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# Noninvasive Treatments for Acute, Subacute, and Chronic Low Back Pain: A Clinical Practice Guideline From the American College of Physicians

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**Description:** The American College of Physicians (ACP) developed this guideline to present the evidence and provide clinical recommendations on noninvasive treatment of low back pain.

**Methods:** Using the ACP grading system, the committee based these recommendations on a systematic review of randomized, controlled trials and systematic reviews published through April 2015 on noninvasive pharmacologic and nonpharmacologic treatments for low back pain. Updated searches were performed through November 2016. Clinical outcomes evaluated included reduction or elimination of low back pain, improvement in back-specific and overall function, improvement in health-related quality of life, reduction in work disability and return to work, global improvement, number of back pain episodes or time between episodes, patient satisfaction, and adverse effects.

**Target Audience and Patient Population:** The target audience for this guideline includes all clinicians, and the target patient population includes adults with acute, subacute, or chronic low back pain.

**Recommendation 1:** *Given that most patients with acute or subacute low back pain improve over time regardless of treatment, clinicians and patients should select nonpharmacologic treatment with superficial heat (moderate-quality evidence), massage, acupuncture, or spinal manipulation (low-quality evidence). If pharmacologic treatment is desired, clinicians and patients should select nonsteroidal anti-inflammatory drugs or skeletal*

*muscle relaxants (moderate-quality evidence). (Grade: strong recommendation)*

**Recommendation 2:** *For patients with chronic low back pain, clinicians and patients should initially select nonpharmacologic treatment with exercise, multidisciplinary rehabilitation, acupuncture, mindfulness-based stress reduction (moderate-quality evidence), tai chi, yoga, motor control exercise, progressive relaxation, electromyography biofeedback, low-level laser therapy, operant therapy, cognitive behavioral therapy, or spinal manipulation (low-quality evidence). (Grade: strong recommendation)*

**Recommendation 3:** *In patients with chronic low back pain who have had an inadequate response to nonpharmacologic therapy, clinicians and patients should consider pharmacologic treatment with nonsteroidal anti-inflammatory drugs as first-line therapy, or tramadol or duloxetine as second-line therapy. Clinicians should only consider opioids as an option in patients who have failed the aforementioned treatments and only if the potential benefits outweigh the risks for individual patients and after a discussion of known risks and realistic benefits with patients. (Grade: weak recommendation, moderate-quality evidence)*

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Low back pain is one of the most common reasons for physician visits in the United States. Most Americans have experienced low back pain, and approximately one quarter of U.S. adults reported having low back pain lasting at least 1 day in the past 3 months (1).

Low back pain is associated with high costs, including those related to health care and indirect costs from missed work or reduced productivity (2). The total costs attributable to low back pain in the United States were estimated at \$100 billion in 2006, two thirds of which were indirect costs of lost wages and productivity (3).

Low back pain is frequently classified and treated on the basis of symptom duration, potential cause, presence or absence of radicular symptoms, and corresponding anatomical or radiographic abnormalities. Acute back pain is defined as lasting less than 4 weeks, subacute back pain lasts 4 to 12 weeks, and chronic back pain lasts more than 12 weeks. Radicular low back pain results in lower extremity pain, paresthesia, and/or

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weakness and is a result of nerve root impingement. Most patients with acute back pain have self-limited episodes that resolve on their own; many do not seek medical care (4). For patients who do seek medical care, pain, disability, and return to work typically improve rapidly in the first month (5). However, up to one third of patients report persistent back pain of at least moderate intensity 1 year after an acute episode, and 1 in 5 report substantial limitations in activity (6). Many noninvasive treatment options are available for radicular and nonradicular low back pain, including pharmacologic and nonpharmacologic interventions.

## GUIDELINE FOCUS AND TARGET POPULATION

The purpose of this American College of Physicians (ACP) guideline is to provide treatment guidance based on the efficacy, comparative effectiveness, and safety of noninvasive pharmacologic and nonpharmacologic treatments for acute (<4 weeks), subacute (4 to 12 weeks), and chronic (>12 weeks) low back pain in primary care. This guideline does not address topical pharmacologic therapies or epidural injection therapies. It serves as a partial update of the 2007 ACP guideline (it excludes evidence on diagnosis). These recommendations are based on 2 background evidence reviews (7, 8) and a systematic review sponsored by the Agency for Healthcare Research and Quality (AHRQ) (9). The target audience for this guideline includes all clinicians, and the target patient population includes adults with acute, subacute, or chronic low back pain.

## METHODS

### Systematic Review of the Evidence

The evidence review was conducted by the AHRQ's Pacific Northwest Evidence-based Practice Center. Additional methodological details can be found in the **Appendix** (available at [Annals.org](http://Annals.org)) as well as in the accompanying articles (7, 8) and full report (9). Reviewers searched several databases for studies published in English from January 2008 through April 2015 and updated the search through November 2016. Studies published before 2007 were identified using the 2007 ACP/American Pain Society (APS) systematic reviews (10, 11). Reviewers combined data when possible using meta-analysis and assessed risk of bias and study quality according to established methods. The study population included adults (aged  $\geq 18$  years) with acute, subacute, or chronic nonradicular low back pain, radicular low back pain, or symptomatic spinal stenosis.

The review evaluated pharmacologic (acetaminophen, nonsteroidal anti-inflammatory drugs [NSAIDs], opioids, skeletal muscle relaxants [SMRs], benzodiazepines, antidepressants, antiseizure medications, and systemic corticosteroids) and nonpharmacologic (psychological therapies, multidisciplinary rehabilitation, spinal manipulation, acupuncture, massage, exercise and related therapies, and various physical modalities) treatments for low back pain. Evaluated outcomes in-

**Table.** The American College of Physicians Guideline Grading System\*

Quality of Evidence	Strength of Recommendation	
	Benefits Clearly Outweigh Risks and Burden or Risks and Burden Clearly Outweigh Benefits	Benefits Finely Balanced With Risks and Burden
High	Strong	Weak
Moderate	Strong	Weak
Low	Strong	Weak
Insufficient evidence to determine net benefits or risks		

\* Adopted from the classification developed by the GRADE (Grading of Recommendations Assessment, Development and Evaluation) workgroup.

cluded reduction or elimination of low back pain, improvement in back-specific and overall function, improvement in health-related quality of life, reduction in work disability, return to work, global improvement, number of back pain episodes or time between episodes, patient satisfaction, and adverse effects.

The magnitude of effect (small, moderate, or large) was determined as previously described (10, 11). A small effect on pain was defined as a mean between-group difference after treatment of 5 to 10 points on a visual analogue scale of 0 to 100 or equivalent, a mean between-group difference of 0.5 to 1.0 point on a numerical rating scale of 0 to 10, or a standardized mean difference of 0.2 to 0.5. A moderate effect was defined as a mean between-group difference of greater than 10 to no more than 20 points on a visual analogue scale of 0 to 100 or equivalent, a mean between-group difference of greater than 1.0 to no more than 2.0 points on a numerical rating scale of 0 to 10 or equivalent, or a standardized mean difference greater than 0.5 but no more than 0.8. For function, a small effect was defined as a mean between-group difference of 5 to 10 points on the Oswestry Disability Index (ODI), a mean between-group difference of 1 to 2 points on the Roland Morris Disability Questionnaire (RDQ), or a standardized mean difference of 0.2 to 0.5. A moderate effect on function was defined as a mean between-group difference of greater than 10 to no more than 20 points on the ODI, a mean between-group difference of greater than 2 to no more than 5 points on the RDQ, or a standardized mean difference greater than 0.5 but no more than 0.8. No large effects were found with any intervention.

### Grading the Evidence and Developing Recommendations

This guideline was developed by ACP's Clinical Guidelines Committee (CGC) according to ACP's guideline development process, details of which can be found in the methods paper (12). The CGC used the evidence tables in the accompanying evidence reviews (7, 8) and full report (9) when reporting the evidence

and graded the recommendations using the ACP's guideline grading system (Table).

### Peer Review

The AHRQ systematic review was sent to invited peer reviewers and posted on the AHRQ Web site for public comments. The accompanying evidence reviews (7, 8) also underwent a peer review process through the journal. The guideline underwent a peer review process through the journal and was posted online for comments from ACP Regents and ACP Governors, who represent ACP members at the regional level.

## BENEFITS AND COMPARATIVE BENEFITS OF PHARMACOLOGIC THERAPIES

### Acute or Subacute Low Back Pain

Appendix Table 1 (available at [Annals.org](#)) summarizes the findings for all therapies for acute or subacute low back pain.

#### Acetaminophen

Low-quality evidence showed no difference between acetaminophen and placebo for pain intensity or function through 4 weeks or between acetaminophen and NSAIDs for pain intensity or likelihood of experiencing global improvement at 3 weeks or earlier (13, 14).

#### NSAIDs

Moderate-quality evidence showed that NSAIDs were associated with a small improvement in pain intensity compared with placebo (14, 15), although several randomized, controlled trials (RCTs) showed no difference in likelihood of achieving pain relief with NSAIDs compared with placebo (16–18). Low-quality evidence showed a small increase in function with NSAIDs compared with placebo (19). Moderate-quality evidence showed that most head-to-head trials of one NSAID versus another showed no differences in pain relief in patients with acute low back pain (14). Low-quality evidence showed no differences in pain between cyclooxygenase (COX)-2-selective NSAIDs versus traditional NSAIDs (14).

#### SMRs

Moderate-quality evidence showed that SMRs improved short-term pain relief compared with placebo after 2 to 4 and 5 to 7 days (20, 21). Low-quality evidence showed no differences between different SMRs for any outcomes in patients with acute pain (20). Low-quality evidence showed inconsistent findings for the effect on pain intensity with a combination of SMRs plus NSAIDs compared with NSAIDs alone (20, 22, 23).

#### Systemic Corticosteroids

Low-quality evidence showed no difference in pain or function between a single intramuscular injection of

methylprednisolone or a 5-day course of prednisolone compared with placebo in patients with acute low back pain (24, 25).

### Other Therapies

Evidence was insufficient to determine effectiveness of antidepressants, benzodiazepines (26, 27), antiseizure medications, or opioids versus placebo in patients with acute or subacute low back pain.

### Chronic Low Back Pain

Appendix Table 2 (available at [Annals.org](#)) summarizes the findings for all therapies for chronic low back pain.

#### NSAIDs

Moderate-quality evidence showed that NSAIDs were associated with small to moderate pain improvement compared with placebo (14, 28, 29). Low-quality evidence showed that NSAIDs were associated with no to small improvement in function (28–31). Moderate-quality evidence showed that most head-to-head trials of one NSAID versus another showed no differences in pain relief in patients with chronic low back pain (14). There were no data on COX-2-selective NSAIDs.

#### Opioids

Moderate-quality evidence showed that strong opioids (tapentadol, morphine, hydromorphone, and oxycodone) were associated with a small short-term improvement in pain scores (about 1 point on a pain scale of 0 to 10) and function compared with placebo (32–36). Low-quality evidence showed that buprenorphine patches improved short-term pain more than placebo in patients with chronic low back pain; however, the improvement corresponded to less than 1 point on a pain scale of 0 to 10 (37–40). Moderate-quality evidence showed no differences among different long-acting opioids for pain or function (33, 41–44), and low-quality evidence showed no clear differences in pain relief between long- and short-acting opioids (45–50). Moderate-quality evidence showed that tramadol achieved moderate short-term pain relief and a small improvement in function compared with placebo (32, 51, 52).

#### SMRs

Evidence comparing SMRs versus placebo was insufficient (53–55). Low-quality evidence showed no differences in any outcome between different SMRs for treatment of chronic low back pain (20).

#### Benzodiazepines

Low-quality evidence showed that tetrazepam improved pain relief at 5 to 7 days and resulted in overall

improvement at 10 to 14 days compared with placebo (20).

### **Antidepressants**

Moderate-quality evidence showed no difference in pain between tricyclic antidepressants (TCAs) or selective serotonin reuptake inhibitors (SSRIs) versus placebo, and low-quality evidence showed no differences in function for antidepressants (56). Moderate-quality evidence showed that duloxetine was associated with a small improvement in pain intensity and function compared with placebo (57–59).

### **Other Therapies**

Evidence was insufficient to determine the effect of acetaminophen, systemic corticosteroids, or antiseizure medications on chronic low back pain.

### **Radicular Low Back Pain**

Appendix Table 3 (available at [Annals.org](http://Annals.org)) summarizes the findings for all treatments for radicular low back pain.

