quality trial not included in the systematic review of massage versus progressive relaxation or usual care in depressed pregnant women[1023].

Efficacy of massage versus usual care

In depressed pregnant women (n=84), mean back pain intensity was significantly lower with massage than with usual care immediately before the last of 32 treatment sessions (over 16 weeks), but the difference was only 0.3 points on a 10-point scale (Table 122)[1023]. Statistical significance of between-group differences was not reported. Outcomes at later follow-up were not reported.

Table 122. Trial of massage versus progressive relaxation and usual care for low back pain in depressed pregnant women

Author, year	Number of patients Duration of follow-up	Main results	Quality score*
Field, 2004[1023]	n=84 16 weeks	**Massage vs. progressive relaxation vs. usual care (mean scores immediately before last treatment)** Back pain (0 to 10): 2.9 vs. 4.0 vs. 2.6 (between group differences not reported) Anxiety (0 to 80): 42 vs. 45 vs. 39 (between group differences not reported) Mood (0 to 60): 8.2 vs. 9.6 vs. 8.7 (between group differences not reported)	1/9

*Excludes criteria involving blinding of patients and care providers, for maximum score of 9

Efficacy of massage versus progressive relaxation therapy

In a small (n=26) trial of non-depressed women included in the systematic review, back pain intensity was lower in the massage therapy group compared to progressive relaxation after treatment (4.6 vs. 3.8 on a 10-point scale), but statistical significance of differences compared to baseline (3.8 vs. 3.2) were not reported[1022]. In a separate trial by the same investigator of depressed pregnant women, mean back pain intensity was moderately lower with massage compared to progressive relaxation immediately before the last of 32 treatment sessions (over 16 weeks), with a difference averaging 1.1 points on a 10-point scale[1023]. Statistical significance of between-group differences and longer-term follow-up results were not reported, and there were baseline differences between groups in pain and other baseline scores.

Harms
In a trial of depressed pregnant women, scores on the Obstetric Complications Scale were higher (superior) in the massage group relative to the relaxation group (102.1 vs. 91.2), primarily related to decreased prematurity and low birth weight in the massage group[1023].

Costs
We found no studies evaluating costs.

Summary of evidence

- For back pain during pregnancy, two lower-quality trials found that massage therapy decreased pain scores, but effects appeared small, were only assessed during treatment, and it was not clear if the differences were significant relative to usual care or progressive relaxation therapy (level of evidence: poor).

Recommendations and findings from other guidelines

- The other guidelines do not address massage during pregnancy.

Supportive devices during pregnancy

Results of search: systematic reviews
A Cochrane review of interventions during pregnancy[1024] included one lower-quality crossover trial (unclear if randomized) of the Ozzlo pillow (a wedge-shaped pillow designed to give support to pregnant women while lying on their side in bed) versus a standard pillow[1025].

Results of search: trials
From 373 potentially relevant citations, we found no additional trials.

Efficacy of supportive devices versus usual care

The Ozzlo pillow was superior to a standard pillow for pain at night (median score 14 vs. 19, p=0.002) and during the day (19 vs. 25, p=0.02), though there was no effect on sleeping scores[1025]. The pillow was rated as at least moderately useful by 47 of 92 women using it versus 31 of 92 using the standard pillow (OR 0.32, 95% CI 0.18-0.58).

Harms
No adverse events from the Ozzlo pillow were described.

Costs
We found no studies evaluating costs.

Summary of evidence

- For back pain during pregnancy, there is insufficient evidence from one lower-quality trial to determine efficacy of the Ozzlo pillow versus standard pillows (level of evidence: poor).

Recommendations and findings from other guidelines

- The other guidelines do not address supportive devices during pregnancy.

Key Question 15

What is the cost-effectiveness associated with different interventions or management strategies (such as care provided by different types of providers) for managing low back pain?

We identified five recent systematic reviews of cost-effectiveness studies of different interventions or management strategies for low back pain[1026-1030]. All found few full cost-effectiveness or cost-utility analyses and important methodological deficiencies in the available cost studies, including inadequate methods for identifying, valuing, and analyzing costs, and lack of sensitivity analyses for evaluating robustness of conclusions. In one systematic review, 12 of 17 included studies did not mention using the societal perspective to analyze costs[1030]. All of the systematic reviews concluded that current economic analyses are insufficient for determining the most cost-effectiveness interventions.

Costs
Individual cost studies are summarized separately elsewhere for each of the interventions reviewed in this report.

Systematic reviews published too recently to be included in this evidence review

Systematic reviews of non-invasive interventions that were published too recently to be included in this evidence review are shown in Appendix 9.

SUMMARY AND DISCUSSION

Specific findings from this evidence review are reported in the executive summary. We identified several key research gaps:

- Nearly all trials are efficacy trials conducted in ideal setting and selected populations, usually with short-term follow-up. More effectiveness studies assessing long-term outcomes in more generalizable populations are needed to determine the effectiveness of interventions in real-world settings.
- For most interventions, data on harms are sparse, with disproportionate attention paid to benefits. Better assessment and reporting of harms (adhering to CONSORT recommendations[1031]) would help provide a more balanced assessment of the balance of benefits to harms associated with different back pain interventions.
- More research is needed on effective interventions for identification and treatment of 'yellow flags' in order to prevent the development of chronic disabling low back pain.
- The optimal use of combinations of medications has not been well studied. In addition, emerging data on potential cardiovascular risks with non-selective NSAIDs may alter risk-benefit assessments. There is also little evidence on opioids specifically for low back pain. In particular, evidence on long-term use of opioids and risks of abuse and addiction remains sparse.

- Decision tools or classification schemes for matching patients to interventions (such as manipulation, specific exercise regimens or other interventions) that they are more likely to benefit from are promising, but require additional validation. In addition, currently available tools include assessment of physical exam findings that many primary care clinicians are unfamiliar with or that have uncertain reliability and reproducibility. More research on decision tools or classification schemes that can be reliably used by most clinicians need to be developed and tested in clinical settings.
- The diagnostic value of provocative discography remains uncertain, and the use of discography to select patients for surgery or other invasive procedures has not been proven to improve clinical outcomes compared to selecting patients based on non-invasive testing. Clinical trials addressing this issue would be very helpful for resolving this long-standing controversy.
- Additional long-term trials with adequate follow-up and appropriate comparison interventions are needed to further clarify the role of fusion in patients with chronic non-specific low back pain.
- Confirmatory trials and trials that evaluate long-term outcomes associated with vertebral disc replacement are needed to help clarify its role as an option for surgical management.
- There is no evidence on optimal sequencing of interventions, and limited evidence on optimal combinations of interventions. In many cases, combinations of interventions were not much more effective than monotherapy, but more research is needed to clarify when and how treatments should be combined.
- High quality research on management of failed back surgery syndrome and back pain during pregnancy is lacking and provides little guidance for appropriate management in these populations.
- Few trials of medications and non-invasive interventions specifically evaluated patients with spinal stenosis or sciatica, and it remains unclear if optimal non-surgical treatments for this condition are different than for patients with non-specific low back pain without spinal stenosis or sciatica.
- Many interventions for low back pain appear to have similar effects on patient outcomes. Higher quality studies of cost-effectiveness could help clarify optimal choices between such interventions.

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APPENDIX 1: SYSTEMATIC REVIEWS SEARCH STRATEGIES

ALL SYSTEMATIC REVIEWS SEARCHES
2005-2008 (updated yearly)

Database: Ovid MEDLINE®

1 ((ache$ or pain$) adj2 (low back or lower back or lumbar)).mp.
2 lbp.mp.
3 exp Back Pain/
4 (1 or 2) and 3
5 low back pain/
6 4 or 5
7 limit 6 to humans
8 limit 7 to "all adult (19 plus years)"
9 meta-analysis.mp. or exp Meta-Analysis/
10 (cochrane or medline).tw.
11 search$.tw.
12 9 or 10 or 11
13 "Review Literature as Topic"/ or systematic review.mp.
14 12 or 13
15 8 and 14
16 from 15 keep ALL

Database: Cochrane Database of Systematic Reviews

1 cochrane back group.gn.
2 back pain.ti.
3 1 or 2
4 from 3 keep ALL

APPENDIX 2: PRIMARY STUDIES SEARCH STRATEGIES

PRIMARY CARE SEARCHES
2005

Basic search strategy of Cochrane Central Register of Controlled Trials, through 4th Quarter 2005

1 randomized controlled trial.pt.
2 controlled clinical trial.pt.
3 Randomized Controlled Trials/
4 Random Allocation/
5 Double-Blind Method/
6 Single-Blind Method/
7 1 or 2 or 3 or 4 or 5 or 6
8 animal/ not human/
9 7 not 8
10 clinical trial.pt.
11 exp clinical trials/
12 (clinic$ adj25 trial$).tw.
13 ((singl$ or doubl$ or trebl$ or tripl$) adj (mask$ or blind$)).tw.
14 placebos/
15 placebo$.tw.
16 random$.tw.
17 research design/
18 (latin adj square).tw.
19 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18
20 19 not 8
21 20 not 9
22 comparative study/
23 exp evaluation studies/
24 follow-up studies/
25 prospective studies/
26 (control$ or prospective$ or volunteer$).tw.
27 cross-over studies/
28 22 or 23 or 24 or 25 or 26 or 27
29 28 not 8
30 29 not (9 or 21)
31 9 or 21 or 30
32 spine/ or coccyx/ or intervertebral disk/ or lumbar vertebrae/ or sacrum/ or spinal canal/ or exp back/
33 (spine or coccyx or intervertebral disk$ or lumbar vertebrae or sacrum or spinal canal or back).tw.
34 spinal diseases/ or intervertebral disk displacement/ or spinal curvatures/ or kyphosis/ or lordosis/ or scoliosis/ or spinal osteophytosis/ or hyperostosis, diffuse idiopathic skeletal/ or spinal stenosis/ or spondylitis/ or spondylolisthesis/ or spondylolysis/
35 (spinal disease$ or spinal curvatur$ or kyphosis or lordosis or scoliosis or spinal osteophytosis or hyperostosis or spinal stenosis or spondyliti$ or spondylolisthesis or spondylolysis).tw.
36 exp BACK INJURIES/ or ((back or lumbar or sacrum or sacral) adj2 (wound$ or injur$ or trauma$)).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
37 34 or 35 or 36
38 exp pain/ or pain$.mp. or ache.mp. or aches.mp. or aching.mp. or ached.mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
39 (32 or 33) and 38
40 exp back pain/ or ((back or lumbar or sacrum or sacral) adj2 (pain$ or ache$ or aching)).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
41 37 or 39 or 40

APPENDIX 2: PRIMARY STUDIES SEARCH STRATEGIES

PRIMARY CARE SEARCHES
2005

Unique intervention search steps (through 4th quarter 2005):

Acetaminophen
42 Acetaminophen.mp. or exp ACETAMINOPHEN/
43 paracetamol.mp.
44 42 or 43
45 41 and 44
46 from 45 keep ALL

Aspirin
42 acetylsalicylic acid.mp.
43 aspirin$.mp. or exp ASPIRIN/
44 42 or 43
45 41 and 44
46 from 45 keep ALL

COX-2
42 rofecoxib.mp.
43 valdecoxib.mp.
44 celecoxib.mp.
45 etoricoxib.mp.
46 lumiracoxib.mp.
47 ((cox-2 or cyclooxygenase-2) adj5 inhib$).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
48 42 or 43 or 44 or 45 or 46 or 47
49 41 and 48
50 from 49 keep ALL

Opioids
42 (Opioid$ or Narcotic$).mp.
43 41 and 42
44 from 43 keep ALL

Basic search strategy of Ovid MEDLINE®, 1966 to September Week 3 2005
1 randomized controlled trial.pt.
2 controlled clinical trial.pt.
3 Randomized Controlled Trials/
4 Random Allocation/
5 Double-Blind Method/
6 Single-Blind Method/
7 1 or 2 or 3 or 4 or 5 or 6
8 animal/ not human/
9 7 not 8
10 clinical trial.pt.
11 exp clinical trials/
12 (clinic$ adj25 trial$).tw.
13 ((singl$ or doubl$ or trebl$ or tripl$) adj (mask$ or blind$)).tw.
14 placebos/
15 placebo$.tw.
16 random$.tw.
17 research design/
18 (latin adj square).tw.
19 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18
20 19 not 8
21 20 not 9
22 comparative study/

APPENDIX 2: PRIMARY STUDIES SEARCH STRATEGIES

PRIMARY CARE SEARCHES
2005

23 exp evaluation studies/
24 follow-up studies/
25 prospective studies/
26 (control$ or prospective$ or volunteer$).tw.
27 cross-over studies/
28 22 or 23 or 24 or 25 or 26 or 27
29 28 not 8
30 29 not (9 or 21)
31 9 or 21 or 30
32 spine/ or coccyx/ or intervertebral disk/ or lumbar vertebrae/ or sacrum/ or spinal canal/ or exp back/
33 (spine or coccyx or intervertebral disk$ or lumbar vertebrae or sacrum or spinal canal or back).tw.
34 spinal diseases/ or intervertebral disk displacement/ or spinal curvatures/ or kyphosis/ or lordosis/ or scoliosis/ or spinal osteophytosis/ or hyperostosis, diffuse idiopathic skeletal/ or spinal stenosis/ or spondylitis/ or spondylolisthesis/ or spondylolysis/
35 (spinal disease$ or spinal curvatur$ or kyphosis or lordosis or scoliosis or spinal osteophytosis or hyperostosis or spinal stenosis or spondyliti$ or spondylolisthesis or spondylolysis).tw.
36 exp BACK INJURIES/ or ((back or lumbar or sacrum or sacral) adj2 (wound$ or injur$ or trauma$)).mp.[mp=title, original title, abstract, name of substance word, subject heading word]
37 34 or 35 or 36
38 exp pain/ or pain$.mp. or ache.mp. or aches.mp. or aching.mp. or ached.mp.[mp=title, original title, abstract, name of substance word, subject heading word]
39 (32 or 33) and 38
40 exp back pain/ or ((back or lumbar or sacrum or sacral) adj2 (pain$ or ache$ or aching)).mp.[mp=title, original title, abstract, name of substance word, subject heading word]
41 37 or 39 or 40

Unique intervention search steps (1966 to September Week 3 2005):

Aceteminophen
42 Acetaminophen.mp. or exp ACETAMINOPHEN/
43 paracetamol.mp.
44 42 or 43
45 41 and 44
46 31 and 45
47 from 46 keep ALL

Aspirin
42 acetylsalicylic acid.mp.
43 aspirin$.mp. or exp ASPIRIN/
44 42 or 43
45 41 and 44
46 31 and 45
47 45 not 46
48 from 47 keep ALL

Corticosteroids
42 Corticosteroid$.mp. or exp Adrenal Cortex Hormones/
43 41 and 42
44 31 and 43
45 43 not 44
46 from 45 keep ALL

COX-2
42 rofecoxib.mp.
43 valdecoxib.mp.
44 celecoxib.mp.
45 etoricoxib.mp.
46 lumiracoxib.mp.

APPENDIX 2: PRIMARY STUDIES SEARCH STRATEGIES

PRIMARY CARE SEARCHES
2005

47 ((cox-2 or cyclooxygenase-2) adj5 inhib$).mp.[mp=title, original title, abstract, name of substance word, subject heading word]
48 42 or 43 or 44 or 45 or 46 or 47
49 41 and 48
50 from 49 keep ALL

Hydrotherapy
42 exp Hydrotherapy/ or Water therapy.mp. or Balneology/
43 (balneotherapy or hydrotherapy).mp.[mp=title, original title, abstract, name of substance word, subject heading word]
44 42 or 43
45 41 and 44
46 limit 45 to english language
47 limit 45 to abstracts
48 46 or 47
49 from 48 keep ALL

Mattresses
42 exp "Bedding and Linens"/ or exp Beds/ or mattress$.mp.
43 41 and 42
44 from 43 keep ALL

Opioids
42 Opioid$.mp. or exp Narcotics/ or narcotic$.mp.
43 41 and 42
44 31 and 43
45 43 not 44
46 from 45 keep ALL

Superficial heat or cold
42 exp HEAT/tu[Therapeutic Use]
43 (((heat or heats or heated or heating or electrotherm$ or therm$ or warm$) adj3 (therap$ or treat$ or procedure$)) or thermother$).mp.[mp=title, original title, abstract, name of substance word, subject heading word]
44 42 or 43
45 41 and 44
46 limit 45 to humans
47 31 and 46
48 46 not 47
49 from 48 keep 1-104 (104)
Tramadol
42 tramadol.mp. or exp TRAMADOL/
43 41 and 42
44 from 43 keep ALL

Yoga
42 yoga.mp. or exp Yoga/
43 41 and 42
44 31 and 43
45 43 not 44
46 from 45 keep ALL

APPENDIX 2: PRIMARY STUDIES SEARCH STRATEGIES

PRIMARY CARE SEARCHES
2005

Basic search strategy of CINAHL (Cumulative Index to Nursing & Allied Health Literature), 1982 to September Week 1 2005

1 spine/ or coccyx/ or intervertebral disk/ or lumbar vertebrae/ or sacrum/ or spinal canal/ or exp back/
2 (spine or coccyx or intervertebral disk$ or lumbar vertebrae or sacrum or spinal canal or back).tw.
3 spinal diseases/ or intervertebral disk displacement/ or spinal curvatures/ or kyphosis/ or lordosis/ or scoliosis/ or spinal osteophytosis/ or hyperostosis, diffuse idiopathic skeletal/ or spinal stenosis/ or spondylitis/ or spondylolisthesis/ or spondylolysis/
4 (spinal disease$ or spinal curvatur$ or kyphosis or lordosis or scoliosis or spinal osteophytosis or hyperostosis or spinal stenosis or spondyliti$ or spondylolisthesis or spondylolysis).tw.
5 exp BACK INJURIES/ or ((back or lumbar or sacrum or sacral) adj2 (wound$ or injur$ or trauma$)).mp.[mp=title, subject heading word, abstract, instrumentation]
6 3 or 4 or 5
7 exp pain/ or pain$.mp. or ache.mp. or aches.mp. or aching.mp. or ached.mp.[mp=title, subject heading word, abstract, instrumentation]
8 (1 or 2) and 7
9 exp back pain/ or ((back or lumbar or sacrum or sacral) adj2 (pain$ or ache$ or aching)).mp.[mp=title, subject heading word, abstract, instrumentation]
10 6 or 8 or 9

Unique intervention search steps (1982 to September Week 1 2005):

Antiepileptic drugs (Gabapentin)
11 gabapentin.mp.
12 10 and 11
13 from 12 keep ALL

Botulinum toxin
11 (botox or (Botuli$)).mp. {mp=title, subject heading word, abstract, instrumentation]
12 10 and 11
13 from 12 keep ALL

Low level lasers
11 ((laser$ adj3 (therap$ or treat$)) or lllt).mp. or exp LASERS/tu[mp=title, subject heading word, abstract, instrumentation]
12 ((HeNe or IR or diode or infrared) adj laser$).mp.[mp=title, subject heading word, abstract, instrumentation]
13 (GaA1As or GaAs or Nd:YAG).mp.[mp=title, subject heading word, abstract, instrumentation]
14 ((low or lower or lowest or lowering) adj3 laser$).mp.[mp=title, subject heading word, abstract, instrumentation]
15 11 or 12 or 13 or 14
16 10 and 15
17 from 16 keep ALL

Mattresses
11 exp "Bedding and Linens"/ or exp Beds/ or mattress$.mp.
12 10 and 11
13 from 12 keep ALL

Superficial heat or cold
11 exp HEAT/tu[Therapeutic Use]
12 (((heat or heats or heated or heating or electrotherm$ or therm$ or warm$) adj3 (therap$ or treat$ or procedure$)) or thermother$).mp.[mp=title, subject heading word, abstract, instrumentation]
13 11 or 12
14 10 and 13
15 from 14 keep ALL

APPENDIX 2: PRIMARY STUDIES SEARCH STRATEGIES

PRIMARY CARE SEARCHES
2005

Tramadol
11 tramadol.mp. or exp TRAMADOL/
12 10 and 11
13 from 12 keep ALL

Ultrasound
11 exp Ultrasonics/ or exp Ultrasonic Therapy/
12 ((ultrasound$ or ultrason$) adj2 (treat$ or therap$)).mp.[mp=title, subject heading word, abstract, instrumentation]
13 11 or 12
14 10 and 13
15 from 14 keep ALL

APPENDIX 2: PRIMARY STUDIES SEARCH STRATEGIES

PRIMARY CARE SEARCHES
2006

Basic search strategy of Cochrane Central Register of Controlled Trials, through 1st Quarter 2006

1 spine/ or coccyx/ or intervertebral disk/ or lumbar vertebrae/ or sacrum/ or spinal canal/ or exp back/
2 (spine or coccyx or intervertebral disk$ or lumbar vertebrae or sacrum or spinal canal or back).tw.
3 spinal diseases/ or intervertebral disk displacement/ or spinal curvatures/ or kyphosis/ or lordosis/ or scoliosis/ or spinal osteophytosis/ or hyperostosis, diffuse idiopathic skeletal/ or spinal stenosis/ or spondylitis/ or spondylolisthesis/ or spondylolysis/
4 (spinal disease$ or spinal curvatur$ or kyphosis or lordosis or scoliosis or spinal osteophytosis or hyperostosis or spinal stenosis or spondyliti$ or spondylolisthesis or spondylolysis).tw.
5 exp BACK INJURIES/ or ((back or lumbar or sacrum or sacral) adj2 (wound$ or injur$ or trauma$)).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
6 3 or 4 or 5
7 exp pain/ or pain$.mp. or ache.mp. or aches.mp. or aching.mp. or ached.mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
8 (1 or 2) and 7
9 exp back pain/ or ((back or lumbar or sacrum or sacral) adj2 (pain$ or ache$ or aching)).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
10 6 or 8 or 9

Unique intervention search steps (through 1st Quarter 2006):

Antidepressants
11 duloxetine.mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
12 10 and 11
13 from 12 keep ALL

Coordination of care
11 (coordinat$ or integrat$).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
12 10 and 11
13 from 12 keep ALL

Corticosteroids
11 (Corticosteroid$ or steroid or steroids).mp. or exp Adrenal Cortex Hormones/[mp=title, original title, abstract, mesh headings, heading words, keyword]
12 10 and 11
13 from 12 keep ALL

Cost benefit
11 ((economic$ or financ$ or cost or costs or costing) adj2 (benefit$ or effectiv$ or evaluat$ or analyz$ or analys$)).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
12 10 and 11
13 from 12 keep ALL

Decision tools
11 ((rule$ or tool$) adj2 (decision$ or decid$)).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
12 10 and 11
13 ((decision$ or decid$) adj2 (support$ or confirm$)).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
14 10 and 13
15 (decision$ or decid$).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
16 10 and 15
17 from 16 keep ALL

APPENDIX 2: PRIMARY STUDIES SEARCH STRATEGIES

PRIMARY CARE SEARCHES
2006

Interdisciplinary
11 ((primary or family or general) adj2 (care or practitioner$ or physician$ or practice$)).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
12 10 and 11
13 (specialist$ or specialty or orthopedics or orthopedist$ or neurologist$ or neurosurgeon$ or surgeon$ or chiropractic$ or occupational therapist$ or physiotherapist$ or physical therapist$).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
14 10 and 13
15 (referral$ or consult$).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
16 (interdisciplin$ or multidisciplin$ or inter-disciplin$ or multi-disciplin$).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
17 11 and 13
18 11 and 15
19 11 and 16
20 13 and 15
21 13 and 16
22 15 and 16
23 17 or 18 or 19 or 20 or 21 or 22
24 10 and 23
25 from 24 keep 1-113 (113)
Intrathecal
11 ((fail$ or unsuccessful$ or ineffectiv$) adj2 (surger$ or surgic$ or operation$)).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
12 10 and 11
13 (fbss or flss).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
14 10 and 13
15 12 or 14
16 ((fail$ or unsuccessful$ or ineffectiv$) adj3 (back or lumbar)).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
17 15 or 16
18 (reoperat$ or re-operat$).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
19 10 and 18
20 (fail$ or unsuccessful$ or ineffectiv$).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
21 19 and 20
22 17 or 21
23 from 22 keep 1-48
24 spine/ or coccyx/ or intervertebral disk/ or lumbar vertebrae/ or sacrum/ or spinal canal/ or exp back/
25 (spine or coccyx or intervertebral disk$ or lumbar vertebrae or sacrum or spinal canal or back).tw.
26 spinal diseases/ or intervertebral disk displacement/ or spinal curvatures/ or kyphosis/ or lordosis/ or scoliosis/ or spinal osteophytosis/ or hyperostosis, diffuse idiopathic skeletal/ or spinal stenosis/ or spondylitis/ or spondylolisthesis/ or spondylolysis/
27 (spinal disease$ or spinal curvatur$ or kyphosis or lordosis or scoliosis or spinal osteophytosis or hyperostosis or spinal stenosis or spondyliti$ or spondylolisthesis or spondylolysis).tw.
28 exp BACK INJURIES/ or ((back or lumbar or sacrum or sacral) adj2 (wound$ or injur$ or trauma$)).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
29 26 or 27 or 28
30 exp pain/ or pain$.mp. or ache.mp. or aches.mp. or aching.mp. or ached.mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
31 (24 or 25) and 30
32 exp back pain/ or ((back or lumbar or sacrum or sacral) adj2 (pain$ or ache$ or aching)).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
33 29 or 31 or 32
34 intrathecal$.mp.
35 33 and 34
36 from 35 keep ALL

APPENDIX 2: PRIMARY STUDIES SEARCH STRATEGIES

PRIMARY CARE SEARCHES
2006

Mattresses
11 exp "Bedding and Linens"/ or exp Beds/ or mattress$.mp.
12 10 and 11
13 from 12 keep ALL

Pregnancy
11 (pregnanc$ or pregnant or prenatal$ or postpartum$).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
12 10 and 11
13 from 12 keep ALL

Self care
11 ((self or selves or themsel$) adj3 (care or look after)).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
12 (patient$ adj3 (informed or information or informing or educat$ or teach$ or learn$)).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
13 11 or 12
14 10 and 13
15 from 14 keep ALL

Superficial heat or cold
11 exp HEAT/tu[Therapeutic Use]
12 (((heat or heats or heated or heating or electrotherm$ or therm$ or warm$) adj3 (therap$ or treat$ or procedure$)) or thermother$).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
13 11 or 12
14 10 and 13
15 from 14 keep ALL

Tramadol
11 tramadol.mp. or exp TRAMADOL/
12 10 and 11
13 from 12 keep ALL

Basic search strategy of Ovid MEDLINE®, 1966 to February Week 3 2006
1 spine/ or coccyx/ or intervertebral disk/ or lumbar vertebrae/ or sacrum/ or spinal canal/ or exp back/
2 (spine or coccyx or intervertebral disk$ or lumbar vertebrae or sacrum or spinal canal or back).tw.
3 spinal diseases/ or intervertebral disk displacement/ or spinal curvatures/ or kyphosis/ or lordosis/ or scoliosis/ or spinal osteophytosis/ or hyperostosis, diffuse idiopathic skeletal/ or spinal stenosis/ or spondylitis/ or spondylolisthesis/ or spondylolysis/
4 (spinal disease$ or spinal curvatur$ or kyphosis or lordosis or scoliosis or spinal osteophytosis or hyperostosis or spinal stenosis or spondyliti$ or spondylolisthesis or spondylolysis).tw.
5 exp BACK INJURIES/ or ((back or lumbar or sacrum or sacral) adj2 (wound$ or injur$ or trauma$)).mp.[mp=title, original title, abstract, name of substance word, subject heading word]
6 3 or 4 or 5
7 exp pain/ or pain$.mp. or ache.mp. or aches.mp. or aching.mp. or ached.mp.[mp=title, original title, abstract, name of substance word, subject heading word]
8 (1 or 2) and 7
9 exp back pain/ or ((back or lumbar or sacrum or sacral) adj2 (pain$ or ache$ or aching)).mp.[mp=title, original title, abstract, name of substance word, subject heading word]
10 6 or 8 or 9

APPENDIX 2: PRIMARY STUDIES SEARCH STRATEGIES

PRIMARY CARE SEARCHES
2006

Unique intervention search steps (1966 to February Week 3 2006):

Coordination of care
11 ((coordinat$ or integrat$) adj3 (care or caring or cares or therap$)).mp.
12 10 and 11
13 from 12 keep ALL

Cost Benefit
11 exp Cost-Benefit Analysis/
12 10 and 11
13 ((economic$ or financ$ or cost or costs or costing) adj2 (benefit$ or effectiv$ or evaluat$)).mp.
14 10 and 13
15 12 or 14
16 limit 15 to english language
17 limit 15 to abstracts
18 16 or 17
19 from 18 keep ALL

Decision tools
11 exp decision support techniques/
12 Clinical decision rule$.mp.
13 ((rule$ or tool$) adj2 (decision$ or decid$)).mp.[mp=title, original title, abstract, name of substance word, subject heading word]
14 11 or 12 or 13
15 10 and 14
16 limit 15 to humans
17 limit 16 to english language
18 limit 16 to abstracts
19 17 or 18
20 from 19 keep ALL

Diagnostic nerve blocks
11 ((nerve$ or nervous) adj2 block$).mp.[mp=title, original title, abstract, name of substance word, subject heading word]
12 10 and 11
13 exp Diagnosis/
14 12 and 13
15 (di or ra or us or pa).fs.
16 10 and 11 and 15
17 14 or 16
18 limit 17 to english language
19 limit 17 to abstracts
20 18 or 19
21 limit 20 to humans
22 from 21 keep ALL

Multidisciplinary
11 exp Primary Health Care/
12 exp Physicians, Family/
13 exp Family Practice/
14 11 or 12 or 13
15 exp Orthopedics/
16 exp neurology/
17 exp surgery/
18 exp chiropractic/
19 exp "Physical Therapy (Specialty)"/
20 exp Occupational Therapy/

APPENDIX 2: PRIMARY STUDIES SEARCH STRATEGIES

PRIMARY CARE SEARCHES
2006

21 15 or 16 or 17 or 18 or 19 or 20
22 exp "Referral and Consultation"/
23 (interdisciplin$ or multidisciplin$ or inter-disciplin$ or multi-disciplin$).mp.[mp=title, original title, abstract, name of substance word, subject heading word]
24 exp Complementary Therapies/
25 exp "Outcome and Process Assessment (Health Care)"/
26 Combined Modality Therapy/
27 10 and 14
28 10 and 21
29 10 and (23 or 26)
30 27 and 28
31 27 and 29
32 28 and 29
33 30 or 31 or 32
34 27 and 22
35 28 and 22
36 29 and 22
37 34 or 35 or 36
38 27 and 24
39 28 and 24
40 29 and 24
41 38 or 39 or 40
42 33 or 37 or 41
43 limit 42 to english language
44 limit 42 to abstracts
45 43 or 44
46 from 45 keep ALL

Pregnancy
11 exp postpartum period/ or exp pregnancy/
12 10 and 11
13 (th or dt or dh or pc).fs.
14 12 and 13
15 exp Pregnancy Complications/
16 10 and 15
17 13 and 16
18 14 or 17
19 limit 18 to english language
20 limit 18 to abstracts
21 19 or 20
22 from 21 keep ALL

Special search strategies of Ovid MEDLINE®, 1966 to February Week 3 2006

Self care
1 exp Self Care/
2 exp Health Education/
3 exp Back Pain/
4 ((self or selves or themsel$) adj3 (care or look after)).mp.[mp=title, original title, abstract, name of substance word, subject heading word]
5 (patient$ adj3 (informed or information or informing or educat$ or teach$ or learn$)).mp.[mp=title, original title, abstract, name of substance word, subject heading word]
6 1 or 2
7 3 and 6
8 4 or 5
9 3 and 8
10 7 or 9
11 limit 10 to english language

APPENDIX 2: PRIMARY STUDIES SEARCH STRATEGIES

PRIMARY CARE SEARCHES
2006

12 limit 10 to abstracts
13 11 or 12
14 from 13 keep ALL

Search strategies of PEDro (Physiotherapy Evidence Database/Centre of Evidence-Based Physiotherapy [Cochrane Collaboration]), through 4th quarter 2006

Hyrdotherapy
1 THERAPY = hyrdrotherapy, balneotherapy
2 PROBLEM = pain
3 BODY PART = lumbar spine, sacroiliac or pelvis
4 Keep ALL

Low level lasers
1 ABSTRACT/TITLE = laser
2 THERAPY = none selected
3 PROBLEM = pain
4 BODY PART = lumbar spine, sacroiliac or pelvis
5 Keep ALL

Mattresses
1 ABSTRACT/TITLE = mattress
2 THERAPY = none selected
3 PROBLEM = pain
4 BODY PART = lumbar spine, sacroiliac or pelvis
5 Keep ALL

Superficial heat or cold
1 THERAPY = electrotherapies, heat or cold
2 PROBLEM = pain
3 BODY PART = lumbar spine, sacroiliac or pelvis
4 Keep ALL

APPENDIX 2: PRIMARY STUDIES SEARCH STRATEGIES

PRIMARY CARE SEARCHES
2007

Basic search strategy of Cochrane Central Register of Controlled Trials, through 1st Quarter 2007

1 spine/ or coccyx/ or intervertebral disk/ or lumbar vertebrae/ or sacrum/ or spinal canal/ or exp back/
2 (spine or coccyx or intervertebral disk$ or lumbar vertebrae or sacrum or spinal canal or back).tw.
3 spinal diseases/ or intervertebral disk displacement/ or spinal curvatures/ or kyphosis/ or lordosis/ or scoliosis/ or spinal osteophytosis/ or hyperostosis, diffuse idiopathic skeletal/ or spinal stenosis/ or spondylitis/ or spondylolisthesis/ or spondylolysis/
4 (spinal disease$ or spinal curvatur$ or kyphosis or lordosis or scoliosis or spinal osteophytosis or hyperostosis or spinal stenosis or spondyliti$ or spondylolisthesis or spondylolysis).tw.
5 exp BACK INJURIES/ or ((back or lumbar or sacrum or sacral) adj2 (wound$ or injur$ or trauma$)).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
6 3 or 4 or 5
7 exp pain/ or pain$.mp. or ache.mp. or aches.mp. or aching.mp. or ached.mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
8 (1 or 2) and 7
9 exp back pain/ or ((back or lumbar or sacrum or sacral) adj2 (pain$ or ache$ or aching)).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
10 6 or 8 or 9

Unique intervention search steps (through 1st Quarter 2007):

Antiepileptic drugs
11 gabapentin.mp.
12 (anticonvulsant$ or anti-convulsant$).mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
13 topiramate.mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
14 valproic acid.mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
15 pregabalin.mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
16 lamotrigine.mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
17 carbamazepine.mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
18 oxcarbazepine.mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
19 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18
20 10 and 19
21 from 20 keep ALL

Lidocaine
11 lidocaine.mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
12 10 and 11
13 from 12 keep ALL

Basic search strategy of Ovid MEDLINE®, 1950 to February Week 3 2007

1 randomized controlled trial.pt.
2 controlled clinical trial.pt.
3 Randomized Controlled Trials/
4 Random Allocation/
5 Double-Blind Method/
6 Single-Blind Method/
7 1 or 2 or 3 or 4 or 5 or 6
8 animal/ not human/
9 7 not 8
10 clinical trial.pt.
11 exp clinical trials/
12 (clinic$ adj25 trial$).tw.
13 ((singl$ or doubl$ or trebl$ or tripl$) adj (mask$ or blind$)).tw.
14 placebos/
15 placebo$.tw.
16 random$.tw.
17 research design/

APPENDIX 2: PRIMARY STUDIES SEARCH STRATEGIES

PRIMARY CARE SEARCHES
2007

18 (latin adj square).tw.
19 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18
20 19 not 8
21 20 not 9
22 comparative study/
23 exp evaluation studies/
24 follow-up studies/
25 prospective studies/
26 (control$ or prospective$ or volunteer$).tw.
27 cross-over studies/
28 22 or 23 or 24 or 25 or 26 or 27
29 28 not 8
30 29 not (9 or 21)
31 9 or 21 or 30
32 spine/ or coccyx/ or intervertebral disk/ or lumbar vertebrae/ or sacrum/ or spinal canal/ or exp back/
33 (spine or coccyx or intervertebral disk$ or lumbar vertebrae or sacrum or spinal canal or back).tw.
34 spinal diseases/ or intervertebral disk displacement/ or spinal curvatures/ or kyphosis/ or lordosis/ or scoliosis/ or spinal osteophytosis/ or hyperostosis, diffuse idiopathic skeletal/ or spinal stenosis/ or spondylitis/ or spondylolisthesis/ or spondylolysis/
35 (spinal disease$ or spinal curvatur$ or kyphosis or lordosis or scoliosis or spinal osteophytosis or hyperostosis or spinal stenosis or spondyliti$ or spondylolisthesis or spondylolysis).tw.
36 exp BACK INJURIES/ or ((back or lumbar or sacrum or sacral) adj2 (wound$ or injur$ or trauma$)).mp.[mp=title, original title, abstract, name of substance word, subject heading word]
37 34 or 35 or 36
38 exp pain/ or pain$.mp. or ache.mp. or aches.mp. or aching.mp. or ached.mp.[mp=title, original title, abstract, name of substance word, subject heading word]
39 (32 or 33) and 38
40 exp back pain/ or ((back or lumbar or sacrum or sacral) adj2 (pain$ or ache$ or aching)).mp.[mp=title, original title, abstract, name of substance word, subject heading word]
41 37 or 39 or 40

Unique intervention search steps (1950 to February Week 3 2007):

Antiepileptic drugs (Gabapentin)

42 gabapentin.mp.
43 exp gamma-Aminobutyric Acid/
44 exp Cyclohexanecarboxylic Acids/
45 exp AMINES/
46 43 and 44 and 45
47 topiramate.mp.[mp=title, original title, abstract, name of substance word, subject heading word]
48 valproic acid.mp.[mp=title, original title, abstract, name of substance word, subject heading word]
49 pregabalin.mp.[mp=title, original title, abstract, name of substance word, subject heading word]
50 lamotrigine.mp.[mp=title, original title, abstract, name of substance word, subject heading word]
51 carbamazepine.mp.[mp=title, original title, abstract, name of substance word, subject heading word]
52 oxcarbazepine.mp.[mp=title, original title, abstract, name of substance word, subject heading word]
53 (anticonvulsant$ or anti-convulsant$).mp.[mp=title, original title, abstract, name of substance word, subject heading word]
54 42 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53
55 41 and 54
56 31 and 55
57 55 not 56
58 from 57 keep ALL

APPENDIX 2: PRIMARY STUDIES SEARCH STRATEGIES

PRIMARY CARE SEARCHES
2007

Antidepressants

42 duloxetine.mp.
43 41 and 42
44 from 43 keep ALL
42 venlafaxine.mp.
43 41 and 42
44 from 43 keep ALL

Lidocaine

42 exp Lidocaine/
43 41 and 42
44 31 and 43
45 43 not 44
46 from 45 keep ALL

APPENDIX 2: PRIMARY STUDIES SEARCH STRATEGIES

INTERVENTIONAL & SURGICAL SEARCHES
2008

Search strategy of Ovid® MEDLINE, 1950 to July Week 2 2008

1 randomized controlled trial.mp. or exp Randomized Controlled Trial/
2 randomized controlled trial.pt.
3 controlled clinical trial.mp. or exp Controlled Clinical Trial/
4 controlled clinical trial.pt.
5 clinical trial.mp. or exp Clinical Trial/
6 clinical trial.pt.
7 or/1-6
8 limit 7 to humans
9 spine/ or coccyx/ or intervertebral disk/ or lumbar vertebrae/ or sacrum/ or spinal canal/ or exp back/ or facet joint/ or zygapophysial joint/ or sacroiliac.mp.[mp=title, original title, abstract, name of substance word, subject heading word]
10 (spine or coccyx or intervertebral disk or lumbar vertebrae or sacrum or spinal canal or back or facet joint or zygapophysial joint or sacroiliac).tw.
11 spinal diseases/ or intervertebral disk displacement/ or spinal osteophytosis/ or hyperostosis, diffuse idiopathic skeletal/ or spinal stenosis/ or spondylitis/ or spondylolisthesis/ or spondylolysis/
12 (spinal disease$ or hyperostosis or spinal stenosis or spondyliti$ or spondylolisthesis or spondylolysis).tw.
13 sciatica/ or radiculopathy/
14 exp BACK INJURIES/ or ((back or lumbar or sacrum or sacral) adj2 (wound$ or injur$ or trauma$)).mp.
15 exp back pain/ or ((back or lumbar or sacrum or sacral) adj2 (pain$ or ache$ or aching)).mp.
16 or/9-15
17 8 and 16
18 exp injections/
19 ((spine$ or spinal$ or nerv$) adj7 block$).mp.
20 (prolotherar$ or sclerotherap$).mp.
21 trigger point injection$.mp.
22 medial branch block$.mp.
23 or/18-22
24 botox.mp. or Botulinum Toxin Type A/
25 (disc$ adj3 (replac$ or prosthe$)).mp.
26 exp Intervertebral Disk/
27 exp "Prostheses and Implants"/
28 25 or (26 and 27)
29 ((intradisc$ or intradisk$) adj5 (electrotherm$ or annuloplast$)).mp.
30 ((intradisc$ or intradisk$) adj5 (radiofrequenc$ or thermocoagulat$)).mp.
31 nucleoplast$.mp.
32 chemonucleolysis.mp. or Intervertebral Disk Chemolysis/
33 spinewand$.mp.
34 dekompress$.mp.
35 limit 34 to english language
36 Injections, Epidural/
37 (epidural adj2 (corticosteroid$ or steroid$)).mp.
38 36 or 37
39 exp spinal cord/
40 exp electric stimulation therapy/
41 (electric$ adj7 stimulat$).mp.
42 (39 and 40) or 41
43 23 or 24 or 28 or 29 or 30 or 31 or 32 or 33 or 35 or 38 or 42
44 17 and 43
45 from 44 keep ALL