### **Benzodiazepines**

Low-quality evidence showed no difference between diazepam and placebo for function at 1 week through 1 year and analgesic use, return to work, or likelihood of surgery through 1 year of follow-up in patients with acute or subacute radicular pain (60). Diazepam resulted in a lower likelihood of pain improvement at 1 week compared with placebo.

### **Systemic Corticosteroids**

Moderate-quality evidence showed no differences in pain between systemic corticosteroids and placebo and no to small effect on function in patients with radicular low back pain (61–66).

### **Other Therapies**

No RCTs evaluated acetaminophen, SMRs, antidepressants, or opioids for radicular low back pain. Results for NSAIDs were inconsistent for pain, and evidence was therefore insufficient (22). There was insufficient evidence to determine the effect of antiseizure medications on radicular low back pain (67–71).

## **HARMS OF PHARMACOLOGIC THERAPIES**

Harms were derived from the identified systematic reviews. Adverse effects generally associated with the drugs can be found in Appendix Table 4 (available at [Annals.org](http://Annals.org)).

Moderate-quality evidence showed no difference among scheduled acetaminophen, acetaminophen taken as needed, or placebo for serious adverse events (13). Moderate-quality evidence showed that more adverse effects occurred with NSAIDs than placebo, COX-2-selective NSAIDs were associated with a decreased risk for adverse effects compared with traditional

NSAIDs, and acetaminophen was associated with a lower risk for adverse effects than NSAIDs (14). Moderate-quality evidence showed that short-term use of opioids increased nausea, dizziness, constipation, vomiting, somnolence, and dry mouth compared with placebo, and SMRs increased risk for any adverse event and central nervous system adverse events (mostly sedation) compared with placebo (20). Moderate-quality evidence showed that antidepressants increased risk for any adverse event compared with placebo, although rates of specific adverse events did not differ (72). The risk for serious adverse events did not differ between duloxetine and placebo, although duloxetine was associated with increased risk for withdrawal due to adverse events (57–59). Low-quality evidence showed no clear differences in adverse effects for gabapentin versus placebo (67, 68). Low-quality evidence showed that benzodiazepines caused more frequent somnolence, fatigue, and lightheadedness than placebo (20). Harms were not well-reported, and no RCTs assessed long-term use of benzodiazepines or risks for addiction, abuse, or overdose. Adverse events for systemic corticosteroids were not well-reported in RCTs, but the largest trial found that oral prednisone was associated with increased risk for any adverse event, insomnia, nervousness, and increased appetite (66). However, low-quality evidence showed no cases of hyperglycemia that required medical attention (24, 61, 64).

## **COMPARATIVE BENEFITS OF NONPHARMACOLOGIC THERAPIES**

### **Acute or Subacute Low Back Pain**

#### **Exercise**

Low-quality evidence showed no difference between exercise therapy and usual care for pain or function in patients with acute or subacute pain (11); additional trials reported inconsistent results (73–75). Moderate-quality evidence showed no clear differences between different exercise regimens in more than 20 head-to-head RCTs in patients with acute low back pain.

#### **Acupuncture**

Low-quality evidence showed that acupuncture resulted in a small decrease in pain intensity compared with sham acupuncture with nonpenetrating needles, but there were no clear effects on function (76–78). Low-quality evidence showed that acupuncture slightly increased the likelihood of overall improvement compared with NSAIDs (76, 79–83).

#### **Massage**

Low-quality evidence showed that massage moderately improved short-term (1 week) pain and function compared with sham therapy for subacute low back pain (84), although 1 trial (85) showed no difference in pain or function at 5 weeks. Moderate-quality evidence showed that massage improved short-term pain relief

and function compared with other interventions (manipulation, exercise therapy, relaxation therapy, acupuncture, or physiotherapy) for patients with subacute to chronic low back pain, but effects were small (84, 86). Low-quality evidence showed that a combination of massage plus another intervention (exercise, exercise and education, or usual care) was superior to the other intervention alone for short-term pain in patients with subacute to chronic low back pain (84).

### **Spinal Manipulation**

Low-quality evidence showed that spinal manipulation was associated with a small effect on function compared with sham manipulation; evidence was insufficient to determine the effect on pain (87, 88). Low-quality evidence showed no difference in pain relief at 1 week between spinal manipulation and inert treatment (educational booklet, detuned ultrasound, detuned or actual short-wave diathermy, antiedema gel, or bed rest), although 1 trial showed better longer-term pain relief (3 months) with spinal manipulation (89). Function did not differ between spinal manipulation and inert treatment at 1 week or 3 months (89). Moderate-quality evidence showed no difference between spinal manipulation and other active interventions for pain relief at 1 week through 1 year or function (analyses included exercise, physical therapy, or back school as the comparator) (89, 90). Low-quality evidence showed that a combination of spinal manipulation plus exercise or advice slightly improved function at 1 week compared with exercise or advice alone, but these differences were not present at 1 or 3 months (89).

### **Superficial Heat**

Moderate-quality evidence showed that a heat wrap moderately improved pain relief (at 5 days) and disability (at 4 days) compared with placebo (91). Low-quality evidence showed that a combination of heat plus exercise provided greater pain relief and improved RDQ scores at 7 days compared with exercise alone in patients with acute pain (92). Low-quality evidence showed that a heat wrap provided more effective pain relief and improved RDQ scores compared with acetaminophen or ibuprofen after 1 to 2 days (93). Low-quality evidence showed no clear differences between a heat wrap and exercise in pain relief or function (92).

### **Low-Level Laser Therapy**

Low-quality evidence showed that a combination of low-level laser therapy (LLLT) and NSAIDs largely decreased pain intensity and resulted in a moderate improvement in function (as measured by the ODI) compared with sham laser therapy plus NSAIDs in patients with acute or subacute pain (94).

### **Lumbar Supports**

Low-quality evidence showed no difference in pain or function between lumbar supports added to an educational program compared with an educational program alone or other active interventions in patients with acute or subacute low back pain (95).

### **Other Therapies**

Evidence was insufficient to determine the effectiveness of transcutaneous electrical nerve stimulation (TENS), electrical muscle stimulation, inferential therapy, short-wave diathermy, traction, superficial cold, motor control exercise (MCE), Pilates, tai chi, yoga, psychological therapies, multidisciplinary rehabilitation, ultrasound, and taping.

### **Chronic Low Back Pain**

#### **Exercise**

Moderate-quality evidence showed that exercise resulted in a small improvement in pain relief and function compared with no exercise (11, 96). Moderate-quality evidence showed that compared with usual care, exercise resulted in small improvements in pain intensity and function at the end of treatment, although effects were smaller at long-term follow-up (96). Moderate-quality evidence showed no clear differences between different exercise regimens in more than 20 head-to-head RCTs in patients with chronic low back pain.

#### **MCE**

Motor control exercise focuses on restoring coordination, control, and strength of the muscles that control and support the spine. Low-quality evidence showed that MCE moderately decreased pain scores and slightly improved function in short- to long-term follow-up compared with a minimal intervention (97). Low-quality evidence showed that MCE resulted in small improvements in pain intensity at short-term ( $\geq 6$  weeks to  $< 4$  months) and intermediate-term ( $\geq 4$  to  $< 8$  months) follow-up compared with general exercise, although improvements were small and no longer significant at long-term follow-up (97). Motor control exercise also resulted in small improvements in function in the short and long term (97). Low-quality evidence showed that MCE resulted in a moderate improvement in pain intensity and function compared with multimodal physical therapy at intermediate follow-up (97). Low-quality evidence showed no clear differences in pain with a combination of MCE plus exercise versus exercise alone (98, 99).

#### **Pilates**

Low-quality evidence showed that Pilates resulted in small or no clear effects on pain and no clear effects on function compared with usual care plus physical activity (100-107). Low-quality evidence showed no clear differences between Pilates and other types of exercise for pain or function (108-110).

### **Tai Chi**

Low-quality evidence showed that tai chi resulted in moderate pain improvement compared with wait-list controls or no tai chi (111, 112), and 1 study showed a small increase in function (111). Moderate-quality evidence showed that tai chi moderately decreased pain intensity at 3 and 6 months compared with backward walking or jogging but not versus swimming (112).

### **Yoga**

Low-quality evidence showed that Iyengar yoga resulted in moderately lower pain scores and improved function compared with usual care at 24 weeks (113). Low-quality evidence showed that yoga resulted in a small decrease in pain intensity compared with exercise (114-118). Low-quality evidence showed that, compared with education, yoga resulted in a small decrease in short-term ( $\leq 12$  weeks) but not long-term (about 1 year) pain intensity and a small increase in short- and long-term function (119).

### **Psychological Therapies**

Low-quality evidence showed that progressive relaxation therapy moderately improved pain intensity and functional status compared with wait-list controls (120). Low-quality evidence showed that electromyography biofeedback training moderately decreased pain intensity (reduction of 5 to 13 points on a 100-point pain scale) compared with wait-list controls, but there was no effect on function (120). Low-quality evidence showed that operant therapy (behavioral therapy involving reinforcement) slightly improved pain intensity compared with wait-list control, although there was no difference for function (120). Low-quality evidence showed that cognitive behavioral therapy (CBT) and other combined psychological therapies (involving education, problem-solving training, coping techniques, imagery, relaxation, goal setting, cognitive pain control, and exercises) were associated with moderately improved pain intensity compared with wait-list controls, but there was no difference in function (120). Moderate-quality evidence showed that mindfulness-based stress reduction is an effective treatment for chronic low back pain. One study showed a small improvement in pain at 26 and 52 weeks and in function at 26 weeks compared with usual care (121). The same study showed no difference between mindfulness-based stress reduction and CBT for improvements in pain or function. Two other studies showed improvement in pain and function compared with education (122, 123). Low-quality evidence showed no difference between psychological therapies and exercise or physical therapy for pain intensity (120). Low-quality evidence showed no differences in pain or function between a combination of psychological therapy plus exercise or physiotherapy compared with exercise or physiotherapy alone (120). Moderate-quality evidence showed no differences between different psychological therapies for pain or function outcomes (120).

### **Multidisciplinary Rehabilitation**

Moderate-quality evidence showed that multidisciplinary rehabilitation moderately reduced short-term (<3 months) and slightly reduced long-term pain intensity and disability compared with usual care, although there was no difference in return to work (124). Low-quality evidence showed that multidisciplinary rehabilitation was associated with moderately lower short-term pain intensity and slightly lower disability than no rehabilitation (124). Moderate-quality evidence showed that multidisciplinary rehabilitation was associated with slightly lower short-term pain intensity and disability, moderately lower long-term pain intensity, and improved function compared with physical therapy and a greater likelihood of returning to work compared with nonmultidisciplinary rehabilitation (124).

### **Acupuncture**

Low-quality evidence showed that acupuncture was associated with moderate improvement in pain relief immediately after treatment and up to 12 weeks later compared with sham acupuncture, but there was no improvement in function (125-130). Moderate-quality evidence showed that acupuncture was associated with moderately lower pain intensity and improved function compared with no acupuncture at the end of treatment (125). Low-quality evidence showed a small improvement in pain relief and function compared with medications (NSAIDs, muscle relaxants, or analgesics) (125).

### **Massage**

Low-quality evidence showed no difference in pain between foot reflexology and usual care for patients with chronic low back pain (131-133). Moderate-quality evidence showed that massage improved short-term pain relief and function compared with other interventions (manipulation, exercise therapy, relaxation therapy, acupuncture, physiotherapy, or TENS) for patients with subacute to chronic low back pain, although effects were small (84, 86). Low-quality evidence showed that a combination of massage plus another intervention (exercise, exercise and education, or usual care) was superior to the other intervention alone for short-term pain in patients with subacute to chronic low back pain (84).

### **Spinal Manipulation**

Low-quality evidence showed no difference in pain with spinal manipulation versus sham manipulation at 1 month (134, 135). Low-quality evidence showed that spinal manipulation slightly improved pain compared with an inert treatment (136-142). Moderate-quality evidence showed no clear differences in pain or function compared with another active intervention. Low-quality evidence showed that a combination of spinal manipulation with another active treatment resulted in greater pain relief and improved function at 1, 3, and 12

months compared with the other treatment alone (134, 143-147).

### **Ultrasound**

Low-quality evidence showed no difference between ultrasound and sham ultrasound for pain at the end of treatment or 4 weeks after treatment (148-150). Low-quality evidence showed no difference between ultrasound and no ultrasound for pain or function (151, 152).