APPENDIX 2: PRIMARY STUDIES SEARCH STRATEGIES

INTERVENTIONAL & SURGICAL SEARCHES
2008

Search strategy of Cochrane Central Register of Controlled Trials, through 2nd Quarter 2008

1 randomized controlled trial.mp. or exp Randomized Controlled Trial/
2 randomized controlled trial.pt.
3 controlled clinical trial.mp. or exp Controlled Clinical Trial/
4 controlled clinical trial.pt.
5 clinical trial.mp. or exp Clinical Trial/
6 clinical trial.pt.
7 or/1-6
8 limit 7 to humans[Limit not valid; records were retained]
9 spine/ or coccyx/ or intervertebral disk/ or lumbar vertebrae/ or sacrum/ or spinal canal/ or exp back/ or facet joint/ or zygapophysial joint/ or sacroiliac.mp.[mp=title, original title, abstract, mesh headings, heading words, keyword]
10 (spine or coccyx or intervertebral disk or lumbar vertebrae or sacrum or spinal canal or back or facet joint or zygapophysial joint or sacroiliac).tw.
11 spinal diseases/ or intervertebral disk displacement/ or spinal osteophytosis/ or hyperostosis, diffuse idiopathic skeletal/ or spinal stenosis/ or spondylitis/ or spondylolisthesis/ or spondylolysis/
12 (spinal disease$ or hyperostosis or spinal stenosis or spondyliti$ or spondylolisthesis or spondylolysis).tw.
13 sciatica/ or radiculopathy/
14 exp BACK INJURIES/ or ((back or lumbar or sacrum or sacral) adj2 (wound$ or injur$ or trauma$)).mp.
15 exp back pain/ or ((back or lumbar or sacrum or sacral) adj2 (pain$ or ache$ or aching)).mp.
16 or/9-15
17 8 and 16
18 exp injections/
19 ((spine$ or spinal$ or nerv$) adj7 block$).mp.
20 (prolotherar$ or sclerotherap$).mp.
21 trigger point injection$.mp.
22 medial branch block$.mp.
23 or/18-22
24 botox.mp. or Botulinum Toxin Type A/
25 (disc$ adj3 (replac$ or prosthe$)).mp.
26 exp Intervertebral Disk/
27 exp "Prostheses and Implants"/
28 25 or (26 and 27)
29 ((intradisc$ or intradisk$) adj5 (electrotherm$ or annuloplast$)).mp.
30 ((intradisc$ or intradisk$) adj5 (radiofrequenc$ or thermocoagulat$)).mp.
31 nucleoplast$.mp.
32 chemonucleolysis.mp. or Intervertebral Disk Chemolysis/
33 spinewand$.mp.
34 dekompress$.mp.
35 limit 34 to english language[Limit not valid; records were retained]
36 Injections, Epidural/
37 (epidural adj2 (corticosteroid$ or steroid$)).mp.
38 36 or 37
39 exp spinal cord/
40 exp electric stimulation therapy/
41 (electric$ adj7 stimulat$).mp.
42 (39 and 40) or 41
43 23 or 24 or 28 or 29 or 30 or 31 or 32 or 33 or 35 or 38 or 42
44 17 and 43
45 from 44 keep ALL

APPENDIX 3. SYSTEMATIC REVIEWS QUALITY RATING SYSTEM

Criteria for Assessing Scientific Quality of Research Reviews*

Criteria	*Operationalization of Criteria*
1. Were the search methods reported? *Were the search methods used to find evidence (original research) on the primary questions stated?* "Yes" if the review states the databases used, date of most recent searches, and some mention of search terms.	The purpose of this index is to evaluate the scientific quality (i.e. adherence to scientific principles) of research overviews (review articles) published in the medical literature. It is not intended to measure literary quality, importance, relevance, originality, or other attributes of overviews. The index is for assessing overviews of primary ("original") research on pragmatic questions regarding causation, diagnosis, prognosis, therapy, or prevention. A research overview is a survey of research. The same principles that apply to epidemiological surveys apply to overviews: a question must be clearly specified, a target population identified and accessed, appropriate information obtained from that population in an unbiased fashion, and conclusions derived, sometimes with the help of formal statistical analysis, as is done in "meta-analyses". The fundamental difference between overviews and epidemiological studies is the unit of analysis, not the scientific issues that the questions in this index address. Since most published overviews do not include a methods section, it is difficult to answer some of the questions in the index. Base your answers, as much as possible, on information provided in the overview. If the methods that were used are reported incompletely relative to a specific question, score it as "can't tell", unless there is information in the overview to suggest either the criterion was or was not met.
2. Was the search comprehensive? *Was the search for evidence reasonably comprehensive?* "Yes" if the review searches at least 2 databases and looks at other sources (such as reference lists, hand searches, queries experts).	
3. Were the inclusion criteria reported? *Were the criteria used for deciding which studies to include in the overview reported?*	
4. Was selection bias avoided? *Was bias in the selection of studies avoided?* "Yes" if the review reports how many studies were identified by searches, numbers excluded, and gives appropriate reasons for excluding them (usually because of pre-defined inclusion/exclusion criteria).	
5. Were the validity criteria reported? *Were the criteria used for assessing the validity of the included studies reported?*	
6. Was validity assessed appropriately? *Was the validity of all the studies referred to in the text assessed using appropriate criteria (either in selecting studies for inclusion or in analyzing the studies that are cited)?* "Yes" if the review reports validity assessment and did some type of analysis with it (e.g. sensitivity analysis of results according to quality ratings, excluded low-quality studies, etc.)	
7. Were the methods used to combine studies reported? *Were the methods used to combine the findings of the relevant studies (to reach a conclusion) reported?* "Yes" for studies that did qualitative analysis if there is some mention that quantitative analysis was not possible and reasons that it could not be done, or if 'best evidence' or some other grading of evidence scheme used.	

APPENDIX 3. SYSTEMATIC REVIEWS QUALITY RATING SYSTEM

Criteria for Assessing Scientific Quality of Research Reviews*

Criteria	*Operationalization of Criteria*
8. Were the findings combined appropriately? *Were the findings of the relevant studies combined appropriately relative to the primary question the overview addresses?* "Yes" if the review performs a test for heterogeneity before pooling, does appropriate subgroup testing, appropriate sensitivity analysis, or other such analysis.	For Question 8, if no attempt has been made to combine findings, and no statement is made regarding the inappropriateness of combining findings, check "No". If a summary (general) estimate is given anywhere in the abstract, the discussion, or the summary section of the paper, and it is not reported how that estimate was derived, mark "No" even if there is a statement regarding the limitations of combining the findings of the studies reviewed. If in doubt, mark "Can't tell".
9. Were the conclusions supported by the reported data? *Were the conclusions made by the author(s) supported by the data and/or analysis reported in the overview?*	For an overview to be scored as "Yes" in Question 9, data (not just citations) must be reported that support the main conclusions regarding the primary question(s) that the overview addresses.
10. What was the overall scientific quality of the overview? *How would you rate the scientific quality of this overview?*	The score for Question 10, the overall scientific quality, should be based on your answers to the first nine questions. The following guidelines can be used to assist with deriving a summary score: If the "Can't tell" option is used one or more times on the preceding questions, a review is likely to have minor flaws at best and it is difficult to rule out major flaws (i.e. a score of 4 or lower). If the "No" option is used on Question 2, 4, 6 or 8, the review is likely to have major flaws (i.e. a score of 3 or less, depending on the number and degree of the flaws)
Scoring:	***Each Question is scored as Yes, Partially/Can't tell or No***

Extensive Flaws		**Major Flaws**		**Minor Flaws**		**Minimal Flaws**
1	**2**	**3**	**4**	**5**	**6**	**7**

* Operationalization of Oxman criteria[50], adapted from Furlan et al[51]

APPENDIX 4. RANDOMIZED CONTROLLED TRIALS QUALITY RATING SYSTEM

Criteria List for Methodological Quality Assessment*

Criteria	*Operationalization of Criteria*	*Score*
A. Was the method of randomization adequate?	A random (unpredictable) assignment sequence. An example of adequate methods is a computer generated random number table and use of sealed opaque envelopes. Methods of allocation using DOB, date of admission, hospital numbers, or alternation should not be regarded as appropriate.	Yes/No/Don't Know
B. Was the treatment allocation concealed?	Assignment generated by an independent person not responsible for determining the eligibility of the patients. This person has no information about the persons included in the trial and has no influence on the assignment sequence or on the decision about eligibility of the patient.	Yes/No/Don't Know
C. Were the groups similar at baseline regarding the most important prognostic factors? *"Yes", if similar:* • *Age & gender* • *Description of type of pain* • *Intensity, duration or severity of pain*	In order to receive a "yes", groups have to be similar in baseline regarding demographic factors, duration or severity of complaints, percentage of patients with neurologic symptoms, and value of main outcome measure(s).	Yes/No/Don't Know
D. Was the patient blinded to the intervention?	The reviewer determines if enough information about the blinding is given in order to score a "yes": Use the author's statement on blinding, unless there is a differing statement/reason not to (no need for explicit information on blinding).	Yes/No/Don't Know
E. Was the care provider blinded to the intervention?		Yes/No/Don't Know
F. Was the outcome assessor blinded to the intervention?		Yes/No/Don't Know
G. Were cointerventions avoided or similar?	Cointerventions should either be avoided in the trial design or similar between the index and control groups.	Yes/No/Don't Know
H. Was the compliance acceptable in all groups?	The reviewer determines if the compliance to the interventions is acceptable, based on the reported intensity, duration, number and frequency of sessions for both the index intervention and control intervention(s).	Yes/No/Don't Know

APPENDIX 4. RANDOMIZED CONTROLLED TRIALS QUALITY RATING SYSTEM

Criteria List for Methodological Quality Assessment*

Criteria	*Operationalization of Criteria*	*Score*
I. Was the drop-out rate described and acceptable? *≤15% drop out rate is acceptable.*	The number of participants who are included in the study but did not complete the observation period or were not included in the analysis must be described and reasons given. If the percentage of withdrawals and drop-outs does not exceed 15% and does not lead to substantial bias, a "yes" is scored.	Yes/No/Don't Know
J. Was the timing of the outcome assessment in all groups similar?	Timing of outcome assessment should be identical for all intervention groups and for all important outcome assessments.	Yes/No/Don't Know
K. Did the analysis include an intention-to-treat analysis? *"Yes" if less than 5% of randomized patients excluded.*	All randomized patients are reported/analyzed in the group they were allocated to by randomization for the most important moments of effect measurement (minus missing values) irrespective of noncompliance and cointerventions.	Yes/No/Don't Know
This list includes only the internal validity criteria (n=11) that refer to characteristics of the study that might be related to selection bias (criteria A and B), performance bias (criteria D, E, G, and H), attrition bias (criteria I and K and detection bias (criteria F and J). The internal validity criteria should be used to define methodologic quality in the meta-analysis.		

* Adapted from methods developed by the Cochrane Back Review Group[56]

APPENDIX 5: QUALITY RATINGS OF INCLUDED SYSTEMATIC REVIEWS

Author, year	Search methods	Comprehensive	Inclusion criteria	Bias avoided	Validity criteria	Validity assessed	Methods for combining studies	Appropriately combined	Conclusions supported	Overall quality
KQ 1a – PREDICTIVE FEATURES OF HISTORY AND PHYSICAL EXAM										
de Graaf, 2006[269]	Yes	Yes	Yes	Yes	Yes	Yes	Partial	Yes	Yes	6/7
Devillé, 2000[270]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
Jarvik, 2002[268]	Yes	Partial	Partial	Can't tell	No	No	Yes	Yes (listed ranges)	Yes	4/7
van den Hoogen, 1995[271]	Yes	Yes (1 database: published before 1995)	Yes	Can't tell (no info why studies excluded)	Yes	Partial (no sensitivity analysis)	Yes	Yes (some analysis of low qual studies)	Yes	5/7
Vroomen, 1999[272]	Yes	Partial (1 electronic database)	Yes	Can't tell	Yes	Partial (no sensitivity analysis)	Yes	Can't tell	Can't tell	5/7
KQ 1b – PROGNOSIS										
Borge, 2001[296]	Yes	No	Partial	Yes	No	No	No	Can't tell	Can't tell	2/7
Crook, 2002[284]	Partial	Yes	Yes	Yes	Yes	Yes	No	Can't tell	Can't tell	4/7
Dionne, 2001[285]	Yes	Yes	Yes	Can't tell	Yes	Partial	No	Can't tell	Can't tell	3/7
Fayad, 2004[286]	Yes	Yes	Yes	Yes	Yes	Yes	Partial	Can't tell	Can't tell	4/7
Hartvigsen, 2004[287]	Yes	Yes	Yes	Can't tell	Yes	Yes	Yes	Yes	Yes	6/7
Kuijer, 2006[288]	Yes	Yes	Yes	Can't tell	Yes	Yes	Yes	Can't tell	Partial	4/7
Linton, 2000[289]	Yes	Yes	Yes	Can't tell	No	No	No	Can't tell	Can't tell	3/7
McIntosh, 2000[290]	Yes	Partial	Yes	Can't tell	Yes	Partial	No	Can't tell	Can't tell	3/7
Pengel, 2003[11]	Yes	Yes	Yes	Can't tell	Yes	Partial	Yes	Yes	Partial	5/7
Pincus, 2002[291]	Yes	Yes	Yes	Can't tell	Yes	Yes	Yes	Yes	Yes	5/7
Pincus, 2006[292]	Yes	Yes	Yes	Can't tell	Yes	Yes	Yes	Yes	Yes	5/7
Shaw, 2001[293]	Yes	Partial	Partial	Yes	No	No	No	Can't tell	Can't tell	2/7
Steenstra, 2005[294]	Yes	Partial	Yes	Yes	Yes	Yes	Yes	Yes	Yes	6/7

APPENDIX 5: QUALITY RATINGS OF INCLUDED SYSTEMATIC REVIEWS

Author, year	Search methods	Comprehensive	Inclusion criteria	Bias avoided	Validity criteria	Validity assessed	Methods for combining studies	Appropriately combined	Conclusions supported	Overall quality
Truchon, 2000[295]	Yes	Yes	Yes	Yes	No	No	No	Cant' tell	Can't tell	3/7
KQ 2a and 2b – DIAGNOSTIC TESTING										
de Graaf, 2006[269]	Yes	Yes	Yes	Yes	Yes	Yes	Partial	Yes	Yes	6/7
Hoffman, 1991[320]	Partial	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	6/7
Jarvik, 2002[268]	Yes	Partial	Partial	Can't tell	No	No	Yes	Yes (listed ranges)	Yes	4/7
Pullman, 2000[321]	Yes	Partial	Partial	Can't tell	No	No	No	Can't tell	Can't tell	2/7
van den Hoogen, 1995[271]	Yes	Yes (1 database: published before 1995)	Yes	Can't tell (no info why studies excluded)	Yes	Partial (no sensitivity analysis)	Yes	Yes (some analysis of low qual studies)	Yes	5/7
KQ 3 – ADVICE TO REMAIN ACTIVE										
Hagen, 2002[359, 360]	Partial	Yes	Yes	Can't tell	Yes	Yes	Yes	Yes	Yes	6/7
Hagen, 2005[64, 65]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
KQ 3 - ADVICE TO REST IN BED										
Hagen, 2005[64, 65]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
KQ 3 – LUMBAR SUPPORTS										
Jellema, 2001[384, 385]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
KQ 3 – SUPERFICIAL HEAT OR COLD										
French, 2006[398]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
KQ 4 – ACETAMINOPHEN										
Schnitzer, 2004[411]	Yes	Partial (databases only)	Yes	Yes	Yes	Yes	No	No	No	4/7
van Tulder, 2000[412, 413]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
KQ 4 – ACUPUNCTURE AND DRY NEEDLING										
Cherkin, 2003[555]	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	4/7

APPENDIX 5: QUALITY RATINGS OF INCLUDED SYSTEMATIC REVIEWS

Author, year	Search methods	Comprehensive	Inclusion criteria	Bias avoided	Validity criteria	Validity assessed	Methods for combining studies	Appropriately combined	Conclusions supported	Overall quality
Ernst, 2001[556]	Yes	Yes	Yes	Can't tell	No	No	No	Can't tell	Can't tell	3/7
Furlan, 2005[69, 70]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
Manheimer, 2005[68]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
KQ 4 – ANTIDEPRESSANTS										
Salerno, 2002[479]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Partial (combined tricyclic and non-tricyclic antidepressants trials; sensitivity analysis showed no differences)	Yes	6/7
Schnitzer, 2004[411]	Yes	Partial (databases only)	Yes	Yes	Yes	Yes	No	Yes	Partial (used rates of improvement from baseline as one criteria for evaluating effectiveness)	5/7
Staiger, 2003[480]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
KQ 4 – BACK SCHOOLS										
Elders, 2000[588]	Yes	Yes	Yes	Yes	No	Yes	Partial	Can't tell	Can't tell	3/7
Heymans, 2005[586, 587]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
Maier-Riehle, 2001[589]	Yes	Yes	Yes	Can't tell (excluded studies)	No	Partial	Yes	Yes	Yes	4/7
van der Hulst, 2005[590]	Yes	Yes	Yes	Yes	Yes	Partial	Yes	Yes	Yes	6/7
KQ 4 – BENZODIAZEPINES										
van Tulder, 2003[488, 489]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7

APPENDIX 5: QUALITY RATINGS OF INCLUDED SYSTEMATIC REVIEWS

Author, year	Search methods	Comprehensive	Inclusion criteria	Bias avoided	Validity criteria	Validity assessed	Methods for combining studies	Appropriately combined	Conclusions supported	Overall quality
KQ 4 – EXERCISE										
Clare, 2004[616]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	6/7
Hayden, 2005[615]	Yes	Yes	Yes	Yes	Yes	Partial (no sensitivity analysis)	Yes	Yes (no hetero-geneity)	Yes	7/7
Hayden, 2005[613, 614]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
Kool, 2004[617]	Yes	Yes	Yes	Can't tell (excluded 14 mid-to-high quality studies)	Yes	Partial	No	Can't tell	Can't tell	7/7
Liddle, 2004[618]	Yes	Yes	Yes	Can't tell	Yes	Partial	No	Yes	Yes	3/7
Machado, 2006[619]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
McNeely, 2003[620]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	4/7
KQ 4 – FUNCTIONAL RESTORATION (PHYSICAL CONDITIONING, WORK CONDITIONING, OR WORK HARDENING)										
Schonstein, 2003[302, 303]	Yes	Partial	Yes	Can't tell	Yes	Yes	Yes	Yes	Yes	6/7
KQ 4 – HERBAL THERAPIES										
Gagnier, 2007[545, 546]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
KQ 4 – INTERDISCIPLINARY REHABILITATION (MULTIDISCIPLINARY REHABILITATION)										
Guzman, 2001[643, 644]	Yes	Yes	Yes	Yes	Yes	Partial	Yes	Yes	Yes	6/7
Karjalainen, 2001[299, 300]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
Tveito, 2004[645]	Partial	Yes	Yes	Yes	Yes	Partial	Yes	Yes	Yes	5/7
KQ 4 – MASSAGE										
Cherkin, 2003[555]	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	5/7
Furlan, 2002[700, 701]	Yes	Yes	Yes	Partial	Yes	Yes	Yes	Yes	Can't tell	6/7
KQ 4 – NEUROREFLEXOTHERAPY										
Urrutia, 2004[582]	Yes	Yes	Yes	Can't tell	Yes	Yes	Yes	Yes	Yes	6/7