### **TENS**

Low-quality evidence showed no difference between TENS and sham TENS for pain intensity or function at short-term follow-up (153). Low-quality evidence showed no difference between TENS and acupuncture in short- or long-term pain (154).

### **LLLT**

Low-quality evidence showed that LLLT slightly improved pain compared with sham laser (155-157), and 1 RCT (155) showed that LLLT slightly improved function compared with sham laser.

### **Lumbar Support**

Evidence was insufficient to compare lumbar support versus no lumbar support. Low-quality evidence showed no difference between a lumbar support plus exercise (muscle strengthening) versus exercise alone for pain or function at 8 weeks or 6 months (158). Low-quality evidence showed no clear differences between lumbar supports and other active treatments (traction, spinal manipulation, exercise, physiotherapy, or TENS) for pain or function (159-161).

### **Taping**

Low-quality evidence showed no differences between Kinesio taping and sham taping for back-specific function after 5 or 12 weeks, although effects on pain were inconsistent between the 2 trials (162, 163). Low-quality evidence showed no differences between Kinesio taping and exercise for pain or function (164, 165).

### **Other Therapies**

Evidence was insufficient to determine the effectiveness of electrical muscle stimulation, interferential therapy, short-wave diathermy, traction, or superficial heat or cold.

## **Radicular Low Back Pain**

### **Exercise**

Low-quality evidence showed that exercise resulted in small improvements in pain and function compared with usual care or no exercise (166-168).

### **Traction**

Low-quality evidence showed no clear differences between traction and other active treatments, between

traction plus physiotherapy versus physiotherapy alone, or between different types of traction in patients with low back pain with or without radiculopathy (169).

### **Other Therapies**

Evidence was insufficient for ultrasound, MCE, Pilates, tai chi, yoga, psychological therapies, multidisciplinary rehabilitation, acupuncture, massage, spinal manipulation, LLLT, electrical muscle stimulation, short-wave diathermy, TENS, interferential therapy, superficial heat or cold, lumbar support, and taping.

## **HARMS OF NONPHARMACOLOGIC THERAPIES**

Evidence on adverse events from the included RCTs and systematic reviews was limited, and the quality of evidence for all available harms data is low. Harms were poorly reported (if they were reported at all) for most of the interventions.

Low-quality evidence showed no reported harms or serious adverse events associated with tai chi, psychological interventions, multidisciplinary rehabilitation, ultrasound, acupuncture, lumbar support, or traction (9, 95, 150, 170-174). Low-quality evidence showed that when harms were reported for exercise, they were often related to muscle soreness and increased pain, and no serious harms were reported. All reported harms associated with yoga were mild to moderate (119). Low-quality evidence showed that none of the RCTs reported any serious adverse events with massage, although 2 RCTs reported soreness during or after massage therapy (175, 176). Adverse events associated with spinal manipulation included muscle soreness or transient increases in pain (134). There were few adverse events reported and no clear differences between MCE and controls. Transcutaneous electrical nerve stimulation was associated with an increased risk for skin site reaction but not serious adverse events (177). Two RCTs (178, 179) showed an increased risk for skin flushing with heat compared with no heat or placebo, and no serious adverse events were reported. There were no data on cold therapy. Evidence was insufficient to determine harms of electrical muscle stimulation, LLLT, percutaneous electrical nerve stimulation, interferential therapy, short-wave diathermy, and taping.

## **COMPARISON OF CONCLUSIONS WITH THOSE OF THE 2007 GUIDELINE**

Some evidence has changed since the 2007 ACP guideline and supporting evidence review. The 2007 review concluded that acetaminophen was effective for acute low back pain, based on indirect evidence from trials of acetaminophen for other conditions and trials of acetaminophen versus other analgesics. However, this update included a placebo-controlled RCT in patients with low back pain that showed no difference in effectiveness between acetaminophen and placebo (low-quality evidence). In addition, contrary to the 2007



review, current moderate-quality evidence showed that TCAs were not effective for chronic low back pain compared with placebo. Additional pharmacologic treatments addressed in the current review included duloxetine and the antiseizure medication pregabalin. Many conclusions about nonpharmacologic interventions are similar between the 2007 review and the update. Additional modalities assessed (with at least low-quality evidence) include mindfulness-based stress reduction, MCE, taping, and tai chi. Additional evidence or changes from the updated review include that superficial heat was found to be more effective for acute or subacute low back pain (moderate-quality evidence) and neither ultrasound nor TENS was shown to be effective compared with controls (low-quality evidence).

The **Figure** summarizes the recommendations and clinical considerations. Additional details on the evidence are available in **Appendix Tables 1 to 4** and the accompanying evidence reviews (7, 8).

## RECOMMENDATIONS

*Recommendation 1: Given that most patients with acute or subacute low back pain improve over time regardless of treatment, clinicians and patients should select nonpharmacologic treatment with superficial heat (moderate-quality evidence), massage, acupuncture, or spinal manipulation (low-quality evidence). If pharmacologic treatment is desired, clinicians and patients should select nonsteroidal anti-inflammatory drugs or skeletal muscle relaxants (moderate-quality evidence). (Grade: strong recommendation)*

Clinicians should inform all patients of the generally favorable prognosis of acute low back pain with or without sciatica, including a high likelihood for substantial improvement in the first month (5, 180). Clinicians should also provide patients with evidence-based information with regard to their expected course, advise them to remain active as tolerated, and provide information about effective self-care options. Clinicians and patients should use a shared decision-making approach to select the most appropriate treatment based on patient preferences, availability, harms, and costs of the interventions. Nonpharmacologic interventions shown to be effective for improving pain and function in patients with acute or subacute low back pain include superficial heat (moderate-quality evidence and moderate improvement in pain and function) and massage (low-quality evidence and small to moderate improvement in pain and function). Low-quality evidence showed that acupuncture had a small effect on improving pain and spinal manipulation had a small effect on improving function compared with sham manipulation but not inert treatment. Harms of nonpharmacologic interventions were sparsely reported, and no serious adverse events were reported. Superficial heat was associated with increased risk for skin flushing, and massage and spinal manipulation were associated with muscle soreness.

We recommend that the choice between NSAIDs and SMRs be individualized on the basis of patient pref-

erences and likely individual medication risk profile. Treatment with NSAIDs resulted in a small improvement in both pain intensity (moderate-quality evidence) and function (low-quality evidence), and treatment with SMRs resulted in a small improvement in pain relief (moderate-quality evidence). There was no evidence for the effect of SMRs on function. Nonsteroidal anti-inflammatory drugs are associated with gastrointestinal and renal risks. Clinicians should therefore assess renovascular and gastrointestinal risk factors before prescribing NSAIDs and recommend the lowest effective doses for the shortest periods necessary. Although they are associated with lower risk for adverse effects than nonselective NSAIDs, COX-2-selective NSAIDs were not assessed for improvement in pain or function. Skeletal muscle relaxants are associated with central nervous system adverse effects, especially sedation.

The updated evidence showed that acetaminophen was not effective at improving pain outcomes versus placebo. However, this study assessed pain at 3 weeks after the intervention, and evidence from head-to-head trials showed no difference between acetaminophen and NSAIDs. Low-quality evidence showed that systemic steroids were not effective in treating acute or subacute low back pain, and we recommend against these drugs for treatment of acute low back pain.

*Recommendation 2: For patients with chronic low back pain, clinicians and patients should initially select nonpharmacologic treatment with exercise, multidisciplinary rehabilitation, acupuncture, mindfulness-based stress reduction (moderate-quality evidence), tai chi, yoga, motor control exercise, progressive relaxation, electromyography biofeedback, low-level laser therapy, operant therapy, cognitive behavioral therapy, or spinal manipulation (low-quality evidence). (Grade: strong recommendation)*

Nonpharmacologic interventions are considered as first-line options in patients with chronic low back pain because fewer harms are associated with these types of therapies than with pharmacologic options. It is important that physical therapies be administered by providers with appropriate training. Moderate-quality evidence showed that exercise therapy resulted in small improvements in pain and function. Specific components associated with greater effects on pain included individually designed programs, supervised home exercise, and group exercise; regimens that included stretching and strength training were most effective. Moderate-quality evidence showed that, compared with usual care, multidisciplinary rehabilitation resulted in moderate pain improvement in the short term (<3 months), small pain improvement in the long term, and small improvement in function in both the short and long term. Low-quality evidence showed that multidisciplinary rehabilitation resulted in a moderate improvement in pain and a small improvement in function compared with no multidisciplinary rehabilitation. Acupuncture had a moderate effect on pain and function compared with no acupuncture (moderate-quality evi-

**Figure.** Summary of the American College of Physicians guideline on noninvasive treatments for acute, subacute, or chronic low back pain.



Summary of the American College of Physicians Guideline on Noninvasive Treatments for Acute, Subacute, or Chronic Low Back Pain

Disease/Condition	Low back pain
Target Audience	All clinicians
Target Patient Population	Adults with acute, subacute, or chronic low back pain
Interventions Evaluated	<p>Pharmacologic interventions: NSAIDs, nonopioid analgesics, opioid analgesics, tramadol and tapentadol, antidepressants, SMRs, benzodiazepines, corticosteroids, antiepileptic drugs</p> <p>Nonpharmacologic interventions: interdisciplinary or multicomponent rehabilitation; psychological therapies; exercise and related interventions, such as yoga or tai chi; complementary and alternative medicine therapies, including spinal manipulation, acupuncture, and massage; passive physical modalities, such as heat, cold, ultrasound, transcutaneous electrical nerve stimulation, electrical muscle stimulation, interferential therapy, short-wave diathermy, traction, LLLT, lumbar supports/braces</p>
Outcomes Evaluated	Pain, function, health-related quality of life, work disability/return to work, global improvement, number of back pain episodes or time between episodes, patient satisfaction, adverse effects
Benefits	<p><b>Acute low back pain</b></p> <p>Pharmacologic</p> <ul style="list-style-type: none"> <li>NSAIDs: improved pain and function (small effect)</li> <li>SMRs: improved pain (small effect)</li> </ul> <p>Nonpharmacologic</p> <ul style="list-style-type: none"> <li>Heat wrap: improved pain and function (moderate effect)</li> <li>Massage: improved pain and function (at 1 but not 5 wk) (small to moderate effect)</li> <li>Acupuncture: improved pain (small effect)</li> <li>Spinal manipulation: improved function (small effect)</li> </ul> <p><b>Chronic low back pain</b></p> <p>Pharmacologic</p> <ul style="list-style-type: none"> <li>NSAIDs: improved pain (small to moderate effect) and function (no to small effect)</li> <li>Opioids: improved pain and function (small effect)                     <ul style="list-style-type: none"> <li>Tramadol: improved pain (moderate effect) and function (small effect)</li> <li>Buprenorphine (patch or sublingual): improved pain (small effect)</li> </ul> </li> <li>Duloxetine: improved pain and function (small effect)</li> </ul> <p>Nonpharmacologic</p> <ul style="list-style-type: none"> <li>Exercise: improved pain and function (small effect)</li> <li>Motor control exercise: improved pain (moderate effect) and function (small effect)</li> <li>Tai chi: improved pain (moderate effect) and function (small effect)</li> <li>Mindfulness-based stress reduction: improved pain and function (small effect)</li> <li>Yoga: improved pain and function (small to moderate effect, depending on comparator)</li> <li>Progressive relaxation: improved pain and function (moderate effect)</li> <li>Multidisciplinary rehabilitation: improved pain (moderate effect) and function (no to small effect)</li> <li>Acupuncture: improved pain (moderate effect) and function (no to moderate effect, depending on comparator)</li> <li>LLLT: improved pain and function (small effect)</li> <li>Electromyography biofeedback: improved pain (moderate effect)</li> <li>Operant therapy: improved pain (small effect)</li> <li>Cognitive behavioral therapy: improved pain (moderate effect)</li> <li>Spinal manipulation: improved pain (small effect)</li> </ul> <p><b>Radicular low back pain</b></p> <ul style="list-style-type: none"> <li>Exercise: improved pain or function (small effect)</li> </ul>
Harms	<p>Generally poorly reported</p> <p>Pharmacologic</p> <ul style="list-style-type: none"> <li>NSAIDs: increased adverse effects compared with placebo and acetaminophen (COX-2–selective NSAIDs decreased risk for adverse effects compared with traditional NSAIDs)</li> <li>Opioids: nausea, dizziness, constipation, vomiting, somnolence, and dry mouth</li> <li>SMRs: increased risk for any adverse event and central nervous system adverse events (mostly sedation)</li> <li>Benzodiazepines: somnolence, fatigue, lightheadedness</li> <li>Antidepressants: increased risk for any adverse event</li> </ul> <p>Nonpharmacologic</p> <ul style="list-style-type: none"> <li>Poorly reported, but no increase in serious adverse effects</li> </ul>