APPENDIX 5: QUALITY RATINGS OF INCLUDED SYSTEMATIC REVIEWS

Author, year	Search methods	Comprehensive	Inclusion criteria	Bias avoided	Validity criteria	Validity assessed	Methods for combining studies	Appropriately combined	Conclusions supported	Overall quality
KQ 4 – NON-SELECTIVE NON-STEROIDAL ANTI-INFLAMMATORY DRUGS (NSAIDS)										
Schnitzer, 2004[411]	Yes	Partial (databases only)	Yes	Yes	Yes	Yes	No	Yes	Partial	5/7
Van Tulder, 2000[412, 413]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
Vroomen, 2000[100]	Yes	Yes	Yes	Can't tell (insufficient detail of excluded studies)	Yes	Yes	Yes	Yes	Yes	5/7
KQ 4 – PSYCHOLOGICAL THERAPIES										
Hoffman, 2007[722]	Yes	Yes	Yes	Partial	Yes	Yes	Yes	Yes	Yes	6/7
Ostelo, 2005[301]	Yes	Yes	Yes	Yes	Yes	Partial (no sensitivity analysis)	Yes	Yes	Yes	6/7
KQ 4 – SKELETAL MUSCLE RELAXANTS										
Browning, 2001[506]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
Schnitzer, 2004[411]	Yes	Partial (data bases only)	Yes	Yes	Yes	Yes	No	Yes	Yes	5/7
van Tulder, 2003[488, 489]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
Vroomen, 2000[100]	Yes	Yes	Yes	Can't tell	Yes	Yes	Yes	Yes	Yes	5/7
KQ 4 – SPA THERAPY AND BALNEOTHERAPY										
Pittler, 2006[745]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
KQ 4 – SPINAL MANIPULATION										
Assendelft, 2003[66, 67]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
Avery, 2004[753]	Yes	Yes	Yes	Yes	No	Partial	No	Partial	Partial	2/7
Bronfort, 2004[754]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Partial	Partial	4/7
Brown, 2005[750]	Yes	Yes	Yes	Can't Tell	Yes	Yes	Yes	Yes	Yes	6/7

APPENDIX 5: QUALITY RATINGS OF INCLUDED SYSTEMATIC REVIEWS

Author, year	Search methods	Comprehensive	Inclusion criteria	Bias avoided	Validity criteria	Validity assessed	Methods for combining studies	Appropriately combined	Conclusions supported	Overall quality
Cherkin, 2003[555]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	5/7
Ernst, 2001[759]	Yes	Yes	Yes	Yes	No	No	Yes	Can't tell	Can't tell	3/7
Ernst, 2003[755]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Partial	Yes	5/7
Ferreira, 2002[752]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Partial	Yes	7/7
Ferreira, 2003[751]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Partial	Yes	5/7
Gay, 2005[756]	Yes	Yes	No	Can't tell	No	No	No	Can't tell	Can't tell	2/7
Kent, 2005[763]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Partial	Yes	5/7
Licciardone, 2005[757]	Yes	Yes	Yes	Yes	No	No	Yes	Partial	Can't tell	4/7
Meeker, 2002[760]	Partial	Yes	No	No	No	No	No	Partial	Partial	1/7
Oliphant, 2004[761]	Yes	Yes	Yes	Can't tell	Yes	Yes	Yes	No	No	3/7
Stevinson, 2002[762]	Yes	Yes	Yes	Can't tell	No	No	No	Can't tell	Can't tell	2/7
Vroomen, 2000[100]	Yes	Yes	Yes	Can't Tell	Yes	Yes	Yes	Yes	Yes	5/7
Woodhead, 2005[758]	Yes	Yes	Yes	Can't Tell	Yes	Yes	Yes	Partial	Partial	4/7
KQ 4 – TRAMADOL										
Schnitzer, 2004[411]	Yes	Partial (data bases only)	Yes	Yes	Yes	Yes	No	Yes	Yes	5/7
KQ 4 – TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION (TENS) (see also Assendelft, 2003 (spinal manipulation)[66, 67]; Clarke, 2005 (traction)[676, 677]; French, 2006 (superficial heat or cold)[398]; Furlan, 2002 (massage)[700, 701]; Manheimer, 2005 (acupuncture[68])										
Khadilkar, 2005[698, 699]	Yes	Yes	Yes	Yes	Yes	Yes (size prohibited analysis)	Yes	Yes	Yes	7/7
KQ 4 – TRACTION										
Clarke, 2006[676, 677]	Yes	Yes	Yes	Can't tell	Yes	Yes	Yes	Yes	Yes	6/7
Harte, 2003[678]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
Philadelphia Panel, 2001[399]	Partial	Yes	Yes	Yes	Yes	Partial	Yes	Partial	Yes	5/7
Vroomen, 2000[100]	Yes	Yes	Yes	Can't tell	Yes	Yes	Yes	Yes	Yes	5/7

APPENDIX 5: QUALITY RATINGS OF INCLUDED SYSTEMATIC REVIEWS

Author, year	Search methods	Comprehensive	Inclusion criteria	Bias avoided	Validity criteria	Validity assessed	Methods for combining studies	Appropriately combined	Conclusions supported	Overall quality
KQ 5 – DECISION TOOLS FOR TARGETING TREATMENT										
Hestboek, 2000[795]	Yes	No (no ML search)	Yes	Yes	Yes	Partial	No	Can't tell	Can't tell	4/7
Najm, 2003[791]	Yes	Yes	Yes	Yes	Yes	Partial (no sensitivity analysis)	No	Partial	Yes	5/7
Seffinger, 2004[792]	Yes	Yes	Yes	Yes	Yes	Partial (no sensitivity analysis)	Yes	Yes	Yes	6/7
van der Wurff, 2000[793, 794]	Yes	Yes	Yes	Can't tell	Yes	Yes	No	Yes	Yes	5/7
KQ 7 – DIAGNOSTIC INTRA-ARTICULAR FACET JOINT BLOCK, SACROILIAC JOINT BLOCK, OR MEDIAL BRANCH BLOCK										
Boswell, 2003[836]	Yes	Yes	Yes	Can't tell	Yes	Partial	No	No	No	2/7
Hansen, 2007[83]	Yes	Yes	Yes	Can't tell	Yes	No (not reported)	Partial	Can't tell	Can't tell	2/7
Sehgal, 2007[837]	Yes	Yes	Yes	Yes	Yes	Partial	No	No	No	2/7
KQ 7 – DIAGNOSTIC SELECTIVE NERVE ROOT BLOCKS										
Datta, 2007[834]	Yes	Yes	Yes	Yes	Yes	Partial	No	No	No	2/7
KQ 7 – PROVOCATIVE DISCOGRAPHY										
Buenaventura, 2007[809]	Yes	Yes	Yes	Can't tell	Yes	Partial	Yes	No	No	3/7
Cohen, 2005[806]	Partial	Partial	No	Can't tell	No	No	No	No	No	1/7
Willems, 2004[810]	Yes	Yes	Yes	Can't tell	No	No	No	No	Can't tell	2/7
KQ 8 – CHEMONUCLEOLYSIS										
Gibson, 2007[81, 82]	Yes	Yes	Yes	Yes	Yes	Partial	Yes	Yes	Yes	6/7
KQ 8 – EPIDURAL STEROID INJECTIONS										
Abdi, 2007[71]	Yes	Yes	Yes	Yes	Partial	Yes	No	No	Yes	3/7
Armon, 2007[74]	Yes	Partial	Yes	Yes	Partial	Partial	Partial	Partial	Partial	4/7
DePalma, 2005[77]	Yes	Yes	Can't tell	Yes	Partial	Yes	No	Can't tell	Yes	4/7

APPENDIX 5: QUALITY RATINGS OF INCLUDED SYSTEMATIC REVIEWS

Author, year	Search methods	Comprehensive	Inclusion criteria	Bias avoided	Validity criteria	Validity assessed	Methods for combining studies	Appropriately combined	Conclusions supported	Overall quality
Luijsterburg, 2007[84]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
Nelemans, 2001[86]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
Resnick, 2005[92]	Yes	Partial	Partial	Can't tell	No	No	Partial	Can't tell	Can't tell	2/7
Staal, 2008[94]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
Tonkovich-Quaranta, 2000[97]	No	No	No	No	No	Partial	Can't tell	Can't tell	No	1/7
Vroomen, 2000[100]	Yes	Yes	Can't tell	Yes	Yes	Yes	Yes	Yes	Yes	5/7
KQ 8 – FACET JOINT INJECTION AND MEDIAL BRANCH BLOCK										
Boswell, 2007[75]	Yes	Yes	Yes	Can't tell	Yes	Partial	Yes	No	No	3/7
Resnick, 2005[92]	Yes	Partial	Partial	Can't tell	No	No	Partial	Can't tell	Can't tell	2/7
Slipman, 2003[93]	Partial	Partial	Yes	Can't tell	No	Partial	Partial	Can't tell	Can't tell	3/7
Staal, 2008[94]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
KQ 8 – INTRADISCAL ELECTROTHERMAL THERAPY (IDET)										
Andersson, 2006[72]	Yes	Partial	Yes	Can't tell	Partial	Partial	Yes	No	No	2/7
Appleby, 2006[73]	Partial	No	Partial	Can't tell	No	No	Yes	No	No	1/7
Gibson, 2005[79, 80]	Yes	Yes	Yes	Yes	Yes	Partial	Yes	Yes	Yes	6/7
NICE, 2004[87]	Yes	Yes	Yes	Yes	No	Yes	No	Can't tell	Can't tell	4/7
Urrutia, 2007[99]	Yes	Partial	Yes	Yes	Yes	Yes	Partial	Yes	Yes	6/7
KQ 8 – INTRADISCALSTEROID INJECTION										
Gibson, 2007[81, 82]	Yes	Yes	Yes	Yes	Yes	Partial	Yes	Yes	Yes	6/7
KQ 8 – LOCAL INJECTIONS										
Abdi, 2005[170]	Yes	Yes	Yes	Yes	Partial	Yes	No	No	Yes	3/7
Resnick, 2005[92]	Yes	Partial	Partial	Can't tell	No	No	Partial	Can't tell	Can't tell	2/7
Staal, 2008[94]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7

APPENDIX 5: QUALITY RATINGS OF INCLUDED SYSTEMATIC REVIEWS

Author, year	Search methods	Comprehensive	Inclusion criteria	Bias avoided	Validity criteria	Validity assessed	Methods for combining studies	Appropriately combined	Conclusions supported	Overall quality
KQ 8 – PERCUTANEOUS INTRADISCAL RADIOFREQUENCY THERMOCOAGULATION (PIRFT) AND COBLATION® NUCLEOPLASTY										
Gibson, 2005[79, 80]	Yes	Yes	Yes	Yes	Yes	Partial	Yes	Yes	Yes	6/7
NICE, 2004[87]	Yes	Yes	Yes	Yes	No	Yes	No	Can't tell	Can't tell	4/7
NICE, 2004[88]	Yes	Yes	Yes	Can't tell	No	Partial	No	Yes	Yes	4/7
Niemisto, 2003[90, 91]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
Urrutia, 2007[99]	Yes	Partial	Yes	Yes	Yes	Yes	Partial	Yes	Yes	6/7
KQ 8 – PROLOTHERAPY										
Dagenais, 2007[76]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
KQ 8 – RADIOFREQUENCY DENERVATION										
Boswell, 2007[75]	Yes	Yes	Yes	Can't tell	Yes	Partial	Yes	No	No	3/7
Geurts, 2001[78]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
Niemisto, 2003[90, 91]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
Resnick, 2005[92]	Yes	Partial	Partial	Can't tell	No	No	Partial	Can't tell	Can't tell	2/7
Slipman, 2003[93]	Partial	Partial	Yes	Can't tell	No	Partial	Partial	Can't tell	Can't tell	3/7
KQ 8 – SACROILIAC JOINT STEROID INJECTION										
Hansen, 2007[83]	Yes	Yes	Yes	Can't tell	Yes	Partial	Yes	Yes	Yes	5/7
KQ 8 (and KQ 11) – SPINAL CORD STIMULATION										
Maillis-Gagnon, 2004[85]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
Taylor, 2006[95, 96]	Yes	Yes	Yes	Can't tell	Yes	Yes	Yes	Yes	Yes	5/7
Turner, 2004[98]	Yes	Yes	Yes	Can't tell	Yes	Partial	Yes	Yes	Yes	5/7
KQ 9 – SURGERY FOR ISTHMIC SPONDYLOLISTHESIS										
Gibson, 2005[79, 80]	Yes	Yes	Yes	Yes	Yes	Partial	Yes	Yes	Yes	6/7
Kwon, 2005[216]	Partial	No	Yes	Can't tell	No	No	Partial	Can't tell	Can't tell	1/7

APPENDIX 5: QUALITY RATINGS OF INCLUDED SYSTEMATIC REVIEWS

Author, year	Search methods	Comprehensive	Inclusion criteria	Bias avoided	Validity criteria	Validity assessed	Methods for combining studies	Appropriately combined	Conclusions supported	Overall quality
KQ 9 – SURGERY FOR NON-RADICULAR LOW BACK PAIN WITH COMMON DEGENERATIVE CHANGES										
Andersson, 2006[72]	Yes	Partial	Yes	Can't tell	Partial	Partial	Yes	No	No	2/7
Bono, 2004[210]	Yes	Partial	Yes	Can't tell	No	No	Yes	Can't tell	Can't tell	3/7
de Kleuver, 2003[212]	Yes	Yes	Yes	Yes	Yes	Yes	Partial	Yes	Partial	6/7
Fenton, 2007[230]	Yes	Can't tell	Yes	Partial	No	No	Yes	Partial (combined RCTs and observational studies)	Partial (incomplete analyses of potential confounders)	3/7
Freeman, 2006[213]	Yes	Partial	No	Partial	No	No	Partial	Can't tell	Yes	4/7
Geisler, 2004[214]	Yes	No	Yes	Can't tell	No	No	No	Can't tell	Can't tell	2/7
Gibson, 2005[79, 80]	Yes	Yes	Yes	Yes	Yes	Partial	Yes	Yes	Yes	6/7
Ibrahim, 2008[215]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Partial	Partial	5/7
Mirza, 2007[218]	Yes	Partial	Yes	Can't tell	Yes	Partial	No	Yes	Yes	5/7
NICE, 2004[221]	Yes	Yes	Yes	Can't tell	No	Partial	No	Partial	Yes	4/7
Resnick, 2005[224]	Yes	Yes	Partial	Can't tell	No	Partial	Can't tell	Can't tell	Can't tell	2/7
Resnick, 2005[225]	Yes	Partial	Partial	Can't tell	No	Partial	Can't tell	Can't tell	Can't tell	2/7
Resnick, 2005[226]	Yes	Partial	Yes	Can't tell	No	Partial	Can't tell	Can't tell	Can't tell	3/7
KQ 9 – SURGERY FOR RADICULOPATHY WITH HERNIATED LUMBAR DISC										
Boult, 2000[211]	Yes	Partial	Yes	Can't tell	No	No	Yes	Yes	Yes	4/7
Gibson, 2007[81, 82]	Yes	Yes	Yes	Yes	Yes	Partial	Yes	Yes	Yes	6/7
NICE, 2005[222]	Yes	Yes	Yes	Can't tell	No	Partial	No	Yes	Yes	4/7
NICE, 2003[219]	Yes	Yes	Yes	Can't tell	No	Partial	No	NA	Yes	4/7
NICE, 2003[220]	Yes	Yes	Yes	Can't tell	No	Partial	No	NA	Yes	4/7
Resnick, 2005[227]	Yes	Partial	Partial	Can't tell	No	Partial	No	Can't tell	Can't tell	2/7

APPENDIX 5: QUALITY RATINGS OF INCLUDED SYSTEMATIC REVIEWS

Author, year	Search methods	Comprehensive	Inclusion criteria	Bias avoided	Validity criteria	Validity assessed	Methods for combining studies	Appropriately combined	Conclusions supported	Overall quality
KQ 9 – SURGERY FOR SPINAL STENOSIS WITH OR WITHOUT DEGENERATIVE SPONDYLOLISTHESIS										
Aalto, 2006[254]	Yes	Yes	Yes	Partial	Yes	Yes	No	Can't tell	Can't tell	4/7
Bono, 2004[210]	Yes	Partial	Yes	Can't tell	No	No	Yes	Can't tell	Can't tell	3/7
Gibson, 2005[79, 80]	Yes	Yes	Yes	Yes	Yes	Partial	Yes	Yes	Yes	6/7
Martin, 2007[217]	Yes	Yes	Yes	Partial	Yes	Partial	Yes	Yes	Yes	5/7
NICE, 2005[223]	Yes	Yes	Yes	Can't tell	No	Partial	No	Yes	Yes	4/7
Resnick, 2005[228]	Yes	Partial	Partial	Can't tell	No	Partial	No	Can't tell	Can't tell	2/7
Resnick, 2005[229]	Yes	Partial	Partial	Can't tell	No	Partial	Can't tell	Can't tell	Can't tell	2/7
Resnick, 2005[225]	Yes	Partial	Partial	Can't tell	No	Partial	Can't tell	Can't tell	Can't tell	2/7
Resnick, 2005[226]	Yes	Partial	Partial	Can't tell	No	Partial	Can't tell (inconsistency between text and tables)	Can't tell	Can't tell	2/7
KQ 10 – ACUPUNCTURE COMBINED WITH OTHER NON-INVASIVE INTERVENTIONS										
Furlan, 2005[69, 70].	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
KQ 10 – COMBINATIONS OF MEDICATIONS										
van Tulder, 2003[488, 489]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
KQ 10 – EXERCISE COMBINED WITH OTHER INTERVENTIONS										
Hayden 2005[613, 614]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
KQ 10 – MASSAGE COMBINED WITH OTHER INTERVENTIONS										
Furland, 2002[700, 701]	Yes	Yes	Yes	Partial	Yes	Yes	Yes	Yes	Can't tell	6/7
KQ 10 – PSYCHOLOGICAL THERAPIES COMBINED WITH OTHER INTERVENTIONS										
Ostelo, 2005[301]	Yes	Yes	Yes	Yes	Yes	Partial (no sensitivity analysis)	Yes	Yes	Yes	6/7

APPENDIX 5: QUALITY RATINGS OF INCLUDED SYSTEMATIC REVIEWS

Author, year	Search methods	Comprehensive	Inclusion criteria	Bias avoided	Validity criteria	Validity assessed	Methods for combining studies	Appropriately combined	Conclusions supported	Overall quality
KQ 10 – SPINAL MANIPULATION COMBINED WITH OTHER INTERVENTIONS										
Assendelft, 2004[66, 67]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
KQ 10 – TRACTION COMBINED WITH OTHER INTERVENTIONS										
Clarke, 2006[676, 677]	Yes	Yes	Yes	Can't tell	Yes	Yes	Yes	Yes	Yes	6/7
KQ 11 – ADHESIOLYSIS AND FORCEFUL EPIDURAL INJECTIONS										
Trescot, 2007[982]	Yes	Yes	Yes	Yes	Yes	Partial	Yes	No (incorrect classification of trial as randomized)	Partial	3/7
KQ 11 – SPINAL CORD STIMULATION										
Mailis-Gagnon, 2004[85]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	5/7
Taylor, 2006[95, 96]	Yes	Yes	Yes	Can't tell	Yes	Yes	Yes	Yes	Yes	5/7
Turner, 2004[98]	Yes	Yes	Yes	Can't tell	Yes	Partial	Yes	Yes	Yes	5/7
KQ 13 – ADVICE TO STAY ACTIVE										
Hilde, 2002[360]	Partial	Yes	Yes	Don't know	Yes	Yes	Yes	Yes	Yes	6/7
KQ 13 – BACK SCHOOLS										
Heymans, 2004[586, 587]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
Linton, 2001[1004]	Partial	Yes	Yes	Can't tell	No	No	No	Don't know	Yes	3/7
KQ 13 – EXERCISE										
Hayden, 2005[613, 614]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
Linton, 2001[1004]	Partial	Yes	Yes	Can't tell	No	No	No	Don't know	Yes	3/7
KQ 13 – LUMBAR SUPPORTS										
Jellema, 2001[385]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
KQ 14 – ACUPUNCTURE DURING PREGNANCY										
Furlan, 2005[69, 70]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7

APPENDIX 5: QUALITY RATINGS OF INCLUDED SYSTEMATIC REVIEWS

Author, year	Search methods	Comprehensive	Inclusion criteria	Bias avoided	Validity criteria	Validity assessed	Methods for combining studies	Appropriately combined	Conclusions supported	Overall quality
Stuge, 2003[1012]	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	6/7
KQ 14 – MASSAGE DURING PREGNANCY										
Stuge, 2003[1012]	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	6/7
KQ 14 – PHYSICAL THERAPY DURING PREGNANCY										
Stuge, 2003[1012]	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	6/7
KQ 14 – SUPPORTIVE DEVICES DURING PREGNANCY										
Young, 2005[1024]	Yes	Partial	Yes	Can't tell	No	Partial	No	Yes	Yes	4/7