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Figure—Continued

<p>Recommendations</p>	<p><i>Recommendation 1: Given that most patients with acute or subacute low back pain improve over time regardless of treatment, clinicians and patients should select nonpharmacologic treatment with superficial heat (moderate-quality evidence), massage, acupuncture, or spinal manipulation (low-quality evidence). If pharmacologic treatment is desired, clinicians and patients should select nonsteroidal anti-inflammatory drugs or skeletal muscle relaxants (moderate-quality evidence). (Grade: strong recommendation)</i></p> <p><i>Recommendation 2: For patients with chronic low back pain, clinicians and patients should initially select nonpharmacologic treatment with exercise, multidisciplinary rehabilitation, acupuncture, mindfulness-based stress reduction (moderate-quality evidence), tai chi, yoga, motor control exercise, progressive relaxation, electromyography biofeedback, low-level laser therapy, operant therapy, cognitive behavioral therapy, or spinal manipulation (low-quality evidence). (Grade: strong recommendation)</i></p> <p><i>Recommendation 3: In patients with chronic low back pain who have had an inadequate response to nonpharmacologic therapy, clinicians and patients should consider pharmacologic treatment with nonsteroidal anti-inflammatory drugs as first-line therapy, or tramadol or duloxetine as second-line therapy. Clinicians should only consider opioids as an option in patients who have failed the aforementioned treatments and only if the potential benefits outweigh the risks for individual patients and after a discussion of known risks and realistic benefits with patients. (Grade: weak recommendation, moderate-quality evidence)</i></p>
<p>High-Value Care</p>	<p>Clinicians should reassure patients that acute or subacute low back pain usually improves over time regardless of treatment and should avoid prescribing costly and potentially harmful treatments. Systemic steroids were not shown to provide benefit and should not be prescribed for patients with acute or subacute low back pain, even with radicular symptoms. For treatment of chronic low back pain, clinicians should select therapies that have the fewest harms and lowest costs. Clinicians should avoid prescribing costly therapies and those with substantial potential harms, such as long-term opioids, and pharmacologic therapies that were not shown to be effective, such as tricyclic antidepressants and selective serotonin reuptake inhibitors.</p>
<p>Clinical Considerations</p>	<p>Clinicians should inform patients with acute or subacute low back pain of the generally very favorable outcome. Thus, patients can avoid potentially harmful and costly tests and treatments.</p> <p>Clinicians should advise patients with acute, subacute, or chronic low back pain to remain active as tolerated.</p> <p>Improvements in pain and function due to pharmacologic and nonpharmacologic interventions were small and often showed no clear differences compared with controls.</p> <p>Few differences in recommended therapies were found when they were studied in head-to-head trials. Therefore, clinicians should base treatment recommendations on patient preferences that also minimize harms and costs.</p>

COX-2 = cyclooxygenase-2; LLLT = low-level laser therapy; NSAID = nonsteroidal anti-inflammatory drug; SMR = skeletal muscle relaxant.

dence) and a moderate effect on pain with no clear effect on function compared with sham acupuncture (low-quality evidence). Moderate-quality evidence showed that mindfulness-based stress reduction resulted in small improvements in pain and function (small effect), and 1 study showed that it was equivalent to CBT for improving back pain and function.

Low-quality evidence showed that tai chi had a moderate effect on pain and a small effect on function. Tai chi sessions in included studies lasted 40 to 45 minutes and were done 2 to 5 times per week for 10 to 24 weeks. Low-quality evidence showed that yoga improved pain and function by a moderate amount compared with usual care and by a small amount compared with education. Low-quality evidence showed that MCE had a moderate effect on pain and a small effect on function. Motor control exercise, tai chi, and yoga were favored over general exercise (low-quality evidence).

Low-quality evidence showed that progressive relaxation had a moderate effect on pain and function, electromyography biofeedback and CBT each had a moderate effect on pain and no effect on function, and operant therapy had a small effect on pain and no effect on function. Low-quality evidence showed that LLLT had a small effect on pain and function. Low-quality evidence showed that spinal manipulation had a small effect on pain compared with inert treatment but no effect compared with sham manipulation. There

were no clear differences between spinal manipulation and other active interventions (moderate-quality evidence).

Harms were poorly reported for nonpharmacologic therapies, although no serious harms were reported for any of the recommended interventions. Muscle soreness was reported for exercise, massage, and spinal manipulation.

Ultrasound, TENS, and Kinesio taping had no effect on pain or function compared with control treatments (low-quality evidence).

*Recommendation 3: In patients with chronic low back pain who have had an inadequate response to nonpharmacologic therapy, clinicians and patients should consider pharmacologic treatment with nonsteroidal anti-inflammatory drugs as first-line therapy, or tramadol or duloxetine as second-line therapy. Clinicians should only consider opioids as an option in patients who have failed the aforementioned treatments and only if the potential benefits outweigh the risks for individual patients and after a discussion of known risks and realistic benefits with patients. (Grade: weak recommendation, moderate-quality evidence)*

Pharmacologic therapy should be considered for patients with chronic low back pain who do not improve with nonpharmacologic interventions. Nonsteroidal anti-inflammatory drugs had a small to moderate effect on pain (moderate-quality evidence) and no to

small effect on function (low-quality evidence) and should be the first option considered. Moderate-quality evidence showed no difference in pain improvement when different NSAIDs were compared with one another. Nonsteroidal anti-inflammatory drugs are associated with gastrointestinal and renal risks. Clinicians should therefore assess renovascular and gastrointestinal risk factors before prescribing NSAIDs and should recommend the lowest effective doses for the shortest periods necessary. COX-2-selective NSAIDs were not assessed for improvement in pain or function, although they are associated with lower risk for adverse effects than nonselective NSAIDs.

For second-line therapies, moderate-quality evidence showed that tramadol had a moderate effect on pain and a small effect on function in the short term. Of note, tramadol is a narcotic and, like other opioids, is associated with the risk for abuse (181). Moderate-quality evidence showed that duloxetine had a small effect on pain and function.

Moderate-quality evidence showed that opioids (morphine, oxycodone, hydromorphone, and tapentadol) had a small effect on short-term pain and function. Low-quality evidence showed that buprenorphine (patch or sublingual) resulted in a small improvement in pain. Opioids should be the last treatment option considered and should be considered only in patients for whom other therapies have failed because they are associated with substantial harms. Moderate-quality evidence showed no difference in pain or function when different long-acting opioids were compared with one another. Harms of short-term use of opioids include increased nausea, dizziness, constipation, vomiting, somnolence, and dry mouth compared with placebo. Studies assessing opioids for the treatment of chronic low back pain did not address the risk for addiction, abuse, or overdose, although observational studies have shown a dose-dependent relationship between opioid use for chronic pain and serious harms (182).

Moderate-quality evidence showed that TCAs did not effectively improve pain or function (low-quality evidence) in patients with chronic low back pain, which is contrary to the 2007 guideline. In addition, moderate-quality evidence showed that SSRIs did not improve pain.

## AREAS OF INCONCLUSIVE EVIDENCE

Evidence is insufficient or lacking to determine treatments for radicular low back pain. Most RCTs enrolled a mixture of patients with acute, subacute, and chronic low back pain, so it is difficult to extrapolate the benefits of treatment compared with its duration. Use of opioids for chronic pain is an important area that requires further research to compare benefits and harms of therapy. The evidence is also insufficient for most physical modalities. Evidence is insufficient on which patients are likely to benefit from which specific therapy. Evidence on patient-important outcomes, such as disability or return to work, was largely unavailable,

and available evidence showed no clear connection with improvements in pain.

## HIGH-VALUE CARE

Clinicians should reassure patients that acute or subacute low back pain usually improves over time, regardless of treatment. Thus, clinicians should avoid prescribing costly and potentially harmful treatments for these patients, especially narcotics. In addition, systemic steroids were not shown to provide benefit and should not be prescribed for patients with acute or subacute low back pain, even with radicular symptoms. For treatment of chronic low back pain, clinicians should select therapies that have the fewest harms and lowest costs because there were no clear comparative advantages for most treatments compared with one another. Clinicians should avoid prescribing costly therapies; those with substantial potential harms, such as long-term opioids (which can be associated with addiction and accidental overdose); and pharmacologic therapies that were not shown to be effective, such as TCAs and SSRIs.

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**Note:** Clinical practice guidelines are “guides” only and may not apply to all patients and all clinical situations. Thus, they are not intended to override clinicians’ judgment. All ACP clinical practice guidelines are considered automatically withdrawn or invalid 5 years after publication or once an update has been issued.