APPENDIX 6: LIST OF EXCLUDED SYSTEMATIC REVIEWS

Author, year, title	Reason for exclusion
KQ 1a – DIAGNOSIS	
Deyo, 1992[273] What can the history and physical examination tell us about low back pain?	Outdated Not clear if systematic methods used
Jarvik, 2003[275] Imaging of adults with low back pain in the primary care setting	Reports same results as another included systematic review (Jarvik, 2002[268])
Rebain, 2002[274] A systematic review of the passive straight leg raising test as a diagnostic aid for low back pain (1989 to 2000)	Does not evaluate diagnostic accuracy of straight leg raise test
KQ 2a and 2b – DIAGNOSTIC TESTING	
Boos, 1996[316] Clinical efficacy of imaging modalities in the diagnosis of low-back pain disorders	Outdated
Deyo, 1992[273] What can the history and physical examination tell us about low back pain?	Outdated
Geisser, 2005[322] A meta-analytic review of surface electromyography among persons with low back pain and normal, healthy controls	Only evaluates ability of surface electromyography to distinguish persons with low back pain from persons without low back pain
Jarvik, 2003[275] Imaging of adults with low back pain in the primary care setting	Reports same results as another included systematic review (Jarvik, 2002[268])
Kardaun, 1989[324] CT, myelography, and phlebography in the detection of lumbar disk herniation: an analysis of the literature	Outdated
Kent, 1992[325] Diagnosis of lumbar spinal stenosis in adults: a metaanalysis of the accuracy of CT, MR, and myelography	Outdated
Littenberg, 1995[317] Clinical efficacy of SPECT bone imaging for low back pain	Outdated
Mohseni-Bandpei, 2000[323] Application of surface electromyography in the assessment of low back pain: a literature review	Only evaluates the ability of surface electromyography to distinguish persons with low back pain from persons without low back pain
KQ 2a and 2b – IMAGING	
Systematic reviews of tests to diagnose serious underlying conditions	
Boos, 1996[316] Clinical efficacy of imaging modalities in the diagnosis of low-back pain disorders	Does not clearly use systematic methods to synthesize the literature
Deyo, 1992[273] What can the history and physical examination tell us about low back pain?	Outdated Not clear if systematic methods used
Jarvik, 2003[275] Imaging of adults with low back pain in the primary care setting	Reports same results as another included systematic review (Jarvik, 2002[268])
Littenberg, 1995[317] Clinical efficacy of SPECT bone imaging for low back pain	Outdated

APPENDIX 6: LIST OF EXCLUDED SYSTEMATIC REVIEWS

Author, year, title	Reason for exclusion
KQ 3 – ADVICE TO REST IN BED	
Allen, 1999[342] Bed rest: a potentially harmful treatment needing more careful evaluation	Outdated Not specific for low back pain
Hagen, 2000[341] The Cochrane review of bed rest for acute low back pain and sciatica	Updated Cochrane review available (Hagen, 2004[64, 65])
Koes, 1994[343] Efficacy of bed rest and orthoses for low back pain	Outdated
Maher, 1999[344] Prescription of activity for low back pain: what works?	Outdated
Scheer, 1995[345] Randomized controlled trials in industrial low back pain relating to return to work. Part 1. Acute interventions	Outdated
van der Weide, 1997[346] Vocational outcome of intervention for low-back pain	Outdated
van Tulder, 1997[193] Conservative treatment of acute and chronic nonspecific low back pain. A systematic review of randomized controlled trials of the most common interventions	Outdated
Waddell, 1997[347] Systematic reviews of bed rest and advice to stay active for acute low back pain	Outdated
KQ 3 – LUMBAR SUPPORTS	
Koes, 1994[343] Efficacy of bed rest and orthoses for low back pain	Outdated
Scheer, 1997[386] Randomized controlled trials in industrial low back pain. Part 3. Subacute/chronic pain interventions	Outdated
van Poppel, 2000[387] Mechanisms of action of lumbar supports	Does not evaluate clinical outcomes from use of lumbar supports
KQ 3 – SUPERFICIAL HEAT-COLD	
Philadelphia Panel, 2001[399] Philadelphia Panel evidence-based clinical practice guidelines on selected rehabilitation interventions for low back pain	Outdated
KQ 4 – ACETAMINOPHEN	
Deyo, 1996[415] Drug therapy for back pain. Which drugs help which patients?	Outdated Systematic methods not reported
van Tulder, 1997[193] Conservative treatment of acute and chronic nonspecific low back pain. A systematic review of randomized controlled trials of the most common interventions	Outdated
KQ 4 – ACUPUNCTURE	
Ernst, 1997[558] Life-threatening adverse reactions after acupuncture? A systematic review	Outdated
Ernst, 1998[559] Acupuncture for back pain. A meta-analysis of randomized controlled trials.	Outdated

APPENDIX 6: LIST OF EXCLUDED SYSTEMATIC REVIEWS

Author, year, title	Reason for exclusion
Ezzo, 2000[563] Is acupuncture effective for the treatment of chronic pain? A systematic review	Outdated
Patel, 1989[562] A meta-analysis of acupuncture for chronic pain	Outdated Not specific for low back pain
Smith, 2000[564] Teasing apart quality and validity in systematic reviews: an example from acupuncture trials in chronic neck and back pain	Outdated
Strauss, 1999[560] Acupuncture and the treatment of chronic low-back pain: a review of the literature	Outdated
ter Riet, 1990[561] Acupuncture and chronic pain: a criteria-based meta-analysis	Outdated Not specific for low back pain
van Tulder, 1999[557, 1032] The effectiveness of acupuncture in the management of acute and chronic low back pain. A systematic review within the framework of the Cochrane Collaboration Back Review Group	Updated Cochrane review available (Furlan, 2005[69, 70])
KQ 4 – ANTIDEPRESSANTS	
Fishbain, 2000[485] Evidence-based data on pain relief with antidepressants	Not specific for low back pain
Goodkin, 1989[482] Antidepressants for the relief of chronic pain: do they work?	Outdated Not specific for low back pain
Onghena, 1992[483] Antidepressant-induced analgesia in chronic non-malignant pain: a meta-analysis of 39 placebo-controlled studies	Outdated Not specific for low back pain
Turner, 1993[484] Do antidepressant medications relieve chronic low back pain?	Outdated
van Tulder, 1997[193] Conservative treatment of acute and chronic nonspecific low back pain. A systematic review of randomized controlled trials of the most common interventions	Outdated
KQ 4 – BACK SCHOOLS	
Cohen, 1994[592] Group education interventions for people with low back pain	Outdated
Di Fabio, 1995[593] Efficacy of comprehensive rehabilitation programs and back school for patients with low back pain: a meta-analysis	Outdated
Keijsers, 1991[594] Validity and comparability of studies on the effects of back schools	Outdated
Koes, 1994[343] The efficacy of back schools: a review of randomized clinical trials	Outdated
Nentwig, 1999[596] Effectiveness of the back school. A review of the results of evidence-based evaluation	Outdated German language
Scheer, 1995[345] Randomized controlled trials in industrial low back pain relating to return to work. Part 1. Acute interventions	Outdated

APPENDIX 6: LIST OF EXCLUDED SYSTEMATIC REVIEWS

Author, year, title	Reason for exclusion
Scheer, 1997[386] Randomized controlled trials in industrial low back pain. Part 3. Subacute/chronic pain interventions	Outdated
Turner, 1996[597] Educational and behavioral interventions for back pain in primary care	Outdated
van der Weide, 1997[346] Vocational outcome of intervention for low-back pain	Outdated
van Tulder, 1997[193] Conservative treatment of acute and chronic nonspecific low back pain. A systematic review of randomized controlled trials of the most common interventions	Outdated
van Tulder, 1999[591] Back schools for non-specific low-back pain	Updated Cochrane review available (Heymans, 2004[586, 587]
KQ 4 – BENZODIAZEPINES	
Deyo, 1996[415] Drug therapy for back pain. Which drugs help which patients?	Outdated Systematic methods not reported
van Tulder, 1997[193] Conservative treatment of acute and chronic nonspecific low back pain. A systematic review of randomized controlled trials of the most common interventions	Outdated
KQ 4 – EXERCISE	
Beckerman, 1993[623] Efficacy of physiotherapy for musculoskeletal disorders: what can we learn from research?	Outdated Not specific for low back pain
Cleland, 2002[627] The role of therapeutic exercise in treating instability-related lumbar spine pain: a systematic review	Systematic methods not used for synthesizing results Instability-related lumbar spine pain not a clearly recognized entity
Colle, 2002[622] Impact of quality scales on levels of evidence inferred from a systematic review of exercise therapy and low back pain	Only included trials identified by an outdated Cochrane review (van Tulder, 2000[621])
Faas, 1996[624] Exercises: which ones are worth trying, for which patients, and when?	Outdated
Hilde, 1998[625] Effect of exercise in the treatment of chronic low back pain: a systematic review, emphasizing type and dose of exercise	Outdated
Koes, 1991[626] Physiotherapy exercises and back pain: a blinded review	Outdated
Maher, 1999[344] Prescription of activity for low back pain: what works?	Outdated
Ostelo, 2003[790] Rehabilitation following first-time lumbar disc surgery. A systematic review within the framework of the Cochrane Collaboration	Post-surgery patients
Scheer, 1995[345] Randomized controlled trials in industrial low back pain relating to return to work. Part 1. Acute interventions	Outdated

APPENDIX 6: LIST OF EXCLUDED SYSTEMATIC REVIEWS

Author, year, title	Reason for exclusion
Scheer, 1997[386] Randomized controlled trials in industrial low back pain. Part 3. Subacute/chronic pain interventions	Outdated
van der Weide, 1997[346] Vocational outcome of intervention for low-back pain	Outdated
van Tulder, 1997[193] Conservative treatment of acute and chronic nonspecific low back pain. A systematic review of randomized controlled trials of the most common interventions	Outdated
van Tulder, 2000[621] Exercise therapy for low back pain. A systematic review within the framework of the Cochrane Collaboration Back Review Group	Updated Cochrane review available (Hayden, 2005[613, 614])
KQ 4 – HERBAL THERAPIES	
Gagnier, 2004[547] Harpgophytum procumbens for osteoarthritis and low back pain: A systematic review	Outdated
KQ 4 – INTERDISCIPLINARY REHABILITATION (MULTIDISCIPLINARY REHABILITATION)	
Di Fabio, 1995[593] Efficacy of comprehensive rehabilitation programs and back school for patients with low back pain: a meta-analysis	Outdated
KQ 4 – LOW LEVEL LASER	
Beckerman, 1992[662] The efficacy of laser therapy for musculoskeletal and skin disorders: a criteria-based meta-analysis of randomized clinical trials	Outdated Not specific for low back pain
Beckerman, 1993[623] Efficacy of physiotherapy for musculoskeletal disorders: what can we learn from research?	Not specific for low back pain
Bjordal, 2003[663] A systematic review of low level laser therapy with location-specific doses for pain from chronic joint disorders	Not specific for low back pain
de Bie, 1998[664] Efficacy of 904 nm laser therapy in the management of musculoskeletal disorders: a systematic review	Not specific for low back pain
Gam, 1993[665] The effect of low-level laser therapy on musculoskeletal pain: a meta-analysis	Outdated Not specific for low back pain
KQ 4 – MASSAGE	
Ernst, 1999[734] Massage therapy for low back pain: a systematic review	Outdated
Ernst, 2003[735] The safety of massage therapy	Not specific for low back pain Includes 2 case reports of serious adverse events following massage in patients with low back pain
Philadelphia Panel, 2001[399] Philadelphia Panel evidence-based clinical practice guidelines on selected rehabilitation interventions for low back pain	Outdated

APPENDIX 6: LIST OF EXCLUDED SYSTEMATIC REVIEWS

Author, year, title	Reason for exclusion
KQ 4 – MODIFIED WORK	
Hlobil, 2005[741] Effectiveness of a return-to-work intervention for subacute low-back pain	Did not evaluate benefits or harms associated with modified work
Krause, 1998[742] Modified work and return to work: a review of the literature	Outdated
Tveito, 2004[645] Low back pain interventions at the workplace: a systematic literature review	Did not evaluate benefits or harms associated with modified work
KQ 4 – MUSCLE RELAXANTS	
Deyo, 1996[415] Drug therapy for back pain. Which drugs help which patients?	Outdated Systematic methods not reported
van Tulder, 1997[193] Conservative treatment of acute and chronic nonspecific low back pain. A systematic review of randomized controlled trials of the most common interventions	Outdated
KQ 4 – NONSTEROIDAL ANTI-INFLAMMATORY DRUGS	
Deyo, 1996[415] Drug therapy for back pain. Which drugs help which patients?	Outdated Systematic methods not reported
Koes, 1997[448] Efficacy of non-steroidal anti-inflammatory drugs for low back pain: a systematic review of randomized clinical trials	Outdated
van der Weide, 1997[346] Vocational outcome of intervention for low-back pain	Outdated
van Tulder, 1997[193] Conservative treatment of acute and chronic nonspecific low back pain. A systematic review of randomized controlled trials of the most common interventions	Outdated
KQ 4 – OPIOIDS	
Bartleson, 2002[508] Evidence for and against the use of opioid analgesics for chronic nonmalignant low back pain: a review	Did not clearly use systematic methods
Brown, 1996[509] Chronic opioid analgesic therapy for chronic low back pain	Not a systematic review
Deyo, 1996[415] Drug therapy for back pain. Which drugs help which patients?	Outdated Systematic methods not reported
Furlan, 2006[510] Opioids for chronic noncancer pain: A meta-analysis of effectiveness and side effects	Not specific to low back pain
Kalso, 2004[511] Opioids in chronic non-cancer pain: systematic review of efficacy and safety	Not specific to low back pain
KQ 4 – PSYCHOLOGICAL THERAPIES	
Morley, 1999[724] Systematic review and meta-analysis of randomized controlled trials of cognitive behavior therapy and behavior therapy for chronic pain in adults, excluding headache	Outdated

APPENDIX 6: LIST OF EXCLUDED SYSTEMATIC REVIEWS

Author, year, title	Reason for exclusion
Scheer, 1997[386] Randomized controlled trials in industrial low back pain. Part 3. Subacute/chronic pain interventions	Outdated
Turner, 1996[597] Educational and behavioral interventions for back pain in primary care	Outdated
van der Weide, 1997[346] Vocational outcome of intervention for low-back pain	Outdated
van Tulder, 1997[193] Conservative treatment of acute and chronic nonspecific low back pain. A systematic review of randomized controlled trials of the most common interventions	Outdated Not specific for low back pain
van Tulder, 2000[723] Behavioral treatment for chronic low back pain. A systematic review within the framework of the Cochrane Back Review Group	Updated Cochrane review available (Ostelo, 2005[301])
KQ 4 – SPINAL MANIPULATION	
Abenhaim, 1992[764] Twenty years of randomized clinical trials of manipulative therapy for back pain: a review	Outdated
Anderson, 1992[765] A meta-analysis of clinical trials of spinal manipulation	Outdated
Assendelft, 1992[766] The efficacy of chiropractic manipulation for back pain: blinded review of relevant randomized clinical trials	Outdated
Assendelft, 1995[767] The relationship between methodological quality and conclusions in reviews of spinal manipulation	Outdated Review of reviews
Assendelft, 1996[768] The effectiveness of chiropractic for treatment of low back pain: an update and attempt at statistical pooling	Outdated
Assendelft, 1996[769] The effectiveness of chiropractic for treatment of low back pain: an update and attempt at statistical pooling	Outdated
Beckerman, 1993[623] Efficacy of physiotherapy for musculoskeletal disorders: what can we learn from research?	Outdated
Brox, 1999[770] Is exercise therapy and manipulation effective in low back pain?	Outdated Norwegian language
di Fabio, 1992[771] Efficacy of manual therapy	Outdated
Ernst, 2000[777] Does spinal manipulation have specific treatment effects?	Not specific for low back pain/lumbar manipulation
Ernst, 2001[778] Spinal manipulation: a systematic review of sham-controlled, double-blind, randomized clinical trials	Not specific for low back pain/lumbar manipulation
Ernst, 2004[779] Cerebrovascular complications associated with spinal manipulation	Cervical manipulation only
Koes, 1991[773]	Outdated

APPENDIX 6: LIST OF EXCLUDED SYSTEMATIC REVIEWS

Author, year, title	Reason for exclusion
Spinal manipulation and mobilization for back and neck pain: a blinded review	
Koes, 1996[772] Spinal manipulation for low back pain. An updated systematic review of randomized clinical trials	Outdated
Mohseni-Bandpei, 1998[774] Spinal manipulation in the treatment of low back pain: a review of the literature with particular emphasis on randomized controlled clinical trials	Outdated
Ottenbacher, 1985[775] Efficacy of spinal manipulation/mobilization therapy. A meta-analysis	Outdated
Scheer, 1995[345] Randomized controlled trials in industrial low back pain relating to return to work. Part 1. Acute interventions	Outdated
Shekelle, 1992[776] Spinal manipulation for low-back pain	Outdated
van der Weide, 1997[346] Vocational outcome of intervention for low-back pain	Outdated
van Tulder, 1997[193] Conservative treatment of acute and chronic nonspecific low back pain. A systematic review of randomized controlled trials of the most common interventions	Outdated
KQ 4 – SYSTEMIC STEROIDS	
Deyo, 1996[415] Drug therapy for back pain. Which drugs help which patients?	Systematic methods not reported
Lipetz, 1998[1033] Oral medications in the treatment of acute low back pain	Not a systematic review
Rozenberg, 1998[188] Glucocorticoid therapy in common lumbar spinal disorders	Not a systematic review
KQ 4 – TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION (TENS)	
Beckerman, 1993[623] Efficacy of physiotherapy for musculoskeletal disorders: what can we learn from research?	Outdated
Brosseau, 2002[702] Efficacy of the transcutaneous electrical nerve stimulation for the treatment of chronic low back pain. A meta-analysis	Updated Cochrane review available (Khadilkar, 2005[698, 699])
Flowerdew, 1997[705] A review of the treatment of chronic low back pain with acupuncture-like transcutaneous electrical nerve stimulation and transcutaneous electrical nerve stimulation	Outdated
Gadsby, 2000[704] Transcutaneous electrical nerve stimulation and acupuncture-like transcutaneous electrical nerve stimulation for chronic low back pain	Updated Cochrane review available (Khadilkar, 2005[698, 699])
Milne, 2001[703] Transcutaneous electrical nerve stimulation (TENS) for chronic low-back pain	Updated Cochrane review available (Khadilkar, 2005[698, 699])

APPENDIX 6: LIST OF EXCLUDED SYSTEMATIC REVIEWS

Author, year, title	Reason for exclusion
van Tulder, 1997[193] Conservative treatment of acute and chronic nonspecific low back pain. A systematic review of randomized controlled trials of the most common interventions	Outdated
KQ 4 – TRACTION	
Beckerman, 1993[623] Efficacy of physiotherapy for musculoskeletal disorders: what can we learn from research	Outdated
van der Heijden, 1995[682] The efficacy of traction for back and neck pain: a systematic, blinded review of randomized clinical trial methods	Outdated
van Tulder, 1997[193] Conservative treatment of acute and chronic nonspecific low back pain. A systematic review of randomized controlled trials of the most common interventions	Outdated
KQ 4 – ULTRASOUND	
Beckerman, 1993[623] Efficacy of physiotherapy for musculoskeletal disorders: what can we learn from research?	Not specific for low back pain
Gam, 1995[717] Ultrasound therapy in musculoskeletal disorders: a meta-analysis	Not specific for low back pain
Robertson, 2001[716] A review of therapeutic ultrasound: effectiveness studies	Not specific for low back pain
van der Windt, 1999[715] Ultrasound therapy for musculoskeletal disorders: a systematic review	Not specific for low back pain
KQ 7 – DIAGNOSTIC INTRA-ARTICULAR FACET JOINT BLOCKS AND MEDIAL BRANCH BLOCK	
Sehgal, 2005[835] Diagnostic utility of facet (zygapophysial) joint injections in chronic spinal pain: A systematic review of evidence	Updated review available (Sehgal, 2007[837])
KQ 7 – DIAGNOSTIC SACROILIAC JOINT BLOCK	
McKenzie-Brown, 2005[186] A systematic review of sacroiliac joint interventions	Updated review available (Hansen, 2007[83])
KQ 7 – DIAGNOSTIC SELECTIVE NERVE ROOT BLOCK	
Everett, 2005[833] A systematic review of diagnostic utility of selective nerve root blocks	Updated review available (Datta, 2007[834])
KQ 7 – PROVOCATIVE DISCOGRAPHY	
Shah, 2005 [807] Discography as a diagnostic test for spinal pain: A systematic and narrative review	Updated review available (Buenaventura, 2007[809])
KQ 8 – BOTULINUM TOXIN	
Difazio, 2002[175] A focused review of the use of botulinum toxins for low back pain	Not a systematic review
KQ 8 – CHEMONUCLEOLYSIS	
Gibson, 1999[176] The Cochrane review of surgery for lumbar disc prolapse and degenerative	Updated Cochrane review available (Gibson, 2007[81, 82])