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## References

1. Deyo RA, Mirza SK, Martin BI. Back pain prevalence and visit rates: estimates from U.S. national surveys, 2002. *Spine (Phila Pa 1976)*. 2006;31:2724-7. [PMID: 17077742]
2. Andersson GB. Epidemiological features of chronic low-back pain. *Lancet*. 1999;354:581-5. [PMID: 10470716]
3. Katz JN. Lumbar disc disorders and low-back pain: socioeconomic factors and consequences. *J Bone Joint Surg Am*. 2006;88 Suppl 2:21-4. [PMID: 16595438]
4. Carey TS, Evans AT, Hadler NM, Lieberman G, Kalsbeek WD, Jackman AM, et al. Acute severe low back pain. A population-based study of prevalence and care-seeking. *Spine (Phila Pa 1976)*. 1996;21:339-44. [PMID: 8742211]
5. Pengel LH, Herbert RD, Maher CG, Refshauge KM. Acute low back pain: systematic review of its prognosis. *BMJ*. 2003;327:323. [PMID: 12907487]
6. Von Korff M, Saunders K. The course of back pain in primary care. *Spine (Phila Pa 1976)*. 1996;21:2833-7. [PMID: 9112707]
7. Chou R, Deyo R, Friedly J, Skelly A, Hashimoto R, Weimer M, et al. Nonpharmacologic therapies for low back pain: a systematic review for an American College of Physicians clinical practice guideline. *Ann Intern Med*. 2017;166:493-505. doi:10.7326/M16-2459
8. Chou R, Deyo R, Friedly J, Skelly A, Weimer M, et al. Systemic pharmacologic therapies for low back pain: a systematic review for an American College of Physicians clinical practice guideline. *Ann Intern Med*. 2017;166:480-92. doi:10.7326/M16-2458
9. Chou R, Deyo R, Friedly J, Skelly A, Hashimoto R, Weimer M, et al. Noninvasive Treatments for Low Back Pain. Comparative Effectiveness Review no. 169. (Prepared by the Pacific Northwest Evidence-based Practice Center under contract no. 290-2012-00014-I.) AHRQ publication no. 16-EHC004-EF. Rockville: Agency for Healthcare Research and Quality; February 2016. Accessed at [www.effectivehealthcare.ahrq.gov/reports/final.cfm](http://www.effectivehealthcare.ahrq.gov/reports/final.cfm) on 19 January 2017.
10. Chou R, Huffman LH; American Pain Society. Medications for acute and chronic low back pain: a review of the evidence for an American Pain Society/American College of Physicians clinical practice guideline. *Ann Intern Med*. 2007;147:505-14. [PMID: 17909211] doi:10.7326/0003-4819-147-7-200710020-00008
11. Chou R, Huffman LH; American Pain Society. Nonpharmacologic therapies for acute and chronic low back pain: a review of the evidence for an American Pain Society/American College of Physicians clinical practice guideline. *Ann Intern Med*. 2007;147:492-504. [PMID: 17909210] doi:10.7326/0003-4819-147-7-200710020-00007
12. Qaseem A, Snow V, Owens DK, Shekelle P; Clinical Guidelines Committee of the American College of Physicians. The development of clinical practice guidelines and guidance statements of the American College of Physicians: summary of methods. *Ann Intern Med*. 2010;153:194-9. [PMID: 20679562] doi:10.7326/0003-4819-153-3-201008030-00010
13. Williams CM, Maher CG, Latimer J, McLachlan AJ, Hancock MJ, Day RO, et al. Efficacy of paracetamol for acute low-back pain: a double-blind, randomised controlled trial. *Lancet*. 2014;384:1586-96. [PMID: 25064594] doi:10.1016/S0140-6736(14)60805-9
14. Roelofs PD, Deyo RA, Koes BW, Scholten RJ, van Tulder MW. Non-steroidal anti-inflammatory drugs for low back pain. *Cochrane Database Syst Rev*. 2008;CD000396. [PMID: 18253976] doi:10.1002/14651858.CD000396.pub3
15. Herrmann WA, Geertsens MS. Efficacy and safety of lornoxicam compared with placebo and diclofenac in acute sciatica/lumbosciatica: an analysis from a randomised, double-blind, multicentre, parallel-group study. *Int J Clin Pract*. 2009;63:1613-21. [PMID: 19832818] doi:10.1111/j.1742-1241.2009.02187.x
16. Basmajian JV. Acute back pain and spasm. A controlled multi-center trial of combined analgesic and antispasm agents. *Spine (Phila Pa 1976)*. 1989;14:438-9. [PMID: 2524114]
17. Goldie I. A clinical trial with indomethacin (indomee®) in low back pain and sciatica. *Acta Orthop Scand*. 1968;39:117-28. [PMID: 4239771]
18. Weber H. Comparison of the effect of diazepam and levomepromazine on pain in patients with acute lumbago-sciatica. *J Oslo City Hosp*. 1980;30:65-8. [PMID: 6446597]
19. Dreiser RL, Marty M, Ionescu E, Gold M, Liu JH. Relief of acute low back pain with diclofenac-K 12.5 mg tablets: a flexible dose, ibuprofen 200 mg and placebo-controlled clinical trial. *Int J Clin Pharmacol Ther*. 2003;41:375-85. [PMID: 14518597]
20. van Tulder MW, Touray T, Furlan AD, Solway S, Bouter LM. Muscle relaxants for non-specific low back pain. *Cochrane Database Syst Rev*. 2003;CD004252. [PMID: 12804507]
21. Ralph L, Look M, Wheeler W, Sacks H. Double-blind, placebo-controlled trial of carisoprodol 250-mg tablets in the treatment of acute lower-back spasm. *Curr Med Res Opin*. 2008;24:551-8. [PMID: 18194591] doi:10.1185/030079908X261014
22. Pareek A, Chandurkar N, Chandanwale AS, Ambade R, Gupta A, Bartakke G. Aceclofenac-tizanidine in the treatment of acute low back pain: a double-blind, double-dummy, randomized, multicentric, comparative study against aceclofenac alone. *Eur Spine J*. 2009;18:1836-42. [PMID: 19421791] doi:10.1007/s00586-009-1019-4
23. Friedman BW, Dym AA, Davitt M, Holden L, Solorzano C, Esses D, et al. Naproxen with cyclobenzaprine, oxycodone/acetaminophen, or placebo for treating acute low back pain: a randomized clinical trial. *JAMA*. 2015;314:1572-80. [PMID: 26501533] doi:10.1001/jama.2015.13043
24. Friedman BW, Holden L, Esses D, Bijur PE, Choi HK, Solorzano C, et al. Parenteral corticosteroids for emergency department patients with non-radicular low back pain. *J Emerg Med*. 2006;31:365-70. [PMID: 17046475]
25. Eskin B, Shih RD, Fiesseler FW, Walsh BW, Allegra JR, Silverman ME, et al. Prednisone for emergency department low back pain: a randomized controlled trial. *J Emerg Med*. 2014;47:65-70. [PMID: 24739318] doi:10.1016/j.jemermed.2014.02.010
26. Hingorani K. Diazepam in backache. A double-blind controlled trial. *Ann Phys Med*. 1966;8:303-6. [PMID: 4224750]
27. Moll W. [Therapy of acute lumbovertebral syndromes through optimal muscle relaxation using diazepam. Results of a double-blind study on 68 cases]. *Med Welt*. 1973;24:1747-51. [PMID: 4272092]
28. Katz N, Borenstein DG, Birbara C, Bramson C, Nemeth MA, Smith MD, et al. Efficacy and safety of tanezumab in the treatment of chronic low back pain. *Pain*. 2011;152:2248-58. [PMID: 21696889] doi:10.1016/j.pain.2011.05.003
29. Kivitz AJ, Gimbel JS, Bramson C, Nemeth MA, Keller DS, Brown MT, et al. Efficacy and safety of tanezumab versus naproxen in the treatment of chronic low back pain. *Pain*. 2013;154:1009-21. [PMID: 23628600] doi:10.1016/j.pain.2013.03.006
30. Birbara CA, Puopolo AD, Munoz DR, Sheldon EA, Mangione A, Bohidar NR, et al; Etoricoxib Protocol 042 Study Group. Treatment of chronic low back pain with etoricoxib, a new cyclo-oxygenase-2 selective inhibitor: improvement in pain and disability—a randomized, placebo-controlled, 3-month trial. *J Pain*. 2003;4:307-15. [PMID: 14622687]
31. Katz N, Ju WD, Krupa DA, Sperling RS, Bozalis Rodgers D, Gertz BJ, et al; Vioxx Chronic Low Back Pain Study Group. Efficacy and safety of rofecoxib in patients with chronic low back pain: results from two 4-week, randomized, placebo-controlled, parallel-group,

- double-blind trials. *Spine (Phila Pa 1976)*. 2003;28:851-8. [PMID: 12941996]
32. Chapparro LE, Furlan AD, Deshpande A, Mailis-Gagnon A, Atlas S, Turk DC. Opioids compared to placebo or other treatments for chronic low-back pain. *Cochrane Database Syst Rev*. 2013; CD004959. [PMID: 23983011] doi:10.1002/14651858.CD004959.pub4(5).
  33. Hale ME, Dvergsten C, Gimbel J. Efficacy and safety of oxycodone extended release in chronic low back pain: results of a randomized, double-blind, placebo- and active-controlled phase III study. *J Pain*. 2005;6:21-8. [PMID: 15629415]
  34. Cloutier C, Taliano J, O'Mahony W, Csanadi M, Cohen G, Sutton I, et al. Controlled-release oxycodone and naloxone in the treatment of chronic low back pain: a placebo-controlled, randomized study. *Pain Res Manag*. 2013;18:75-82. [PMID: 23662289]
  35. Rauck RL, Nalamachu S, Wild JE, Walker GS, Robinson CY, Davis CS, et al. Single-entity hydrocodone extended-release capsules in opioid-tolerant subjects with moderate-to-severe chronic low back pain: a randomized double-blind, placebo-controlled study. *Pain Med*. 2014;15:975-85. [PMID: 24517082] doi:10.1111/pme.12377
  36. Wen W, Sitar S, Lynch SY, He E, Ripa SR. A multicenter, randomized, double-blind, placebo-controlled trial to assess the efficacy and safety of single-entity, once-daily hydrocodone tablets in patients with uncontrolled moderate to severe chronic low back pain. *Expert Opin Pharmacother*. 2015;16:1593-606. [PMID: 26111544] doi:10.1517/14656566.2015.1060221
  37. Steiner DJ, Sitar S, Wen W, Sawyerr G, Munera C, Ripa SR, et al. Efficacy and safety of the seven-day buprenorphine transdermal system in opioid-naïve patients with moderate to severe chronic low back pain: an enriched, randomized, double-blind, placebo-controlled study. *J Pain Symptom Manage*. 2011;42:903-17. [PMID: 21945130] doi:10.1016/j.jpainsymman.2011.04.006
  38. Gordon A, Callaghan D, Spink D, Cloutier C, Dzungowski P, O'Mahony W, et al. Buprenorphine transdermal system in adults with chronic low back pain: a randomized, double-blind, placebo-controlled crossover study, followed by an open-label extension phase. *Clin Ther*. 2010;32:844-60. [PMID: 20685494] doi:10.1016/j.clinthera.2010.04.018
  39. Miller K, Yarlas A, Wen W, Dain B, Lynch SY, Ripa SR, et al. The impact of buprenorphine transdermal delivery system on activities of daily living among patients with chronic low back pain: an application of the International Classification of Functioning, Disability and Health. *Clin J Pain*. 2014;30:1015-22. [PMID: 24394747] doi:10.1097/AJP.0000000000000068
  40. Yarlas A, Miller K, Wen W, Lynch SY, Munera C, Pergolizzi JV Jr, et al. Buprenorphine transdermal system compared with placebo reduces interference in functioning for chronic low back pain. *Postgrad Med*. 2015;127:38-45. [PMID: 25526229]
  41. Allan L, Richarz U, Simpson K, Slappendel R. Transdermal fentanyl versus sustained release oral morphine in strong-opioid naïve patients with chronic low back pain. *Spine (Phila Pa 1976)*. 2005;30:2484-90. [PMID: 16284584]
  42. Rauck RL, Bookbinder SA, Bunker TR, Alftine CD, Ghalie R, Negro-Vilar A, et al. The ACTION study: a randomized, open-label, multicenter trial comparing once-a-day extended-release morphine sulfate capsules (AVINZA) to twice-a-day controlled-release oxycodone hydrochloride tablets (OxyContin) for the treatment of chronic, moderate to severe low back pain. *J Opioid Manag*. 2006;2:155-66. [PMID: 17319449]
  43. Nicholson B, Ross E, Sasaki J, Weil A. Randomized trial comparing polymer-coated extended-release morphine sulfate to controlled-release oxycodone HCl in moderate to severe nonmalignant pain. *Curr Med Res Opin*. 2006;22:1503-14. [PMID: 16870075]
  44. Ueberall MA, Mueller-Schwefe GH. Safety and efficacy of oxycodone/naloxone vs. oxycodone vs. morphine for the treatment of chronic low back pain: results of a 12 week prospective, randomized, open-label blinded endpoint streamlined study with prolonged-release preparations. *Curr Med Res Opin*. 2015;31:1413-29. [PMID: 25942606] doi:10.1185/03007995.2015.1047747
  45. Jamison RN, Raymond SA, Slawsby EA, Nedeljkovic SS, Katz NP. Opioid therapy for chronic noncancer back pain. A randomized prospective study. *Spine (Phila Pa 1976)*. 1998;23:2591-600. [PMID: 9854758]
  46. Hale ME, Fleischmann R, Salzman R, Wild J, Iwan T, Swanton RE, et al. Efficacy and safety of controlled-release versus immediate-release oxycodone: randomized, double-blind evaluation in patients with chronic back pain. *Clin J Pain*. 1999;15:179-83. [PMID: 10524470]
  47. Salzman RT, Roberts MS, Wild J, Fabian C, Reder RF, Goldenheim PD. Can a controlled-release oral dose form of oxycodone be used as readily as an immediate-release form for the purpose of titrating to stable pain control? *J Pain Symptom Manage*. 1999;18:271-9. [PMID: 10534967]
  48. Hale ME, Speight KL, Harsanyi Z, Iwan T, Slagle NS, Lacouture PG, et al. Efficacy of 12 hourly controlled-release codeine compared with as required dosing of acetaminophen plus codeine in patients with chronic low back pain. *Pain Res Manag*. 1997;2:33-8.
  49. Gostick N, Allen J, Cranfield R, Currie J, Grillage M, Hildebrand P, et al. A comparison of the efficacy and adverse effects of controlled-release dihydrocodeine and immediate-release dihydrocodeine in the treatment of pain in osteoarthritis and chronic back pain. *Proceedings of The Edinburgh Symposium on Pain Control and Medical Education*. 1989:137-43.
  50. Beaulieu AD, Peloso P, Bensen W, Clark AJ, Watson CP, Gardner-Nix J, et al. A randomized, double-blind, 8-week crossover study of once-daily controlled-release tramadol versus immediate-release tramadol taken as needed for chronic noncancer pain. *Clin Ther*. 2007;29:49-60. [PMID: 17379046]
  51. Lee JH, Lee CS; Ultracet ER Study Group. A randomized, double-blind, placebo-controlled, parallel-group study to evaluate the efficacy and safety of the extended-release tramadol hydrochloride/acetaminophen fixed-dose combination tablet for the treatment of chronic low back pain. *Clin Ther*. 2013;35:1830-40. [PMID: 24183364] doi:10.1016/j.clinthera.2013.09.017
  52. Schiphorst Preuper HR, Geertzen JHB, van Wijhe M, Boonstra AM, Molmans BHW, Dijkstra PU, et al. Do analgesics improve functioning in patients with chronic low back pain? An explorative triple-blinded RCT. *Eur Spine J*. 2014;23:800-6.
  53. Casale R. Acute low back pain: symptomatic treatment with a muscle relaxing drug. *Clin J Pain*. 1988;4:81-8.
  54. Basmajian JV. Cyclobenzaprine hydrochloride effect on skeletal muscle spasm in the lumbar region and neck: two double-blind controlled clinical and laboratory studies. *Arch Phys Med Rehabil*. 1978;59:58-63. [PMID: 623512]
  55. Pratzel HG, Alken RG, Ramm S. Efficacy and tolerance of repeated oral doses of tolperisone hydrochloride in the treatment of painful reflex muscle spasm: results of a prospective placebo-controlled double-blind trial. *Pain*. 1996;67:417-25. [PMID: 8951937]
  56. Urquhart DM, Hoving JL, Assendelft WW, Roland M, van Tulder MW. Antidepressants for non-specific low back pain. *Cochrane Database Syst Rev*. 2008;CD001703. [PMID: 18253994] doi:10.1002/14651858.CD001703.pub3
  57. Skljarevski V, Ossanna M, Liu-Seifert H, Zhang Q, Chappell A, Iyengar S, et al. A double-blind, randomized trial of duloxetine versus placebo in the management of chronic low back pain. *Eur J Neurol*. 2009;16:1041-8. [PMID: 19469829] doi:10.1111/j.1468-1331.2009.02648.x
  58. Skljarevski V, Zhang S, Desai D, Alaka KJ, Palacios S, Mizogowski T, et al. Duloxetine versus placebo in patients with chronic low back pain: a 12-week, fixed-dose, randomized, double-blind trial. *J Pain*. 2010;11:1282-90. [PMID: 20472510] doi:10.1016/j.jpain.2010.03.002
  59. Skljarevski V, Desai D, Liu-Seifert H, Zhang Q, Chappell AS, Detke MJ, et al. Efficacy and safety of duloxetine in patients with chronic low back pain. *Spine (Phila Pa 1976)*. 2010;35:E578-85. [PMID: 20461028] doi:10.1097/BRS.0b013e3181d3cef6
  60. Brötz D, Maschke E, Burkard S, Engel C, Mänz C, Ernemann U, et al. Is there a role for benzodiazepines in the management of lum-

- bar disc prolapse with acute sciatica? *Pain*. 2010;149:470-5. [PMID: 20362397] doi:10.1016/j.pain.2010.02.015
61. Finckh A, Zufferey P, Schurch MA, Balagué F, Waldburger M, So AK. Short-term efficacy of intravenous pulse glucocorticoids in acute discogenic sciatica. A randomized controlled trial. *Spine (Phila Pa 1976)*. 2006;31:377-81. [PMID: 16481946]
62. Haimovic IC, Beresford HR. Dexamethasone is not superior to placebo for treating lumbosacral radicular pain. *Neurology*. 1986;36:1593-4. [PMID: 2946981]
63. Porsman O, Friis H. Prolapsed lumbar disc treated with intramuscularly administered dexamethasonophosphate. A prospectively planned, double-blind, controlled clinical trial in 52 patients. *Scand J Rheumatol*. 1979;8:142-4. [PMID: 386492]
64. Friedman BW, Esses D, Solorzano C, Choi HK, Cole M, Davitt M, et al. A randomized placebo-controlled trial of single-dose IM corticosteroid for radicular low back pain. *Spine (Phila Pa 1976)*. 2008;33:E624-9. [PMID: 18665021] doi:10.1097/BRS.0b013e3181822711
65. Holve RL, Barkan H. Oral steroids in initial treatment of acute sciatica. *J Am Board Fam Med*. 2008;21:469-74. [PMID: 18772303] doi:10.3122/jabfm.2008.05.070220
66. Goldberg H, Firtch W, Tyburski M, Pressman A, Ackerson L, Hamilton L, et al. Oral steroids for acute radiculopathy due to a herniated lumbar disk: a randomized clinical trial. *JAMA*. 2015;313:1915-23. [PMID: 25988461] doi:10.1001/jama.2015.4468
67. McCleane GJ. Does gabapentin have an analgesic effect on background, movement and referred pain? A randomised, double-blind, placebo controlled study. *The Pain Clinic*. 2001;13:103-7.
68. Yildirim K, Sişecioğlu M, Karatay S, Erdal A, Levent A, Uğur M, et al. The effectiveness of gabapentin in patients with chronic radiculopathy. *The Pain Clinic*. 2003;15:213-8.
69. Yaksi A, Ozgönel L, Ozgönel B. The efficiency of gabapentin therapy in patients with lumbar spinal stenosis. *Spine (Phila Pa 1976)*. 2007;32:939-42. [PMID: 17450066]
70. Khoromi S, Patsalides A, Parada S, Salehi V, Meegan JM, Max MB. Topiramate in chronic lumbar radicular pain. *J Pain*. 2005;6:829-36. [PMID: 16326371]
71. Muehlbacher M, Nickel MK, Kettler C, Tritt K, Lahmann C, Leiberich PK, et al. Topiramate in treatment of patients with chronic low back pain: a randomized, double-blind, placebo-controlled study. *Clin J Pain*. 2006;22:526-31. [PMID: 16788338]
72. Salerno SM, Browning R, Jackson JL. The effect of antidepressant treatment on chronic back pain: a meta-analysis. *Arch Intern Med*. 2002;162:19-24. [PMID: 11784215]
73. Hagen EM, Ødelien KH, Lie SA, Eriksen HR. Adding a physical exercise programme to brief intervention for low back pain patients did not increase return to work. *Scand J Public Health*. 2010;38:731-8. [PMID: 20817653] doi:10.1177/1403494810382472
74. Machado LA, Maher CG, Herbert RD, Clare H, McAuley JH. The effectiveness of the McKenzie method in addition to first-line care for acute low back pain: a randomized controlled trial. *BMC Med*. 2010;8:10. [PMID: 20102596] doi:10.1186/1741-7015-8-10
75. Pengel LH, Refshauge KM, Maher CG, Nicholas MK, Herbert RD, McNair P. Physiotherapist-directed exercise, advice, or both for subacute low back pain: a randomized trial. *Ann Intern Med*. 2007;146:787-96. [PMID: 17548410] doi:10.7326/0003-4819-146-11-200706050-00007
76. Lee JH, Choi TY, Lee MS, Lee H, Shin BC, Lee H. Acupuncture for acute low back pain: a systematic review. *Clin J Pain*. 2013;29:172-85. [PMID: 23269281] doi:10.1097/AJP.0b013e31824909f9
77. Hasegawa TM, Baptista AS, de Souza MC, Yoshizumi AM, Nattour J. Acupuncture for acute non-specific low back pain: a randomised, controlled, double-blind, placebo trial. *Acupunct Med*. 2014;32:109-15. [PMID: 24316509] doi:10.1136/acupmed-2013-010333
78. Vas J, Aranda JM, Modesto M, Benítez-Parejo N, Herrera A, Martínez-Barquín DM, et al. Acupuncture in patients with acute low back pain: a multicentre randomised controlled clinical trial. *Pain*. 2012;153:1883-9. [PMID: 22770838] doi:10.1016/j.pain.2012.05.033
79. Gao H, Wei C. Extrapoint acupuncture treatment of 36 cases of acute lumbar sprain [in Chinese]. *Journal of Gansu College of Traditional Chinese Medicine*. 2006;2006:49-50.
80. Jin M, Chen J. Acupuncture treatment for 40 cases of acute lumbar sprain [in Chinese]. *Journal of Gansu College of Traditional Chinese Medicine*. 2008;2006:49-50.
81. Lan J. Analysis of application of acupuncture analgesia in acute lumbar sprain [in Chinese]. *Journal of Community Medicine*. 2009;68-9.
82. Yao-chi W, Bi-meng Z, Chong-miao W, Jun-feng Z, Ping S, Liu GZ. [Observation on short-term and long-term therapeutic effects of electroacupuncture at Houxi (SI 3) on acute lumbar sprain]. *Zhongguo Zhen Jiu*. 2007;27:3-5. [PMID: 17378192]
83. Chen Y. Clinical observation of electroacupuncture at SI3 in addition to drug therapy in acute lumbar sprain [in Chinese]. *Journal of Community Medicine*. 2010:39.
84. Furlan AD, Imamura M, Dryden T, Irvin E. Massage for low-back pain. *Cochrane Database Syst Rev*. 2008;CD001929. [PMID: 18843627] doi:10.1002/14651858.CD001929.pub2
85. Farasyn A, Meeusen R, Nijs J. A pilot randomized placebo-controlled trial of roprotherapy in patients with subacute non-specific low back pain. *J Back Musculoskelet Rehabil*. 2006;19:111-7.
86. Yoon YS, Yu KP, Lee KJ, Kwak SH, Kim JY. Development and application of a newly designed massage instrument for deep cross-friction massage in chronic non-specific low back pain. *Ann Rehabil Med*. 2012;36:55-65. [PMID: 22506236] doi:10.5535/arm.2012.36.1.55
87. von Heymann WJ, Schloemer P, Timm J, Muehlbauer B. Spinal high-velocity low amplitude manipulation in acute nonspecific low back pain: a double-blinded randomized controlled trial in comparison with diclofenac and placebo. *Spine (Phila Pa 1976)*. 2013;38:540-8. [PMID: 23026869] doi:10.1097/BRS.0b013e318275d09c
88. Hoiriis KT, Pflieger B, McDuffie FC, Cotsonis G, Elsangak O, Hinson R, et al. A randomized clinical trial comparing chiropractic adjustments to muscle relaxants for subacute low back pain. *J Manipulative Physiol Ther*. 2004;27:388-98. [PMID: 15319761]
89. Rubinstein SM, Terwee CB, Assendelft WJ, de Boer MR, van Tulder MW. Spinal manipulative therapy for acute low-back pain. *Cochrane Database Syst Rev*. 2012;CD008880. [PMID: 22972127] doi:10.1002/14651858.CD008880.pub2
90. Schneider M, Haas M, Glick R, Stevans J, Landsittel D. Comparison of spinal manipulation methods and usual medical care for acute and subacute low back pain: a randomized clinical trial. *Spine (Phila Pa 1976)*. 2015;40:209-17. [PMID: 25423308] doi:10.1097/BRS.0000000000000724
91. French SD, Cameron M, Walker BF, Reggans JW, Esterman AJ. Superficial heat or cold for low back pain. *Cochrane Database Syst Rev*. 2006;CD004750. [PMID: 16437495]
92. Mayer JM, Ralph L, Look M, Erasala GN, Verna JL, Matheson LN, et al. Treating acute low back pain with continuous low-level heat wrap therapy and/or exercise: a randomized controlled trial. *Spine J*. 2005;5:395-403. [PMID: 15996609]
93. Nadler SF, Steiner DJ, Erasala GN, Hengehold DA, Hinkle RT, Beth Goodale M, et al. Continuous low-level heat wrap therapy provides more efficacy than ibuprofen and acetaminophen for acute low back pain. *Spine (Phila Pa 1976)*. 2002;27:1012-7. [PMID: 12004166]
94. Konstantinovic LM, Cutovic MR, Milovanovic AN, Jovic SJ, Dragin AS, Letic MDj, et al. Low-level laser therapy for acute neck pain with radiculopathy: a double-blind placebo-controlled randomized study. *Pain Med*. 2010;11:1169-78. [PMID: 20704667] doi:10.1111/j.1526-4637.2010.00907.x
95. Oleske DM, Lavender SA, Andersson GB, Kwasy MM. Are back supports plus education more effective than education alone in promoting recovery from low back pain?: Results from a randomized clinical trial. *Spine (Phila Pa 1976)*. 2007;32:2050-7. [PMID: 17762804]
96. van Middelkoop M, Rubinstein SM, Verhagen AP, Ostelo RW, Koes BW, van Tulder MW. Exercise therapy for chronic nonspecific low-back pain. *Best Pract Res Clin Rheumatol*. 2010;24:193-204. [PMID: 20227641] doi:10.1016/j.berh.2010.01.002