APPENDIX 6: LIST OF EXCLUDED SYSTEMATIC REVIEWS

Author, year, title	Reason for exclusion
lumbar spondylosis	
Gibson, 2000[177] Surgery for lumbar disc prolapse	Updated Cochrane review available (Gibson, 2007[81, 82])
Scheer, 1996[190] Randomized controlled trials in industrial low back pain relating to return to work. Part 2. Discogenic low back pain	Outdated
Stevens, 1997[191] Efficacy of lumbar discectomy and percutaneous treatments for lumbar disc herniation	Outdated
KQ 8 – EPIDURAL STEROID INJECTION	
Abdi, 2005[170] Role of epidural steroids in the management of chronic spinal pain: A systematic review of effectiveness and complications	Updated review available (Abdi, 2007[71])
Boswell, 2003[172] Epidural steroids in the management of chronic spinal pain and radiculopathy	Updated review available (Abdi, 2007[71])
Cannon, 2000[173] Lumbosacral epidural steroid injections	Not a systematic review
Haselkorn, 1995[178] Epidural steroid injections and the management of sciatica: a meta-analysis	Outdated Published as abstract only
Kepes, 1985[181] Treatment of backache with spinal injections of local anesthetics, spinal and systemic steroids. A review	Not a systematic review
Koes, 1995[184] Efficacy of epidural steroid injections for low-back pain and sciatica: a systematic review of randomized clinical trials	Outdated
Koes, 1999[183] Epidural steroid injections for low back pain and sciatica: An updated systematic review of randomized clinical trials	Outdated
Nelemans, 1999[187] Injection therapy for subacute and chronic benign low-back pain	Updated Cochrane review available (Nelemans, 2001[86])
Rozenberg, 1998[188] Glucocorticoid therapy in common lumbar spinal disorders	Not a systematic review
Rozenberg, 1999[189] Efficacy of epidural steroids in low back pain and sciatica. A critical appraisal by a French task force of randomized trials	Outdated
Scheer, 1996[190] Randomized controlled trials in industrial low back pain relating to return to work. Part 2. Discogenic low back pain	Outdated
Scheer, 1997[386] Randomized controlled trials in industrial low back pain. Part 3. Subacute/chronic pain interventions	Outdated (only 1 study of injections included in this review)
van Tulder, 1997[193] Conservative treatment of acute and chronic nonspecific low back pain. A systematic review of randomized controlled trials of the most common interventions	Outdated

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Author, year, title	Reason for exclusion
Watts, 1995[194] A meta-analysis on the efficacy of epidural corticosteroids in the treatment of sciatica	Outdated
KQ 8 – FACET JOINT STEROID INJECTION	
Boswell, 2005[171] Therapeutic facet joint interventions in chronic spinal pain: A systematic review of effectiveness and complications	Updated review available (Boswell, 2007[75])
Nelemans, 1999[187] Injection therapy for subacute and chronic benign low-back pain	Updated Cochrane review available (Nelemans, 2001[86])
KQ 8 – INTRADISCAL ELECTROTHERMAL THERAPY (IDET)	
Chou, 2005[174] Intradiscal electrothermal annuloplasty	Doesn't clearly use systematic methods
Gibson, 1999[176] The Cochrane review of surgery for lumbar disc prolapse and degenerative lumbar spondylosis	Updated Cochrane review available (Gibson, 2005[79, 80])
Gibson, 2000[255] Surgery for degenerative lumbar spondylosis	Updated Cochrane review available (Gibson, 2005[79, 80])
Heary, 2001[179] Intradiscal electrothermal annuloplasty: the IDET procedure	Not a systematic review
Wetzel, 2002[196] Intradiscal electrothermal therapy used to manage chronic discogenic low back pain. New directions and interventions	Not a systematic review
KQ 8 – INTRADISCAL STEROID INJECTION	
Gibson, 1999[176, 177] The Cochrane review of surgery for lumbar disc prolapse and degenerative lumbar spondylosis	Updated Cochrane review available (Gibson, 2007[81, 82])
Gibson, 2000[177] Surgery for lumbar disc prolapse	Updated Cochrane review available (Gibson, 2007[81, 82])
KQ 8 – LOCAL INJECTIONS	
Nelemans, 1999[187] Injection therapy for subacute and chronic benign low-back pain	Updated Cochrane review available (Nelemans, 2001[86])
KQ 8 – PROLOTHERAPY	
Kim, 2004[182] Critical review of prolotherapy for osteoarthritis, low back pain, and other musculoskeletal conditions: A physiatric perspective	Systematic methods not clearly used
Yelland, 2004[197] Prolotherapy injections for chronic low-back pain	Updated Cochrane review available (Dagenais, 2007[76])
KQ 8 – RADIOFREQUENCY DENERVATION	
Boswell, 2005[171] Therapeutic facet joint interventions in chronic spinal pain: A systematic review of their role in chronic spinal pain management and complications	Updated review available (Boswell, 2007[75])
Hooten, 2005[180] Radiofrequency Neurotomy for Low Back Pain: Evidence-Based Procedural Guidelines	Focused on technical aspects; did not evaluate efficacy

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Author, year, title	Reason for exclusion
Manchikanti, 2002[185] Medial Branch Neurotomy in Management of Chronic Spinal Pain: Systematic Review of the Evidence	Updated review available (Boswell, 2007[75])
KQ 8 – SACROILIAC JOINT STEROID INJECTION	
McKenzie-Brown, 2005[186] A systematic review of sacroiliac joint interventions	Updated review available (Hansen, 2007[83])
KQ 8 – SPINAL CORD STIMULATION FOR BACK PAIN WITHOUT FAILED BACK SURGERY SYNDROME	
Turner, 1995[192] Spinal cord stimulation for chronic low back pain: a systematic literature synthesis	Outdated
Wetzel, 2000[195] Treatment of chronic pain in failed back surgery patients with spinal cord stimulation: a review of current literature and proposal for future investigation	Did not use systematic methods
KQ 9 – SURGERY	
Surgery for non-radicular low back pain with common degenerative changes	
Gibson, 1999[176] The Cochrane review of surgery for lumbar disc prolapse and degenerative lumbar spondylosis	Updated Cochrane review available (Gibson, 2005[79, 80])
Gibson, 2000[255] Surgery for degenerative lumbar spondylosis	Updated Cochrane review available (Gibson, 2005[79, 80])
Turner, 1992[260] Patient outcomes after lumbar spinal fusions	Outdated
Turner, 1993[261] Meta-analysis of the results of lumbar spine fusion	Outdated
Surgery for isthmic spondylolithesis	
Gibson, 1999[176] The Cochrane review of surgery for lumbar disc prolapse and degenerative lumbar spondylosis	Updated Cochrane review available (Gibson, 2005[79, 80])
Gibson, 2000[177] Surgery for degenerative lumbar spondylosis	Updated Cochrane review available (Gibson, 2005[79, 80])
Surgery for spinal stenosis with or without degenerative spondylolisthesis	
Gibson, 1999[176] The Cochrane review of surgery for lumbar disc prolapse and degenerative lumbar spondylosis	Updated Cochrane review available (Gibson, 2005[79, 80])
Gibson, 2000[255] Surgery for degenerative lumbar spondylosis	Updated Cochrane review available (Gibson, 2005[79, 80])
Mardjetko, 1994[257] Degenerative lumbar spondylolisthesis. A meta-analysis of literature 1970-1993	Outdated
Niggemeyer, 1997[258] Comparison of surgical procedures for degenerative lumbar spinal stenosis: a meta-analysis of the literature from 1975 to 1995	Outdated
Turner, 1992[259] Surgery for lumbar spinal stenosis. Attempted meta-analysis of the literature	Outdated
Surgery for radiculopathy with herniated disc	

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Author, year, title	Reason for exclusion
Gibson, 1999[176] The Cochrane review of surgery for lumbar disc prolapse and degenerative lumbar spondylosis	Updated Cochrane review available (Gibson, 2007[81, 82])
Gibson, 2000[177] Surgery for lumbar disc prolapse	Updated Cochrane review available (Gibson, 2007[81, 82])
Hoffman, 1993[256] Surgery for herniated lumbar discs: a literature synthesis	Outdated
Scheer, 1996[190] Randomized controlled trials in industrial low back pain relating to return to work. Part 2. Discogenic low back pain	Outdated
Stevens, 1997[191] Efficacy of lumbar discectomy and percutaneous treatments for lumbar disc herniation	Outdated

APPENDIX 7: QUALITY RATINGS OF TRIALS

Author, year	Randomization	Concealed treatment allocation	Baseline group similarity	Patient blinded	Care provider blinded	Outcome assessor blinded	Cointerventions avoided or similar	Compliance acceptable in all groups	Drop-out rate described and acceptable	Timing of outcome assessment in all groups similar	Intention to treat analysis	Score
KQ 1c – IDENTIFICATION AND TREATMENT OF YELLOW FLAGS												
Gatchel, 2003[306]	Yes (balanced allocation method)	Yes (balanced allocation method)	Don't know	NA	NA	Don't know	Yes	Yes	Yes	Yes (balanced allocation method)	Yes (balanced allocation method)	6/9
George, 2003[308]	Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	7/9
Hay, 2005[304]	Yes	Yes	Yes			Yes	No	Yes	No	Yes	Yes	7/9
Jellema, 2005[305]	Yes	Don't know	Yes			Yes	Yes	Yes	Yes	Yes	Don't know	6/9
Von Korff, 2005[307]	Don't Know	Don't know	Yes			No	Yes	Yes	No	Don't Know	Don't know	4/9
KQ 2d – IMAGING												
Deyo, 1987[330]	Yes	Don't know	Yes	NA	NA	No	NA	Yes	No	Yes	Yes	5/8
Djais, 2005[331]	Don't know	Don't know	Yes			Don't know		Don't know	No	Yes	No	3/8
Gilbert, 2004[334]	Yes	Yes	No			Yes		Don't know	Yes	Yes	Yes	6/8
Jarvik, 1997[338]	Yes	Yes	Yes			No		Yes	No	Yes	No	5/8
Jarvik, 2003[337]	Yes	Yes	Yes			Yes		Yes	Yes	Yes	No	7/8
Kendrick, 2001[332]	Don't know	Yes	Yes			No		Yes	Yes	Yes	Yes	6/8
Kerry, 2002[333]	Don't know	Yes	No			No		Yes	Yes	Yes	No	4/8
Modic, 2005[335, 336]	Don't know	Yes	Yes			Don't know		Yes	No	Yes	No	4/8
KQ 3 – ADVICE TO REMAIN ACTIVE												
Pengel, 2007[362]	Yes	Yes	Yes	NA	NA	Yes	Yes	Yes	Yes	Yes	Can't tell	8/9
Frost 2004[361]	Yes	Yes	Yes			Yes	Don't know	Yes	No	Yes	Yes	7/9
Little 2001[363]	Don't know	Yes	Don't know			Yes	Don't know	Yes	No	Yes	Don't know	4/9
Stankovic, 1990, 1995[364, 365]	Yes	Yes	Don't know			Don't know	Don't know	Don't know	Don't know	Yes	Don't know	3/9

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KQ 3 – ADVICE TO RESTRICT EARLY MORNING FLEXION												
Snook, 1998[377, 378]	No	No	Don't know	No	NA	Don't know	Don't know	Don't know	No	Yes	Yes	2/10
KQ 3 – LAY-FACILITATED GROUPS FOR SELF-CARE												
Haas, 2005[379]	Don't know	Yes	Yes	NA	NA	Don't know	Don't know	No	No	Yes	No	3/9
Von Korff, 1998[380]	Don't know	Don't know	Yes			Don't know	Don't know	Yes	Yes	Yes	Yes	5/9
KQ 3 – MATTRESSES												
Atherton, 1983[396]	No	No	Don't know	No	No	No	Yes	Yes	Yes	Yes	No	4/11
Garfin, 1981[397]	No	No	No	No	No	No	Don't know	Don't know	No	Don't know	No	0/11
Kovacs, 2003[395]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11/11
KQ 3 – SELF-CARE BOOKS												
Burton, 1999[374]	Yes	Yes	Yes	NA	NA	Yes	Don't know	Yes	No	Yes	No	6/9
Cherkin, 1996[368]	Don't know	Don't know	Yes			Yes	Don't know	Yes	Yes	Yes	Yes	6/9
Cherkin, 1998[367].	Don't know	Yes	Yes			Yes	No	Yes	Yes	Yes	Yes	7/9
Cherkin, 2001[369]	Yes	Don't know	Yes			Yes	Yes	Yes	Yes	Yes	Yes	8/9
Hazard, 2000[370]	Don't know	Yes	Don't know			Yes	Don't know	Yes	Yes	Yes	Yes	5/9
Linton, 2000[309]	Yes	Yes	Yes			No	Don't know	Yes	No	Yes	No	5/9
Little 2001[363]	Don't know	Yes	Don't know			Yes	Don't know	Yes	No	Yes	Don't know	4/9
Roberts, 2002[372]	Yes	Don't know	No (pop. w/ previous LBP)			Yes	Don't know	Don't know	No	Yes	No	4/9
Roland, 1989[373]	No	No	Don't know			Don't know	Don't know	Yes	No	Yes	No	2/9
Sherman, 2005[371]	Yes	Yes	Yes			Yes	Yes	No	Yes	Yes	Yes	8/9

APPENDIX 7: QUALITY RATINGS OF TRIALS

Author, year	Randomization	Concealed treatment allocation	Baseline group similarity	Patient blinded	Care provider blinded	Outcome assessor blinded	Cointerventions avoided or similar	Compliance acceptable in all groups	Drop-out rate described and acceptable	Timing of outcome assessment in all groups similar	Intention to treat analysis	Score
KQ 3 – SELF-CARE E-MAIL DISCUSSION GROUPS												
Lorig, 2002[375]	Don't know	Don't know	Don't know	NA	NA	No	Don't know	No	No	Yes	Yes	2/9
KQ 3 - SELF-CARE EXERCISE VIDEOTAPE												
Miller, 2004[376]	Yes	Yes	Don't know	NA	NA	Don't know	Don't know	No	No	Yes	No	3/9
KQ 3 – SELF-HELP TOOLS FOR BACK SURGERY DECISIONS												
Deyo, 2000[382]	Yes	Yes	Yes	NA	NA	Don't know	Don't know	Yes	Yes	Yes	No	6/9
KQ 4 – ACETAMINOPHEN												
Doran, 1975[393]	Don't know	Don't know	Don't know	No	No	No	Don't know	Don't know	Yes	Yes	No	2/11
Hackett, 1988[420]	Don't know	Don't know	Don't know	Yes	Don't know	Don't know	Don't know	Don't know	Yes	Yes	No	3/11
KQ 4 – ACUPRESSURE												
Hsieh, 2004[578]	Yes	Yes	Yes	No	NA	Yes	Don't know	Yes	No	Yes	No	6/10
Hsieh, 2006[579]	Yes	Yes	Yes	No		Yes	Don't know	Don't know	No	Yes	No	5/10
KQ 4 – ACUPUNCTURE												
Brinkhaus, 2006[566]	Yes	Yes	Yes	Yes	NA	Don't know	Don't know	Yes	Yes	Yes	Yes	8/10
Thomas, 2006[567]	Yes	Yes	Yes	No		No	No (phys. therapy & manipulation)	Yes	Yes	Yes	Yes	7/10
Witt, 2006[568]	Yes	Yes	Yes	No		Don't know	Yes	Yes	Yes	Yes	Yes	8/10
KQ 4 – ANTIEPILEPTIC DRUGS												
Khoromi, 2005[503]	Yes	Yes	Don't know	Yes	Yes	Yes	Don't know	Don't know	No	Yes	Yes	7/11
McCleane, 2001[501]	Yes	Don't know	Yes	Yes	Yes	Yes	Yes	Don't know	Yes	Yes	No	8/11
Muehlbacher, 2006[504]	Yes	Don't know	Yes	Yes	Yes	Yes	Don't know	Don't know	Yes	Yes	Don't know	7/11

APPENDIX 7: QUALITY RATINGS OF TRIALS

Author, year	Randomization	Concealed treatment allocation	Baseline group similarity	Patient blinded	Care provider blinded	Outcome assessor blinded	Cointerventions avoided or similar	Compliance acceptable in all groups	Drop-out rate described and acceptable	Timing of outcome assessment in all groups similar	Intention to treat analysis	Score
Yildirim, 2003[502]	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Yes	Don't know	Yes	Yes	No	3/11
KQ 4 – ASPIRIN												
Evans, 1980[416]	Don't know	Don't know	Don't know	No	No	Yes	Yes	Don't know	Yes	Yes	No	4/11
KQ 4 – BRIEF EDUCATIONAL INTERVENTION												
Indahl, 1995 and 1998[603, 604]	No	Yes	Yes	NA	NA	Yes	Don't know	Don't know	Yes	Yes	Yes	7/9
Karjalainen, 2003 and 2004[609, 610]	Yes	Yes	Yes			No	Yes	Yes	No	Yes	Yes	7/9
Molde Hagen, 2000 and 2003[607, 608]	No	Yes	Don't know			Don't know	Don't know	Don't know	Yes	Yes	Yes	4/9
Niemisto, 2003 and 2005[611, 612]	Don't know	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	8/9
KQ 4 – EXERCISE												
UK BEAM Trial, 2004[629]	Don't know	Don't know	Yes	NA	NA	No	Don't know	No	No	Yes	No	2/9
KQ 4 – FUNCTIONAL RESTORATION (PHYSICAL CONDITIONING, WORK CONDITIONING, OR WORK HARDENING)												
Gatchel, 2003[306]	Yes (balanced allocation method)	Yes (balanced allocation method)	Don't know	NA	NA	Don't know	Yes	Don't know	Yes	Yes	Yes	6/9
KQ 4 – HYDROTHERAPY												
McIlveen, 1998[638]	Yes	No	No	NA	NA	No	Don't know	Don't know	Yes	Yes	No	3/9
Sjogren, 1997[639]	No	No	Yes			No	Don't know	Don't know	Yes	Yes	No	4/9
Yozbatiran, 2004[640]	Don't know	Don't know	Yes (small sample sizes)			No	Don't know	Don't know	Yes	Yes	Yes	2/9

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Author, year	Randomization	Concealed treatment allocation	Baseline group similarity	Patient blinded	Care provider blinded	Outcome assessor blinded	Cointerventions avoided or similar	Compliance acceptable in all groups	Drop-out rate described and acceptable	Timing of outcome assessment in all groups similar	Intention to treat analysis	Score
KQ 4 – INTERFERENTIAL THERAPY												
Hurley, 2001[661]	Don't know	Yes	No	NA	NA	Yes	Don't know	Yes	No	Yes	Yes	5/10
Hurley, 2004[659]	Yes	Yes	Yes	No		Yes	Don't know	Yes	No	Yes	Yes	7/10
Werners, 1999[660]	Yes	No	Yes	No		Don't know	Don't know	Yes	No	Yes	No	4/10
KQ 4 – LOW LEVEL LASER THERAPY												
Basford, 1999[666]	Yes	Don't know	Yes	Yes	Yes	Yes	Don't know	Yes	Yes	Yes	No	8/11
Gur, 2003[670]	Don't know	Don't know	Yes	No	No	Don't know	Don't know	Don't know	Yes	Don't know	Yes	3/11
Klein, 1990[667]	Yes	Don't know	Yes	Yes	Yes	Yes	Don't know	Don't know	Don't know	Yes	Don't know	6/11
Longo, 1988[671]	Don't know	Don't know	Don't know	Yes	Yes	Yes	Yes	Don't know	No	Yes	Don't know	5/11
Monticone, 2004[672]	No	Don't know	Don't know	No	No	No	Don't know	Don't know	Don't know	Yes	Don't know	1/11
Soriano, 1998[668]	Don't know	Don't know	Yes	Yes	Yes	Don't know	Yes	Don't know	Yes	Yes	N	6/11
Toya, 1994[669]	Yes	Yes	Don't know	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	10/11
KQ 4 – OPIOIDS												
Allan, 2005[513]	Don't know	Yes	Yes	No	No	No	Yes	Don't know	No	Yes	No	4/11
Baratta, 1976[514]	Don't know	Don't know	Don't know	Yes	Yes	Yes	Don't know	Don't know	Yes	Yes	No	5/11
Gostick, 1989[515]	Don't know	Don't know	Don't know	Yes	Yes	Yes	Yes	Don't know	No	Yes	No	5/11
Hale, 1997[426]	Don't know	Don't know	Yes	Yes	Yes	Yes	No	Don't know	No	Yes	No	5/11
Hale, 1999[516]	Don't know	Don't know	No	Yes	Yes	Yes	No	Don't know	Yes	Yes	No	5/11
Hale, 2005[512]	Yes	Yes	Yes	Yes	Yes	Yes	Don't know	Don't know	No	Yes	No	7/11
Jamison, 1998[517]	Don't know	Don't know	Don't know	No	No	No	Don't know	Don't know	Yes	Yes	Yes	3/11
Salzman, 1999[518]	Don't know	Don't know	Yes	No	No	No	Don't know	Don't know	No	Yes	No	2/11