97. Byström MG, Rasmussen-Barr E, Grooten WJ. Motor control exercises reduces pain and disability in chronic and recurrent low back pain: a meta-analysis. *Spine (Phila Pa 1976)*. 2013;38:E350-8. [PMID: 23492976] doi:10.1097/BRS.0b013e31828435fb
98. Koumantakis GA, Watson PJ, Oldham JA. Trunk muscle stabilization training plus general exercise versus general exercise only: randomized controlled trial of patients with recurrent low back pain. *Phys Ther*. 2005;85:209-25. [PMID: 15733046]
99. Cairns MC, Foster NE, Wright C. Randomized controlled trial of specific spinal stabilization exercises and conventional physiotherapy for recurrent low back pain. *Spine (Phila Pa 1976)*. 2006;31:E670-81. [PMID: 16946640]
100. Wells C, Kolt GS, Marshall P, Hill B, Bialocerkowski A. The effectiveness of Pilates exercise in people with chronic low back pain: a systematic review. *PLoS One*. 2014;9:e100402. [PMID: 24984069] doi:10.1371/journal.pone.0100402
101. Gladwell V, Head S, Hagggar M, Beneke R. Does a program of Pilates improve chronic non-specific low back pain? *J Sport Rehabil*. 2006;15:338-50.
102. Borges J, Baptista AF, Santana N, Souza I, Kruschewsky RA, Galvão-Castro B, et al. Pilates exercises improve low back pain and quality of life in patients with HTLV-1 virus: a randomized crossover clinical trial. *J Bodyw Mov Ther*. 2014;18:68-74. [PMID: 24411152] doi:10.1016/j.jbmt.2013.05.010
103. da Fonseca JL, Magini M, de Freitas TH. Laboratory gait analysis in patients with low back pain before and after a Pilates intervention. *J Sport Rehabil*. 2009;18:269-82. [PMID: 19561369]
104. MacIntyre L. The Effect of Pilates on Patients' Chronic Low Back Pain: A Pilot Study [dissertation]. Johannesburg, South Africa: University of the Witwatersrand; 2006.
105. Miyamoto GC, Costa LO, Galvanin T, Cabral CM. Efficacy of the addition of modified Pilates exercises to a minimal intervention in patients with chronic low back pain: a randomized controlled trial. *Phys Ther*. 2013;93:310-20. [PMID: 23064732] doi:10.2522/ptj.20120190
106. Quinn K, Barry S, Barry L. Do patients with chronic low back pain benefit from attending Pilates classes after completing conventional physiotherapy treatment? *Physiother Pract Res*. 2011;32:5-12.
107. Rydeard R. Evaluation of a Targeted Exercise Rehabilitation Approach and Its Effectiveness in the Treatment of Pain, Functional Disability and Muscle Function in a Population with Longstanding Unresolved Low Back Pain [dissertation]. Kingston, ON, Canada: Queen's University; 2001.
108. Gagnon L. Efficacy of Pilates Exercises as Therapeutic Intervention in Treating Patients with Low Back Pain [dissertation]. Knoxville, TN: University of Tennessee; 2005.
109. Rajpal N, Arora M, Chauhan V. The study on efficacy of Pilates and McKenzie exercise in postural low back pain—a rehabilitative protocol. *Physiotherapy and Occupational Therapy Journal*. 2008;1:33-56.
110. Wajswelner H, Metcalf B, Bennell K. Clinical Pilates versus general exercise for chronic low back pain: randomized trial. *Med Sci Sports Exerc*. 2012;44:1197-205. [PMID: 22246216] doi:10.1249/MSS.0b013e318248f665
111. Hall AM, Maher CG, Lam P, Ferreira M, Latimer J. Tai chi exercise for treatment of pain and disability in people with persistent low back pain: a randomized controlled trial. *Arthritis Care Res (Hoboken)*. 2011;63:1576-83. [PMID: 22034119] doi:10.1002/acr.20594
112. Weifen W, Muheremu A, Chaohui C, Wenge L, Lei S. Effectiveness of tai chi practice for non-specific chronic low back pain on retired athletes: a randomized controlled study. *J Musculoskelet Pain*. 2013;21:37-45.
113. Williams K, Abildso C, Steinberg L, Doyle E, Epstein B, Smith D, et al. Evaluation of the effectiveness and efficacy of Iyengar yoga therapy on chronic low back pain. *Spine (Phila Pa 1976)*. 2009;34:2066-76. [PMID: 19701112] doi:10.1097/BRS.0b013e3181b315cc
114. Sherman KJ, Cherkin DC, Erro J, Miglioretti DL, Deyo RA. Comparing yoga, exercise, and a self-care book for chronic low back pain: a randomized, controlled trial. *Ann Intern Med*. 2005;143:849-56. [PMID: 16365466] doi:10.7326/0003-4819-143-12-200512200-00003
115. Sherman KJ, Cherkin DC, Wellman RD, Cook AJ, Hawkes RJ, Delaney K, et al. A randomized trial comparing yoga, stretching, and a self-care book for chronic low back pain. *Arch Intern Med*. 2011;171:2019-26. [PMID: 22025101] doi:10.1001/archinternmed.2011.524
116. Nambi GS, Inbasekaran D, Khuman R, Devi S, Shanmuganath, Jagannathan K. Changes in pain intensity and health related quality of life with Iyengar yoga in nonspecific chronic low back pain: a randomized controlled study. *Int J Yoga*. 2014;7:48-53. [PMID: 25035607] doi:10.4103/0973-6131.123481
117. Tekur P, Nagarathna R, Chametcha S, Hankey A, Nagendra HR. A comprehensive yoga programs improves pain, anxiety and depression in chronic low back pain patients more than exercise: an RCT. *Complement Ther Med*. 2012;20:107-18. [PMID: 22500659] doi:10.1016/j.ctim.2011.12.009
118. Aboagye E, Karlsson ML, Hagberg J, Jensen I. Cost-effectiveness of early interventions for non-specific low back pain: a randomized controlled study investigating medical yoga, exercise therapy and self-care advice. *J Rehabil Med*. 2015;47:167-73. [PMID: 25403347] doi:10.2340/16501977-1910
119. Cramer H, Lauche R, Haller H, Dobos G. A systematic review and meta-analysis of yoga for low back pain. *Clin J Pain*. 2013;29:450-60. [PMID: 23246998] doi:10.1097/AJP.0b013e31825e1492
120. Henschke N, Ostelo RW, van Tulder MW, Vlaeyen JW, Morley S, Assendelft WJ, et al. Behavioural treatment for chronic low-back pain. *Cochrane Database Syst Rev*. 2010:CD002014. [PMID: 20614428] doi:10.1002/14651858.CD002014.pub3
121. Cherkin DC, Sherman KJ, Balderson BH, Cook AJ, Anderson ML, Hawkes RJ, et al. Effect of mindfulness-based stress reduction vs cognitive behavioral therapy or usual care on back pain and functional limitations in adults with chronic low back pain: a randomized clinical trial. *JAMA*. 2016;315:1240-9. [PMID: 27002445] doi:10.1001/jama.2016.2323
122. Morone NE, Greco CM, Moore CG, Rollman BL, Lane B, Morrow LA, et al. A mind-body program for older adults with chronic low back pain: a randomized clinical trial. *JAMA Intern Med*. 2016;176:329-37. [PMID: 26903081] doi:10.1001/jamainternmed.2015.8033
123. Morone NE, Rollman BL, Moore CG, Li Q, Weiner DK. A mind-body program for older adults with chronic low back pain: results of a pilot study. *Pain Med*. 2009;10:1395-407. [PMID: 20021599] doi:10.1111/j.1526-4637.2009.00746.x
124. Kamper SJ, Apeldoorn AT, Chiarotto A, Smeets RJ, Ostelo RW, Guzman J, et al. Multidisciplinary biopsychosocial rehabilitation for chronic low back pain. *Cochrane Database Syst Rev*. 2014:CD000963. [PMID: 25180773] doi:10.1002/14651858.CD000963.pub3
125. Lam M, Galvin R, Curry P. Effectiveness of acupuncture for non-specific chronic low back pain: a systematic review and meta-analysis. *Spine (Phila Pa 1976)*. 2013;38:2124-38. [PMID: 24026151] doi:10.1097/01.brs.0000435025.65564.b7
126. Cho YJ, Song YK, Cha YY, Shin BC, Shin IH, Park HJ, et al. Acupuncture for chronic low back pain: a multicenter, randomized, patient-assessor blind, sham-controlled clinical trial. *Spine (Phila Pa 1976)*. 2013;38:549-57. [PMID: 23026870] doi:10.1097/BRS.0b013e318275e601
127. Haake M, Müller HH, Schade-Brittinger C, Basler HD, Schäfer H, Maier C, et al. German Acupuncture Trials (GERAC) for chronic low back pain: randomized, multicenter, blinded, parallel-group trial with 3 groups. *Arch Intern Med*. 2007;167:1892-8. [PMID: 17893311]
128. Leibing E, Leonhardt U, Köster G, Goerlitz A, Rosenfeldt JA, Hilgers R, et al. Acupuncture treatment of chronic low-back pain—a randomized, blinded, placebo-controlled trial with 9-month follow-up. *Pain*. 2002;96:189-96. [PMID: 11932074]
129. Sator-Katzenschlager SM, Scharbert G, Kozek-Langenecker SA, Szeles JC, Finster G, Schiesser AW, et al. The short- and long-term benefit in chronic low back pain through adjuvant electrical versus manual auricular acupuncture. *Anesth Analg*. 2004;98:1359-64. [PMID: 15105215]