APPENDIX 7: QUALITY RATINGS OF TRIALS

Author, year	Randomization	Concealed treatment allocation	Baseline group similarity	Patient blinded	Care provider blinded	Outcome assessor blinded	Cointerventions avoided or similar	Compliance acceptable in all groups	Drop-out rate described and acceptable	Timing of outcome assessment in all groups similar	Intention to treat analysis	Score
Wiesel, 1980[353]	Don't know	Don't know	Don't know (no data on pain intensity or duration)	Yes	Yes	Yes	Don't know (concomitant NSAIDs allowed & tracked, with no diff between gps in use stated, but no data provided)	Don't know	No	Don't know	No	3/11
KQ 4 – PERCUTANEOUS ELECTRICAL NERVE STIMULATION (PENS)												
Ghoname, 1999[712]	Yes	Don't know	Don't know	Don't know	No	Don't know	Don't know	Don't know	No	Yes	Don't know	2/11
Weiner, 2003[713]	Yes	Don't know	Yes	Don't know	No	Yes	Don't know	Don't know	No	Yes	Don't know	4/11
Yokoyama, 2004[711]	Don't know	Don't know	Yes	No	No	Don't know	Don't know	Don't know	Yes	Yes	No	3/11
KQ 4 – SHORT WAVE DIATHERMY												
Gibson, 1985[673]	Don't know	Don't know	Don't know	Yes (to sham dia-thermy)	No	Yes	Don't know	Don't know	Yes	Yes	No	4/11
Rasmussen, 1979[674]	Don't know	Don't know	Don't know	No	No	Don't know	Don't know	Don't know	Yes	Yes	Yes	3/11
Sweetman, 1993[675]	Yes	No	Yes	No	No	Don't know	Don't know	Don't know	Yes	Yes	Yes	5/11
KQ 4 – SPA THERAPY												
Constant, 1995[748]	Don't know	No	Yes	NA	NA	Yes	Don't know	Don't know	Yes	Yes	Yes	5/9
Constant, 1998[747]	Don't know	Yes	Don't know			Yes	Don't know	Don't know	Yes	Yes	Yes	5/9
Guillemin, 1994[746]	Don't know	Don't know	No			Yes	Don't know	Don't know	Yes	Yes	Yes	4/9
Konrad, 1992[696]	Don't know	Don't know	Yes			Yes	Don't know	Don't know	Yes	Yes	No	4/9

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Author, year	Randomization	Concealed treatment allocation	Baseline group similarity	Patient blinded	Care provider blinded	Outcome assessor blinded	Cointerventions avoided or similar	Compliance acceptable in all groups	Drop-out rate described and acceptable	Timing of outcome assessment in all groups similar	Intention to treat analysis	Score
Yurtkuran, 1997[749]	Yes	Don't know	Don't know	NA	NA	Yes	Don't know	Don't know	Yes	Yes	Yes	5/9
KQ 4 – SPINAL MANIPULATION												
Hurwitz, 2002[780, 781]	Yes	Yes	Yes	NA	NA	Don't know	Yes (not applicable effectiveness study)	No	Yes	Yes	Yes	7/9
Santilli, 2006[782]	Yes	Yes	Yes	NA	NA	Yes	No	Yes	Yes	Yes	Yes	5/9
UK BEAM Trial, 2004[629]	Don't know	Don't know	Yes	NA	NA	No	Don't know	No	No	Yes	No	2/9
KQ 4 – SYSTEMIC CORTICOSTEROIDS												
Finckh, 2006[536]	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	10/11
Friedman, 2006[539]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11/11
Haimovic, 1986[537]	Yes	Don't know	Don't know	Yes	Yes	Yes	Don't know	Don't know	Yes	Don't know	Yes	6/11
Porsman, 1979[538]	Don't know	Don't know	Yes	Yes	Yes	Yes	Don't know	Don't know	Yes	Yes	No	6/11
KQ 4 – TRAMADOL												
Raber, 1999[531]	Don't know	Don't know	Don't know	Yes	Yes	Yes	Don't know	Yes	No	Don't know	No	4/11
Sorge, 1997[532]	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	5/11
KQ 4 - ULTRASOUND												
Ansari, 2006[718]	Don't know	Don't know	No	Yes	No	Don't know	Don't know	Don't know	No (5/15)	Yes	No	2/11
Nwuga, 1983[719]	No	No	Don't know	Yes	Don't know	Yes	Don't know	Don't know	Don't know	Yes	Don't know	3/11
Roman, 1960[720]	Don't know	Don't know	Don't know	Yes	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	1/11
KQ 4 – YOGA												

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Galantino, 2004[642]	Don't know	Don't know	No	NA	NA	Don't know	Don't know	Don't know	No	Yes	Yes	2/9
Sherman, 2005[371]	Yes	Yes	Yes			Yes	Yes	No	Yes	Yes	Yes	8/9
Williams, 2005[641]	Yes	Don't know	No			Yes	Yes	Yes	No	Yes	No	5/9
KQ 5 – DECISION TOOLS AND OTHER METHODS OF PREDICTION												
Brennan, 2006[800]	Yes	Don't know	Don't know	NA	NA	Yes	Don't know	Yes	No	Yes	Yes	5/9
Childs, 2004[796]	Yes	Yes	Yes			Don't know	Don't know	Yes	Yes	Yes	Yes	7/9
Fritz, 2003[799]	Yes	Don't know	Yes	NA	NA	Yes	Don't know	Yes 26% vs. 15% attending <50% of sessions	Yes	Yes	Yes	7/9
KQ 6 – PRIMARY CARE REFERRAL AND MULTIDISCIPLINARY OUTCOMES												
Hurwitz, 2002[780, 781]	Yes	Yes	Yes	NA	NA	Don't know	Yes (not applicable - effectiveness study)	No	Yes	Yes	Yes	7/9
REFER TO APPENDIX 8 FOR KQ 7 QUALITY SCORES ON DIAGNOSTIC ACCURACY TRIALS												
KQ 8 – BOTULINUM TOXIN INJECTIONS												
Foster, 2001[105]	Yes	Yes	Don't know	Yes	Yes	AQ	Don't know	Yes	Yes	Yes	Yes	9/11
KQ 8 – CHEMONUCLEOLYSIS												
Bromley, 1984[127]	Yes	Yes	No	Yes	Yes	Don't know	Don't know	Yes	Yes	Yes	Yes	8/11
Burton, 2000[103]	No	No	Don't know	NA	NA	Yes	Don't know	Yes	No	Yes	No	3/9
Dabezies, 1988[133]	Don't know	Yes	Yes	Yes	Yes	Yes	Don't know	Yes	No	Yes	No	7/11
Fraser, 1982[136]	Don't know	Don't know	No	Yes	Don't know	Yes	Don't know	Yes	No	No	Yes	5/11

APPENDIX 7: QUALITY RATINGS OF TRIALS

Author, year	Randomization	Concealed treatment allocation	Baseline group similarity	Patient blinded	Care provider blinded	Outcome assessor blinded	Cointerventions avoided or similar	Compliance acceptable in all groups	Drop-out rate described and acceptable	Timing of outcome assessment in all groups similar	Intention to treat analysis	Score
Hoogland, 2006[110]	No	No	Don't know	Don't know	Don't know	Don't know	Don't know	Yes	Yes	Yes	No	3/11
Javid, 1983[144]	Yes	Yes	Don't know	Yes	Yes	Yes	Don't know	Yes	Yes	Yes	Yes	9/11
Krugluger, 2000[873]	Don't know	Don't know	No	Don't know	Don't know	Don't know	Don't know	Yes	No	Yes	Don't know	2/11
Schwestschenau, 1976[162]	Don't know	Don't know	Yes	Yes	Don't know	Yes	Don't know	Yes	Yes	No	Yes	6/11
Wittenberg, 2001[122]	No	Don't know	Yes	Don't know	Don't know	Don't know	Don't know	Yes	No	Yes	Yes	4/11
KQ 8 – EPIDURAL STEROID INJECTIONS												
Ackerman, 2007[101]	Yes	Don't know	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes (for pain relief)	Yes	9/11
Arden, 2005[123]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	9/11
Beliveau, 1971[125]	No	No	Don't know	Don't know	Don't know	Don't know	Don't know	Yes	Don't know	No	Don't know	1/11
Breivik, 1976[126]	Yes	Don't know	Don't know	Yes	No	Yes	Don't know	Yes	No	Don't know	Yes	5/11
Bush, 1991[128]	Don't know	Don't know	Don't know	Yes	Don't know	Yes	Yes	Yes	No	Yes	Yes	6/11
Buttermann, 2004[842]	Yes	Don't know	Don't know	No	No	Don't know	Yes	No	Yes	Yes	Yes	5/11
Carette, 1997[130]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	10/11
Cuckler, 1985[132]	Don't know	Don't know	Don't know	Yes	Yes	Yes	Don't know	Yes	Yes	Don't know	Don't know	5/11
Dashfield, 2005[843]	Don't know	Yes	Yes	Yes	No	Don't know	Don't know	Yes	Yes	Yes	Yes	7/11
Dilke, 1973[135]	Don't know	Don't know	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	7/11
Fukusaki, 1988[106]	Don't know	Don't know	Yes	No	No	Yes	Don't know	Yes	Yes	Yes	Yes	6/11

APPENDIX 7: QUALITY RATINGS OF TRIALS

Author, year	Randomization	Concealed treatment allocation	Baseline group similarity	Patient blinded	Care provider blinded	Outcome assessor blinded	Cointerventions avoided or similar	Compliance acceptable in all groups	Drop-out rate described and acceptable	Timing of outcome assessment in all groups similar	Intention to treat analysis	Score
Helliwell, 1985[143]	Don't know	Don't know	Don't know	Yes	Don't know	Don't know	Don't know	Yes	No	No (varied for long-term f/u)	Don't know	2/11
Jeong, 2007[111]	Don't know	Don't know	Don't know	Yes	No	Yes	Don't know	Yes	Yes	No	No	4/11
Karpinnen, 2001[145]	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	10/11
Klenerman, 1984[147]	Don't know	Don't know	Don't know	Don't know	Don't know	Yes	Don't know	Yes	No	No (varied for long-term f/u)	No	2/11
Kraemer, 1997a[148]	Don't know	Don't know	Don't Know	Don't know	Don't know	Don't know	Don't know	Yes	Don't know	Yes	Don't know	2/11
Kraemer, 1997b[148]	Don't know	Yes	Don't know	Yes	Yes	Don't know	Don't know	Yes	Don't know	Yes	Don't know	5/11
Manchikanti, 2004[115]	Yes	Don't know	Yes	Yes	No	Yes	Don't know	Yes	Yes	Yes	Yes	8/11
Mathews, 1987[151]	Don't know	Don't know	No (unequal distrib-ution, no baseline pain data)	Yes	Don't know	Yes	Yes	Yes	No	Don't know	Don't know	4/11
Ng, 2005[152]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11/11
Ridley, 1988[158]	Yes	Don't know	Don't know	Don't know	Don't know	Yes	Don't know	Yes	Yes	Yes	Don't know	5/11
Riew, 2000[159]	Don't know	Yes	Yes	Yes	Yes	Yes	Don't know	Yes	Yes	Yes	Yes	9/11
Rogers, 1992[161]	No	Don't know	Yes	Yes	No	Yes	Don't know	Yes	Don't know	Yes	Don't know	5/11
Snoek, 1977[164]	Don't know	Don't know	Don't know	Yes	No	Yes	Yes	Yes	No	No	Don't know	4/11

APPENDIX 7: QUALITY RATINGS OF TRIALS

Author, year	Randomization	Concealed treatment allocation	Baseline group similarity	Patient blinded	Care provider blinded	Outcome assessor blinded	Cointerventions avoided or similar	Compliance acceptable in all groups	Drop-out rate described and acceptable	Timing of outcome assessment in all groups similar	Intention to treat analysis	Score
Wilson-MacDonald, 2005[167]	Yes	Yes	Yes	Yes	Yes	Yes	Don't know	Yes	Yes	Don't know	Yes	9/11
Zahaar, 1991[169]	Don't know	Don't know	Don't know	Yes	No	Don't know	Don't know	Yes	No	No (for long term f/u)	Yes	3/11
KQ 8 – FACET JOINT INJECTION OR THERAPEUTIC MEDIAL BRANCH BLOCK												
Carette, 1991[129]	Yes	Don't know	Yes	Yes	Yes	Don't know	No	Yes	Yes	Yes	Yes	7/11
Fuchs, 2005[859]	Yes	Don't know	Yes	No	No	Yes	Don't know	Yes	No	Yes	Yes	6/11
Lilius, 1989[150, 860]	Don't know	Don't know	Yes	Don't know	Don't know	Yes	Don't know	Yes	Don't know	Yes	Don't know	4/11
Manchikanti, 2001[862]	No	No	No	No	No	No	Don't know	Yes	Yes	No	Yes	3/11
Nash, 1989[116]	No	No	Don't know	No	No	Don't know	Don't know	Yes	No	Yes	No	2/11
KQ 8 – INTRADISCAL ELECTROTHERMAL THERAPY (IDET)												
Freeman, 2005[138]	Don't know	Yes	No	Yes	Yes	Yes	Don't know	Yes	Yes	Yes	Yes	8/11
Pauza, 2004[157]	Yes	Don't know	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	8/11
KQ 8 – INTRADISCAL STEROID INJECTIONS												
Buttermann, 2004[104]	Yes	Don't know	Yes	No	No	Yes	No	Yes	No	No	No	5/11
Graham, 1975[109]	No	No	Don't know	Don't know	No	Yes	Don't know	Yes	Yes	Don't know	Yes	4/11
Khot, 2004[112]	Don't know	Don't know	Yes	Yes	No	Don't know	Don't know	Yes	No	Yes	No	4/11
Simmons, 1992[119]	Don't know	Don't know	Don't know	Yes	Yes	Yes	Don't know	Yes	Don't know	Yes	Yes	6/11
KQ 8 – LOCAL INJECTIONS												
Collee, 1991[131]	Don't know	Don't know	Yes	Yes	Yes	Yes	Yes	Yes	Don't know	Yes	Don't know	7/11

APPENDIX 7: QUALITY RATINGS OF TRIALS

Author, year	Randomization	Concealed treatment allocation	Baseline group similarity	Patient blinded	Care provider blinded	Outcome assessor blinded	Cointerventions avoided or similar	Compliance acceptable in all groups	Drop-out rate described and acceptable	Timing of outcome assessment in all groups similar	Intention to treat analysis	Score
Garvey, 1989[140]	Yes	Don't know	Don't know	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	8/11
Hameroff, 1981[142]	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Yes	Don't know	No	Yes	Don't know	2/11
Sonne, 1985[165]	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Yes	Yes	Yes	Yes	4/11
KQ 8 – PERCUTANEOUS INTRADISCAL RADIOFREQUENCY THERMOCOAGULATION (PIRFT)												
Barendse, 2001[124]	Yes	Yes	Yes	Yes	Yes	Yes	Don't know	Yes	Yes	Yes	Yes	10/11
KQ 8 – PROLOTHERAPY												
Dechow, 1999[134]	Yes	Don't know	Yes	Yes	Yes	Yes	Don't know	Yes	Yes	Yes	Yes	9/11
Klein, 1993[146]	Yes	Don't know	Yes	Yes	Yes	Yes	Yes	Don't know	Yes	Yes	Yes	9/11
Mathews, 1987[151]	Don't know	Don't know	No	Yes	Don't know	Yes	Yes	Yes	No	Don't know	Don't know	4/11
Ongley, 1987[156]	Yes	Don't know	Yes	No (manip-ulation)	No	Yes	No	Don't know	Yes	Yes	Yes	6/11
Yelland, 2004[168]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11/11
KQ 8 – RADIOFREQUENCY DENERVATION												
Gallagher, 1994[139]	Don't know	Don't know	Don't know	Don't know	Don't know	Yes	Don't know	Yes	No	Yes	No	3/11
Geurts, 2003[108]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11/11
Leclaire, 2001[149]	Don't know	Yes	Yes	Yes	Don't know	Yes	Yes	Yes	Yes	Yes	Yes	9/11
Nath, 2008[117]	Yes	Don't know	No	Yes	Yes	Yes	Don't know	Yes	Yes	Yes	Yes	8/11
Oh, 2004[118]	Don't know	Don't know	Yes	No	Don't know	Don't know	Don't know	Yes	Yes (none reported)	Yes	Yes	5/11

APPENDIX 7: QUALITY RATINGS OF TRIALS

Author, year	Randomization	Concealed treatment allocation	Baseline group similarity	Patient blinded	Care provider blinded	Outcome assessor blinded	Cointerventions avoided or similar	Compliance acceptable in all groups	Drop-out rate described and acceptable	Timing of outcome assessment in all groups similar	Intention to treat analysis	Score
Tekin, 2007[120]	Yes	Don't know	Yes	Don't know	Don't know	Don't know	Don't know	Yes	No	Yes	Yes	5/11
van Kleef, 1999[166]	Yes	Don't know	Don't know	Yes	Yes	Yes	Yes	Yes	No	Yes	Don't know	7/11
van Wijk, 2005[121]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11/11
KQ 8 – SACROILIAC JOINT STEROID INJECTION												
Luukkainen, 2002[114]	Don't know	Don't know	Yes	Yes	No	Yes	Don't know	Yes	Don't know	Yes	Yes	6/11
KQ 9 – FUSION FOR NON-RADICULAR LOW BACK PAIN WITH COMMON DEGENERATIVE CHANGES												
Brox, 2003[245]	Yes	Yes	Yes	NA	NA	Yes	Don't know	Yes	Yes	Yes	Yes	8/9
Brox, 2006[244]	Yes	Yes	No			Yes	Don't know	Yes	Yes	Yes	Yes	8/9
Fairbank, 2005[246]	Yes	Yes	Yes			No	Don't know	No	Yes	Yes	Yes	6/9
Fritzell, 2001[247]	Yes	Yes	Yes			Don't know	Don't know	Yes	Yes	Yes	Yes	7/9
Hallett, 2007[263]	Yes	Yes	Don't know	NA	NA	Don't know	Don't know	Yes	Yes	Yes	Don't know	5/9
KQ 9 – DISK REPLACEMENT SURGERY FOR NON-RADICULAR LOW BACK PAIN WITH DEGENERATIVE DISC DISEASE												
Blumenthal, 2005[252]	Yes	Yes	Yes	No	NA	No	Don't Know	Yes	Yes	Yes	Yes	7/10
Zigler, 2007[253]	Don't know	Yes	Yes	No		No	Don't know	Yes	Yes	Yes	No	5/10
KQ 9 – SURGERY FOR ISTHMIC SPONDYLOLISTHESIS												
Inamdar, 2006[233]	Don't know	Don't know	Don't know	NA	NA	Don't know	Don't know	Yes	Don't know	Yes	Don't know	2/9
Kim, 2006[235]	Don't know	Don't know	Yes			Don't know	Don't know	Yes	No	Yes	No	3/9
Swan, 2006[928]	No	No	Yes			Yes	Don't know	Yes	Yes (93% at 2 years)	Yes	No (93%)	5/9
Videbaek, 2006[927]	Don't know	Don't know	Yes			Don't know	Don't know	Yes	No	Yes	No	3/9
Moller, 2000[925]	No	No	Yes			Don't know	Don't know	Don't know	Yes	Yes	Yes	4/9

APPENDIX 7: QUALITY RATINGS OF TRIALS

Author, year	Randomization	Concealed treatment allocation	Baseline group similarity	Patient blinded	Care provider blinded	Outcome assessor blinded	Cointerventions avoided or similar	Compliance acceptable in all groups	Drop-out rate described and acceptable	Timing of outcome assessment in all groups similar	Intention to treat analysis	Score
KQ 9 – SURGERY FOR SPINAL STENOSIS WITH OR WITHOUT DEGENERATIVE SPONDYLOLISTHESIS												
Amundsen, 2000[243]	Yes	Don't know	Yes			Don't know	Don't know	Yes	Yes	Yes	Yes	6/9
Anderson, 2006[231]	Don't know	Yes	Yes			Don't know	Don't know	Yes	Yes	Yes	Don't know	5/9
Fernandez-Fairen, 2007[232]	Yes	Don't know	Yes			Don't know	Don't know	Yes	Don't know	Yes	Yes	5/9
Inamdar, 2006[233]	Don't know	Don't know	Don't know			Don't know	Don't know	Yes	Don't know	Yes	Don't know	2/9
Kim, 2006[235]	Don't know	Don't know	Yes			Don't know	Don't know	Yes	No	Yes	No	3/9
Malmivaara, 2007[236]	Yes	Yes	No			No	No	Yes	Yes	Yes	Yes	6/9
Weinstein, 2007[241]	Yes	Don't know	Don't know (Baseline character-istics for inter-vention group not reported)	NA	NA	Don't know	Don't know	No	Yes	Yes	Yes	4//9
Weinstein, 2008[250]	Yes	Don't know	Don't know			Don't know	Yes	No	Yes	Yes	Yes	5/9
Zucherman, 2004[251]	Don't know	Yes	Don't know (prior epidural/ 64 vs 48%)			Don't know	Don't know	Don't know	No	Yes	Don't know	2/9
KQ 9 – SURGERY FOR RADICULOPATHY WITH HERNIATED LUMBAR DISC												
Katayama, 2006[234]	Don't know	Don't know	Don't know	NA	NA	Don't know	Don't know	Yes (assumed)	No (not described)	Don't know	Don't know	1/9

APPENDIX 7: QUALITY RATINGS OF TRIALS

Author, year	Randomization	Concealed treatment allocation	Baseline group similarity	Patient blinded	Care provider blinded	Outcome assessor blinded	Cointerventions avoided or similar	Compliance acceptable in all groups	Drop-out rate described and acceptable	Timing of outcome assessment in all groups similar	Intention to treat analysis	Score
Hoogland, 2006[110]	No	No	Don't know			Don't know	Don't know	Yes	Yes	Yes	No	3/9
Haines, 2002[949, 970]	Don't know	Yes	Don't know			Don't know	Don't know	Yes	No	Yes	No	3/9
Osterman, 2006[237]	Yes	Yes	Yes (duration of symptoms 77 vs. 60 days)	NA	NA	Don't know	No (exercise)	No	Yes	Yes	Yes	6/9
Peul, 2007[238, 239]	Yes	Yes	Yes			No	Don't know	Yes	Yes	Yes	Yes	7/9
Weber, 1983[248]	Don't know	Don't know	Don't know			No	Don't know	Yes	Don't know	Yes	Yes	4/9
Weinstein, 2006[249]	Yes	Yes	Yes			Don't know	Yes	No	Yes	Yes	No	6/9
KQ 10 – COMBINATION MEDICATION THERAPIES												
Jamison, 1998[517]	Don't know	Don't know	Don't know	No	No	No	Don't know	Don't know	Yes	Ys	Yes	3/11
KQ 10 – COMBINATION THERAPIES FOR SPINAL STENOSIS												
Whitman, 2006[630]	Yes	Yes	Yes	NA	NA	Yes	Don't know	Yes	Yes	Yes	Yes	8/9
KQ 10 – EXERCISE OR SPINAL MANIPULATION COMBINED WITH OTHER INTERVENTIONS												
Pengel, 2007[362]	Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Don't know	8//9
UK BEAM Trial, 2004[629]	Don't know	Don't know	Yes	NA	NA	No	Don't know	No	No	Yes	No	2/9
Hurwitz, 2002[780, 781]	Yes	Yes	Yes			Don't know	Yes (NA:effective-ness study)	No	Yes	Yes	Yes	7/9
KQ 10 – SELF-CARE ADVICE COMBINED WITH OTHER INTERVENTIONS												
Cherkin, 1996[368]	Don't know	Don't know	Yes	NA	NA	Yes	Don't know	Yes	Yes	Yes	Ys	6/9

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Author, year	Randomization	Concealed treatment allocation	Baseline group similarity	Patient blinded	Care provider blinded	Outcome assessor blinded	Cointerventions avoided or similar	Compliance acceptable in all groups	Drop-out rate described and acceptable	Timing of outcome assessment in all groups similar	Intention to treat analysis	Score
Hurley, 2001[661]	Don't know	Yes	No	NA	NA	Yes	Don't know	Yes	No	Yes	Yes	5/9
Little, 2001[363]	Don't know	Yes	Don't know			Yes	Don't know	Yes	No	Yes	Don't know	4/9
Wand, 2004[977]	Yes	Yes	Yes			Yes	Don't know	Don't know	No	Yes	Yes	6/9
Wright, 2005[978]	Yes	Yes	Yes			No	No	Don't know	No	Yes	No	3/9
KQ 11 – FAILED SURGERY, ADHESIOLYSIS AND FORCEFUL EPIDURAL INJECTIONS												
Dashfield, 2005[843]	Don't know	Yes	Yes	Yes	No	Don't know	Don't know	Yes	Yes	Yes	Yes	7/11
Heavner, 1999[985]	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Yes	No	Yes	No	2/11
Manchikanti, 2001[986]	No	No	No	No	No	No	Don't know	Yes	Yes	No	Yes	3/11
Manchikanti, 2004[115]	Yes	Don't know	Yes	Yes	No	Yes	Don't know	Yes	Yes	Yes	Yes	8/11
Meadeb, 2001[848]	Don't know	Don't know	No	Yes	Don't know	Yes	Don't know	Don't know	No	Yes	No	3/11
Revel, 1996[850]	Don't know	Don't know	Yes	Yes	Don't know	Don't know	Don't know	Yes	Yes	Yes	Don't know	5/11
Veihelmann, 2006[987]	No	Don't know	Don't know	No	No	Yes	Don't know	No	No	Yes	No	2/11
KQ 11 – FAILED SURGERY, NON-INVASIVE												
Timm, 1994[998]	Don't know	Don't know	Yes	NA	NA	Don't know	Don't know	Don't know	Don't know	Yes	Don't know	2/9
KQ 11 – FAILED SURGERY, SPINAL CORD STIMULATION												
Kumar, 2007[113]	Yes	Yes	Yes	NA	NA	Don't know	Yes	No	Yes	Yes	No	6/9
North, 2005[153]	Yes	Yes	Don't know			No	Yes	Yes	Yes	Yes	No	6/9
KQ 12 – COORDINATION OF CARE/ SECONDARY PREVENTION												
Meeuwesen, 1996[1003]	No	No	Yes	NA	NA	Don't know	Don't know	No	No	Yes	No	2/9

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Author, year	Randomization	Concealed treatment allocation	Baseline group similarity	Patient blinded	Care provider blinded	Outcome assessor blinded	Cointerventions avoided or similar	Compliance acceptable in all groups	Drop-out rate described and acceptable	Timing of outcome assessment in all groups similar	Intention to treat analysis	Score
Rossignol, 2000[1002]	Yes	Yes	No	NA	NA	Yes	Don't know	Don't know	Yes	Yes	No	4/9
KQ 13 – ADVICE TO STAY ACTIVE												
Molde Hagen, 2003[608]	No	Yes	Don't know	NA	NA	Don't know	Don't know	Don't know	Yes	Yes	Yes	4/9
KQ 13 – EXERCISE												
Hides, 2001[1006]	Don't know	Don't know	No	NA	NA	Yes	Yes	Don't know	Yes	Yes	No	4/9
Kellett, 1991[1007]	Don't know	Don't know	Don't know			Don't know	Don't know	No	No	Yes	No	1/9
Soukup, 1999[1008]	Don't know	Don't know	No	NA	NA	No	Don't know	Yes	Yes	Yes	No	3/9
Stankovic, 1995[364]	Yes	Yes	Don't know			Don't know	Don't know	Don't know	Don't know	Yes	Don't know	3/9
KQ 13 – OCCUPATIONAL INTERVENTION												
Verbeek, 2002[1009]	Yes	Yes	Yes	NA	NA	Yes	Yes	No (24% c/o in control group)	Yes	Yes	Yes	4/9
KQ 14 – ACUPUNCTURE DURING PREGNANCY												
Guerreiro da Silva, 2004[1013]	No	No	No	No	NA	Don't know	Don't know	Yes	Yes	Yes	No	4/10
Kvorning, 2004[1014]	Yes	Yes	No	No		Yes	No	Yes	No	Yes	No	5/10
KQ 14 – PHYSICAL THERAPY DURING PREGNANCY												
Suputtitada, 2002[1016]	Don't know	Don't know	Yes	NA	NA	Don't know	Don't know	Don't know	Yes	Yes	No	3/9
KQ 14 – MASSAGE DURING PREGNANCY												
Field, 2004[1023]	Don't' know	Don't know	Don't know	NA	NA	No	Don't know	Don't know	No	Yes	No (not stated)	1/9

APPENDIX 8: QUALITY RATINGS OF DIAGNOSTIC ACCURACY TRIALS

KQ 7 – DIAGNOSTIC INTRA-ARTICUALR FACET JOINT BLOCK AND MEDIAL BRANCH BLOCK/OUTCOMES												
Author, year	**Randomization**	**Concealed Treatment Allocation**	**Baseline Group Similarity**	**Patient Blinded**	**Care provider Blinded**	**Outcome Assessor Blinded**	**Cointerventions Avoided or Similar**	**Compliance Acceptable in All Groups**	**Drop-out Rate Described and Acceptable**	**Timing of Outcome Assessment in All Groups Similar**	**Intention to Treat Analysis**	**Score**
Birkenmaier, 2007[838]	Yes	Don't know	Don't know	Don't know	NO	Don't know	Don't know	YES	Don't know	YES	Don't know	3/11

KQ 7 – DISCOGRAPHY/POSITIVE RATES IN PERSONS WITHOUT SIGNIFICANT LOW BACK PAIN										
Author, year	**Consecutive series or random subset**	**Prospective**	**Evaluates patients with a spectrum of symptoms**	**Adequate description of discography technique**	**Use of current discography technique**	**Adequate description of criteria for positive test**	**Appropriate definition for positive test**	**Statistical analysis of predictors for positive tests**	**Investigator not aware of clinical symptoms**	**Score**
Carragee, 1999[815]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	8/9
Carragee, 2000[813]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9
Carragee, 2000[814]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9
Carragee, 2002[812]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9
Carragee, 2006[816]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8/9
Derby, 2005[817]	Yes	Yes	Yes	Yes	Yes	Yes	Don't know	Yes	Don't know	7/9
Walsh, 1990[811]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	8/9

KQ 7 – DISCOGRAPHY/PREDICTORS OF POSITIVE RESPONSES										
Author/year	**Consecutive series or random subset**	**Prospective**	**Evaluates patients with a spectrum of symptoms**	**Adequate description of discography technique**	**Use of current discography technique**	**Adequate description of criteria for positive test**	**Appropriate definition for positive test**	**Statistical analysis of predictors for positive tests**	**Investigator not aware of clinical symptoms**	**Score**
Block, 1996[818]	Yes	Yes	Don't know	Yes	Yes	Yes	Yes	Yes	Yes	7/9
Heggeness, 1997[819]	Yes	No	Don't know	No	Don't know	Don't know	Don't know	Yes	Don't know	2/9
Manchikanti, 2001[820]	Yes	Don't' know	Yes	No	Yes	Yes	Yes	Yes	Don't know	6/9
Ohnmeiss, 1995[821]	Yes	Yes	Don't know	No	Don't know	Yes	Yes	Yes	Don't know	5/9

KQ 7 – DISCOGRAPHY/OUTCOMES												
Author, year	**Randomization**	**Concealed treatment allocation**	**Baseline group similarity**	**Patient blinded**	**Care provider blinded**	**Outcome assessor blinded**	**Cointerventions avoided or Similar**	**Compliance acceptable in all groups**	**Drop-out rate described and acceptable**	**Timing of outcome assessment in all groups similar**	**Intention to treat analysis**	**Score**
Carragee, 2006[823]	NA	NA	Yes	NA	NA	Yes	Don't know	Yes	Yes	Yes	Yes	5/9
Madan, 2002[822]	NA	NA	Don't know	NA	NA	Don't know	Don't know	Yes	Yes	Yes	Yes	4/9

APPENDIX 9. SYSTEMATIC REVIEWS PUBLISHED TOO RECENTLY TO BE INCLUDED IN THIS EVIDENCE REVIEW

Author, year Intervention	Intervention
Ammendolia, 2008[1034]	Acupuncture
Bronfort, 2008[1035]	Spinal manipulation
Brox, 2008[1036]	Bach schools, brief education, and fear-avoidance training
Brox, 2008[1037]	Back schools, brief education, and fear-avoidance training
Carreon, 2008[1038]	Surgery for non-radicular low back pain
Chrubasik, 2007[1039]	Herbal therapy
Clarke, 2007[1040]	Traction
Dagenais, 2008[1041]	Prolotherapy
Dagenais, 2008[1042]	Medication-assisted manipulation
Deshpande, 2007[1043]	Opioids
Engers, 2008[1044]	Individual patient education
Freeman, 2008[1045]	IDET, percutaneous discectomy, and nucleoplasty
Furlan, 2008[1046]	Massage
Gagnier, 2008[1047]	Herbal supplements
Gatchel, 2008[1048]	Cognitive-behavioral therapy
Gay, 2008[1049]	Traction
Henchoz, 2008[1050]	Exercise therapy
Imamura, 2008[1051]	Massage
Khadilkar, 2008[1052]	TENS
Lawrence, 2008[1053]	Spinal manipulation
Liddle, 2007[1054]	Advice
Machado, 2008 e-published ahead of print[1055]	Various non-interventional, non-surgical therapies
Macedo, 2009[1056]	Motor control exercise therapy
Martell, 2007[1057]	Opioids
Mayer, 2008[1058]	Lumbar extensor strengthening exercises
Norlund, 2009[1059]	Interdisciplinary rehabilitation
Novak, 2008[1060]	Epidural steroid injection
Pennick, 2007[1061]	Interventions for back and pelvic pain during pregnancy
Perrot, 2008[1062]	Antidepressants
Poiraudeau, 2007[1063]	Functional restoration
Poitras, 2008[1064]	TENS, interferential therapy, electrical muscle stimulation, ultrasound, and thermotherapy
Racz, 2008[1065]	Adhesiolysis
Roelofs, 2008[1066, 1067]	Non-steroidal anti-inflammatory drugs
Sahar, 2007[1068]	Insoles
Slade, 2007[1069]	Unloaded movement facilitation exercise therapy
Standaert, 2008[1070]	Lumbar stabilization exercises
Stuber, 2008[1071]	Spinal manipulation during pregnancy
Urquhart 2008[1072]	Antidepressants
van Duijvenbode, 2008[1073]	Lumbar supports
van Geen, 2007[1074]	Interdisciplinary rehabilitation
Vlachojannis, 2008[1075]	Herbal therapy
Wai, 2008[1076]	Physical activity, smoking cessation, and weight loss
Williams, 2007[1077]	Spinal manipulation
Williams, 2007[1078]	Workplace rehabilitation
Wolfer, 2008[1079]	Provocative discography
Yousefi-Nooraie, 2007[1080]	Low level laser therapy for nonspecific low back pain
Yuan, 2008[1081]	Acupuncture
Yuan, 2008[1082]	Acupuncture

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Acupressure	An intervention consisting of manipulation with the fingers instead of needles at specific acupuncture points.
Acupuncture	An intervention consisting of the insertion of needles at specific acupuncture points.
Acute low back pain	Low back pain present less than four weeks' duration (sometimes grouped with subacute low back pain as symptoms present for less than 3 months).
Back school	An intervention consisting of an education and a skills program, including exercise therapy, in which all lessons are given to groups of patients and supervised by a paramedical therapist or medical specialist.
Biofeedback	The use of auditory and visual signals reflecting muscle tension or activity in order to inhibit or reduce the muscle activity.
Brief educational interventions	Individualized assessment and education about low back pain problems without supervised exercise therapy or other specific interventions.
Cauda equina syndrome	Compression (usually due to a massive, centrally herniated disc) on nerve roots from the lower cord segments, often resulting in urinary retention or incontinence from loss of sphincter function, bilateral motor weakness of the lower extremities, and saddle anesthesia.
Chemonucleolysis	Treatment of herniated discs with intradiscal injections of an enzyme extracted from papaya (chymopapain). Chymopapain acts by digesting the jelly-like inner portion of the disc known as the nucleus pulposus, while at the same time, leaving the outer portion, the annulus fibrosis, essentially intact.
Chronic low back pain	Low back pain present more than 3 months.
Cognitive behavioral therapy or treatment (CBT)	An intervention that involves working with cognitions to change emotions, thoughts, and behaviors.
Effect size	A measure of the difference in outcome between intervention groups. Commonly expressed as a risk ration (relative risk), odds ratio, or risk difference for binary outcomes and as difference in means for continuous outcomes. May be referred to as treatment effect.
Exercise	Either a supervised exercise program or formal home exercise regimen. Exercise therapy can range from programs aimed at general physical fitness or aerobic exercise to programs more specifically aimed at muscle strengthening, flexibility, or stretching, or different combinations of these elements.
Facet joint injection	Injection of long lasting steroid ("cortisone") in the facet joints – part of the bony structure in the back. The steroid injected reduces the inflammation and/or swelling of tissue in the joint space. This may in turn reduce pain, and other symptoms caused by inflammation or irritation of the joint and surrounding structure.
Functional restoration (also referred to as work hardening or work conditioning)	An intervention that involves simulated or actual work tests in a supervised environment in order to enhance job performance skills and improve strength, endurance, flexibility, and cardiovascular fitness in injured workers.
Herniated disc	Herniation of the nucleus pulposus of an intervertebral disc through its fibrous outer covering.
Interdisciplinary therapy (also referred to as multidisciplinary therapy)	An intervention that combines and coordinates physical, vocational, and behavioral components and is provided by multiple health care professionals with different clinical backgrounds. The intensity and content of interdisciplinary therapy varies widely.
Interferential therapy	The superficial application of a medium frequency alternating current modulated to

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	produce low frequencies up to 150 Hz.
Low-level laser therapy	The superficial application of lasers at wavelengths between 632 and 904 nm. Optimal treatment parameters (wavelength, dosage, dose-intensity) are uncertain.
Massage	Soft tissue manipulation using the hands or a mechanical device through a variety of specific methods.
Neurogenic claudication	Symptoms of leg pain (and occasionally weakness) on walking or standing, relieved by sitting or spinal flexion, associated with spinal stenosis.
Neuroreflexotherapy	A technique from Spain characterized by the temporary implantation of staples superficially into the skin over trigger points in the back and referred tender points in the ear.
Nonspecific back pain	Pain occurring primarily in the back with no signs of a serious underlying condition such as cancer, infection, fracture, or cauda equine syndrome.
Positive predictive value	The proportion of people with a positive test who have the disease.
Progressive relaxation	A technique that involves the deliberate tensing and relaxation of muscles, in order to facilitate the recognition and release of muscle tension.
Prolotherapy	A procedure that uses a dextrose (sugar water) solution, which is injected into the ligament or tendon where it attaches to the bone. This causes a localized inflammation in these weak areas which then increases the blood supply and flow of nutrients and stimulates the tissue to repair itself.
Psychological therapies	Includes biofeedback (the use of auditory and visual signals reflecting muscle tension or activity to inhibit or reduce the muscle activity), progressive relaxation (a technique that involves the deliberate tensing and relaxation of muscles to facilitate the recognition and release of muscle tension), and standard cognitive-behavioral and operant therapy.
Radiculopathy	Dysfunction of a nerve root associated with pain, sensory impairment, weakness, or diminished deep tendon reflexes in the nerve root distribution.
Sciatica	Pain radiating down the leg below the knee in the distribution of the sciatic nerve, suggesting nerve root compromise due to mechanical pressure or inflammation.
Sensitivity	The proportion of people who truly have a designated disorder who are so identified by the test. The test may consist of, or include, clinical observations. The proportion of truly diseased persons in the screened population who are identified as diseased by the screening test—that is, the true-positive rate.
Sham therapy	An inactive treatment or procedure that is intended to mimic as closely as possible a therapy in a clinical trial.
Shortwave diathermy	Therapeutic elevation of the temperature of deep tissues by application of shortwave electromagnetic radiation with a frequency range from 10 to 100 MHz.
Spa treatment	One of several alternative modalities used in Europe to relieve LBP and other chronic ailments. Specific thermal techniques are used, including mineral water bathing, thermal techniques, and a temporary change of lifestyle. Most patients are treated while staying in spa resorts.
Specificity	The proportion of people who are truly free of a designated disorder who are so identified by the test. The test may consist of, or include, clinical observations. The proportion of truly non-diseased persons who are identified as such by the screening test; that is, the true-negative rate.

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Spinal manipulation	Manual therapy in which loads are applied to the spine using short or long lever methods. High velocity thrusts are applied to a spinal joint beyond its restricted range of movement. Spinal mobilization, or low-velocity, passive movements within or at the limit of joint range, is often used in conjunction with spinal manipulation.
Spinal stenosis	Narrowing of the spinal canal that may result in bony constriction of the cauda equina and the emerging nerve roots.
Standardized mean difference	An effect size measure for continuous variables, computed as the difference between two means divided by the variability of that difference.
Straight leg raise test	A procedure in which the hip is flexed with the knee extended in order to passively stretch the sciatic nerve and elicit symptoms suggesting nerve root tension. A positive test is usually considered reproduction of the patient's sciatica when the leg is raised between 30 and 70 degrees. Reproduction of the patient's sciatica when the unaffected leg is lifted is referred to as a positive 'crossed' straight leg raise test.
Subacute low back pain	Low back pain present between 4 weeks and 3 months.
Thermography	A diagnostic procedure that images the infrared radiation (heat) emitted from body surfaces.
Transcutaneous electrical nerve stimulation (TENS)	Use of a small battery-operated device to provide continuous electrical impulses via surface electrodes, with the goal of providing symptomatic relief by modifying pain perception.
Yoga	An intervention distinguished from traditional exercise therapy by the utilization of specific body positions, breathing techniques, and emphasis on mental focus. Many styles of yoga are practiced, each emphasizing different postures and techniques.