130. Yeh CH, Suen LK, Shen J, Chien LC, Liang Z, Glick RM, et al. Changes in sleep with auricular point acupressure for chronic low back pain. *Behav Sleep Med*. 2016;14:279-94. [PMID: 26244591] doi:10.1080/15402002.2014.981820
131. Eghbali M, Safari R, Nazari F, Abdoli S. The effects of reflexology on chronic low back pain intensity in nurses employed in hospitals affiliated with Isfahan University of Medical Sciences. *Iran J Nurs Midwifery Res*. 2012;17:239-43. [PMID: 23833620]
132. Quinn F, Hughes CM, Baxter GD. Reflexology in the management of low back pain: a pilot randomised controlled trial. *Complement Ther Med*. 2008;16:3-8. [PMID: 18346622] doi:10.1016/j.ctim.2007.05.001
133. Poole H, Glenn S, Murphy P. A randomised controlled study of reflexology for the management of chronic low back pain. *Eur J Pain*. 2007;11:878-87. [PMID: 17459741]
134. Rubinstein SM, van Middelkoop M, Assendelft WJ, de Boer MR, van Tulder MW. Spinal manipulative therapy for chronic low-back pain. *Cochrane Database Syst Rev*. 2011;CD008112. [PMID: 21328304] doi:10.1002/14651858.CD008112.pub2
135. Senna MK, Machaly SA. Does maintained spinal manipulation therapy for chronic nonspecific low back pain result in better long-term outcome? *Spine (Phila Pa 1976)*. 2011;36:1427-37. [PMID: 21245790] doi:10.1097/BRS.0b013e3181f5dfe0
136. Postacchini F, Facchini M, Palieri P. Efficacy of various forms of conservative treatment in low back pain. A comparative study. *Neuro-orthopedics*. 1988;6:28-35.
137. Koes BW, Bouter LM, van Mameren H, Essers AH, Verstegen GM, Hofhuizen DM, et al. Randomised clinical trial of manipulative therapy and physiotherapy for persistent back and neck complaints: results of one year follow up. *BMJ*. 1992;304:601-5. [PMID: 1532760]
138. Gibson T, Grahame R, Harkness J, Woo P, Blagrove P, Hills R. Controlled comparison of short-wave diathermy treatment with osteopathic treatment in non-specific low back pain. *Lancet*. 1985;1:1258-61. [PMID: 2860453]
139. Pope MH, Phillips RB, Haugh LD, Hsieh CY, MacDonald L, Haldeman S. A prospective randomized three-week trial of spinal manipulation, transcutaneous muscle stimulation, massage and corset in the treatment of subacute low back pain. *Spine (Phila Pa 1976)*. 1994;19:2571-7. [PMID: 7855683]
140. Balthazard P, de Goumoens P, Rivier G, Demeulenaere P, Balabeni P, Dériaz O. Manual therapy followed by specific active exercises versus a placebo followed by specific active exercises on the improvement of functional disability in patients with chronic non specific low back pain: a randomized controlled trial. *BMC Musculoskelet Disord*. 2012;13:162. [PMID: 22925609] doi:10.1186/1471-2474-13-162
141. Bicalho E, Setti JA, Macagnan J, Cano JL, Manfria EF. Immediate effects of a high-velocity spine manipulation in paraspinal muscles activity of nonspecific chronic low-back pain subjects. *Man Ther*. 2010;15:469-75. [PMID: 20447857] doi:10.1016/j.math.2010.03.012
142. Haas M, Vavrek D, Peterson D, Polissar N, Neradilek MB. Dose-response and efficacy of spinal manipulation for care of chronic low back pain: a randomized controlled trial. *Spine J*. 2014;14:1106-16. [PMID: 24139233] doi:10.1016/j.spinee.2013.07.468
143. UK BEAM Trial Team. United Kingdom back pain exercise and manipulation (UK BEAM) randomised trial: effectiveness of physical treatments for back pain in primary care. *BMJ*. 2004;329:1377. [PMID: 15556955]
144. Hsieh CY, Adams AH, Tobis J, Hong CZ, Danielson C, Platt K, et al. Effectiveness of four conservative treatments for subacute low back pain: a randomized clinical trial. *Spine (Phila Pa 1976)*. 2002;27:1142-8. [PMID: 12045509]
145. Licciardone JC, Stoll ST, Fulda KG, Russo DP, Siu J, Winn W, et al. Osteopathic manipulative treatment for chronic low back pain: a randomized controlled trial. *Spine (Phila Pa 1976)*. 2003;28:1355-62. [PMID: 12838090]
146. Rasmussen J, Laetgaard J, Lindecrona AL, Qvistgaard E, Bliddal H. Manipulation does not add to the effect of extension exercises in chronic low-back pain (LBP). A randomized, controlled, double blind study. *Joint Bone Spine*. 2008;75:708-13. [PMID: 19028434] doi:10.1016/j.jbspin.2007.12.011
147. Evans DP, Burke MS, Lloyd KN, Roberts EE, Roberts GM. Lumbar spinal manipulation on trial. Part I—clinical assessment. *Rheumatol Rehabil*. 1978;17:46-53. [PMID: 153574]
148. Ebadi S, Henschke N, Nakhostin Ansari N, Fallah E, van Tulder MW. Therapeutic ultrasound for chronic low-back pain. *Cochrane Database Syst Rev*. 2014;CD009169. [PMID: 24627326] doi:10.1002/14651858.CD009169.pub2
149. Ebadi S, Ansari NN, Naghdi S, Jalaei S, Sadat M, Bagheri H, et al. The effect of continuous ultrasound on chronic non-specific low back pain: a single blind placebo-controlled randomized trial. *BMC Musculoskelet Disord*. 2012;13:192. [PMID: 23031570] doi:10.1186/1471-2474-13-192
150. Mohseni-Bandpei MA, Critchley J, Staunton T, Richardson B. A prospective randomised controlled trial of spinal manipulation and ultrasound in the treatment of chronic low back pain. *Physiotherapy*. 2006;92:34-42. doi:10.1016/j.physio.2005.05.005
151. Durmus D, Durmaz Y, Canturk F. Effects of therapeutic ultrasound and electrical stimulation program on pain, trunk muscle strength, disability, walking performance, quality of life, and depression in patients with low back pain: a randomized-controlled trial. *Rheumatol Int*. 2010;30:901-10. [PMID: 19644691] doi:10.1007/s00296-009-1072-7
152. Durmus D, Alayli G, Goktepe AS, Taskaynatan MA, Bilgici A, Kuru O. Is phonophoresis effective in the treatment of chronic low back pain? A single-blind randomized controlled trial. *Rheumatol Int*. 2013;33:1737-44. [PMID: 23283539] doi:10.1007/s00296-012-2634-7
153. van Middelkoop M, Rubinstein SM, Kuijpers T, Verhagen AP, Ostelo R, Koes BW, et al. A systematic review on the effectiveness of physical and rehabilitation interventions for chronic non-specific low back pain. *Eur Spine J*. 2011;20:19-39. [PMID: 20640863] doi:10.1007/s00586-010-1518-3
154. Manheimer E, White A, Berman B, Forys K, Ernst E. Meta-analysis: acupuncture for low back pain. *Ann Intern Med*. 2005;142:651-63. [PMID: 15838072] doi:10.7326/0003-4819-142-8-200504190-00014
155. Basford JR, Sheffield CG, Harmsen WS. Laser therapy: a randomized, controlled trial of the effects of low-intensity Nd:YAG laser irradiation on musculoskeletal back pain. *Arch Phys Med Rehabil*. 1999;80:647-52. [PMID: 10378490]
156. Soriano F, Rios R. Gallium arsenide laser treatment of chronic low back pain: a prospective, randomized and double blind study. *Laser Therapy*. 1998;10:175-80.
157. Toya S, Motegi M, Inomata K, Ohshiro T. Report on a computer-randomized double blind clinical trial to determine the effectiveness of the GaAlAs (830 nm) diode laser for pain attenuation in selected pain groups. *Laser Therapy*. 1994;6:143-8.
158. Dalichau S, Scheele K. [Effects of elastic lumbar belts on the effect of a muscle training program for patients with chronic back pain]. *Z Orthop Ihre Grenzgeb*. 2000;138:8-16. [PMID: 10730357]
159. Hsieh CY, Phillips RB, Adams AH, Pope MH. Functional outcomes of low back pain: comparison of four treatment groups in a randomized controlled trial. *J Manipulative Physiol Ther*. 1992;15:4-9. [PMID: 1531488]
160. Doran DM, Newell DJ. Manipulation in treatment of low back pain: a multicentre study. *Br Med J*. 1975;2:161-4. [PMID: 123815]
161. Coxhead CE, Inskip H, Meade TW, North WR, Troup JD. Multicentre trial of physiotherapy in the management of sciatic symptoms. *Lancet*. 1981;1:1065-8. [PMID: 6112444]
162. Castro-Sánchez AM, Lara-Palomo IC, Matarán-Peñarrocha GA, Fernández-Sánchez M, Sánchez-Labraca N, Arroyo-Morales M. Kinesio taping reduces disability and pain slightly in chronic non-specific low back pain: a randomized trial. *J Physiother*. 2012;58:89-95. [PMID: 22613238] doi:10.1016/S1836-9553(12)70088-7
163. Parreira Pdo C, Costa Lda C, Takahashi R, Hespagnol Junior LC, Luz Junior MA, Silva TM, et al. Kinesio taping to generate skin convolutions is not better than sham taping for people with chronic non-specific low back pain: a randomized trial. *J Physiother*. 2014;60:90-6. [PMID: 24952836] doi:10.1016/j.jphys.2014.05.003

164. Paoloni M, Bernetti A, Fratocchi G, Mangone M, Parrinello L, Del Pilar Cooper M, et al. Kinesio taping applied to lumbar muscles influences clinical and electromyographic characteristics in chronic low back pain patients. *Eur J Phys Rehabil Med*. 2011;47:237-44. [PMID: 21430611]
165. Kachanathu SJ, Alenazi AM, Seif HE, Hafez AR, Alroumim MA. Comparison between Kinesio taping and a traditional physical therapy program in treatment of nonspecific low back pain. *J Phys Ther Sci*. 2014;26:1185-8. [PMID: 25202177] doi:10.1589/jpts.26.1185
166. Albaladejo C, Kovacs FM, Royuela A, del Pino R, Zamora J; Spanish Back Pain Research Network. The efficacy of a short education program and a short physiotherapy program for treating low back pain in primary care: a cluster randomized trial. *Spine (Phila Pa 1976)*. 2010;35:483-96. [PMID: 20147875] doi:10.1097/BRS.0b013e3181b9c9a7
167. Albert HB, Manniche C. The efficacy of systematic active conservative treatment for patients with severe sciatica: a single-blind, randomized, clinical, controlled trial. *Spine (Phila Pa 1976)*. 2012;37:531-42. [PMID: 21494193] doi:10.1097/BRS.0b013e31821ace7f
168. Hofstee DJ, Gijtenbeek JM, Hoogland PH, van Houwelingen HC, Kloet A, Lötters F, et al. Westeinde sciatica trial: randomized controlled study of bed rest and physiotherapy for acute sciatica. *J Neurosurg*. 2002;96:45-9. [PMID: 11797655]
169. Wegner I, Widyahening IS, van Tulder MW, Blomberg SE, de Vet HC, Brønfort G, et al. Traction for low-back pain with or without sciatica. *Cochrane Database Syst Rev*. 2013;CD003010. [PMID: 23959683] doi:10.1002/14651858.CD003010.pub5
170. Calmels P, Queneau P, Hamonet C, Le Pen C, Maurel F, Lerouvreur C, et al. Effectiveness of a lumbar belt in subacute low back pain: an open, multicentric, and randomized clinical study. *Spine (Phila Pa 1976)*. 2009;34:215-20. [PMID: 19179915] doi:10.1097/BRS.0b013e31819577dc
171. Sato N, Sekiguchi M, Kikuchi S, Shishido H, Sato K, Konno S. Effects of long-term corset wearing on chronic low back pain. *Fuku-shima J Med Sci*. 2012;58:60-5. [PMID: 22790893]
172. Diab AA, Moustafa IM. Lumbar lordosis rehabilitation for pain and lumbar segmental motion in chronic mechanical low back pain: a randomized trial. *J Manipulative Physiol Ther*. 2012;35:246-53. [PMID: 22632584] doi:10.1016/j.jmpt.2012.04.021
173. Diab AA, Moustafa IM. The efficacy of lumbar extension traction for sagittal alignment in mechanical low back pain: a randomized trial. *J Back Musculoskelet Rehabil*. 2013;26:213-20. [PMID: 23640324] doi:10.3233/BMR-130372
174. Moustafa IM, Diab AA. Extension traction treatment for patients with discogenic lumbosacral radiculopathy: a randomized controlled trial. *Clin Rehabil*. 2013;27:51-62. [PMID: 22684211] doi:10.1177/0269215512446093
175. Hsieh LL, Kuo CH, Yen MF, Chen TH. A randomized controlled clinical trial for low back pain treated by acupressure and physical therapy. *Prev Med*. 2004;39:168-76. [PMID: 15207999]
176. Chatchawan U, Thinkhamrop B, Kharmwan S, Knowles J, Eungpinichpong W. Effectiveness of traditional Thai massage versus Swedish massage among patients with back pain associated with myofascial trigger points. *J Bodyw Mov Ther*. 2005;9:298-309.
177. Buchmuller A, Navez M, Millette-Bernardin M, Pouplin S, Presles E, Lantéri-Minet M, et al; Lombotens Trial Group. Value of TENS for relief of chronic low back pain with or without radicular pain. *Eur J Pain*. 2012;16:656-65. [PMID: 22337531] doi:10.1002/j.1532-2149.2011.00061.x
178. Nadler SF, Steiner DJ, Erasala GN, Hengehold DA, Abeln SB, Weingand KW. Continuous low-level heatwrap therapy for treating acute nonspecific low back pain. *Arch Phys Med Rehabil*. 2003;84:329-34. [PMID: 12638099]
179. Nadler SF, Steiner DJ, Petty SR, Erasala GN, Hengehold DA, Weingand KW. Overnight use of continuous low-level heatwrap therapy for relief of low back pain. *Arch Phys Med Rehabil*. 2003;84:335-42. [PMID: 12638100]
180. Hestbaek L, Leboeuf-Yde C, Manniche C. Low back pain: what is the long-term course? A review of studies of general patient populations. *Eur Spine J*. 2003;12:149-65. [PMID: 12709853]
181. Drug Enforcement Administration, Department of Justice. Schedule of controlled substances: placement of tramadol into schedule IV. Final rule. *Fed Regist*. 2014;79:37623-30. [PMID: 25016619]
182. Chou R, Deyo R, Devine B, Hansen R, Sullivan S, Jarvik JG, et al. The Effectiveness and Risks of Long-Term Opioid Treatment of Chronic Pain. Evidence Report/Technology Assessment no. 218. (Prepared by the Pacific Northwest Evidence-based Practice Center under contract no. 290-212-00014-I.) AHRQ publication no. 14-E005-EF. Rockville: Agency for Healthcare Research and Quality; 2014.

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## APPENDIX: DETAILED METHODS

The evidence review was conducted by the AHRQ's Pacific Northwest Evidence-based Practice Center. Details of the ACP guideline development process can be found in ACP's methods paper (12). Disclosures of interests and management of any conflicts can be found at [www.acponline.org/clinical\\_information/guidelines/guidelines/conflicts\\_cgc.htm](http://www.acponline.org/clinical_information/guidelines/guidelines/conflicts_cgc.htm).

### Key Questions Addressed

1. What are the comparative benefits and harms of different pharmacologic therapies for acute or chronic nonradicular low back pain, radicular low back pain, or spinal stenosis, including NSAIDs, acetaminophen, opioids, muscle relaxants, antiseizure medications, antidepressants, corticosteroids, and topical or patch-delivered medications?

2. What are the comparative benefits and harms of different nonpharmacologic, noninvasive therapies for acute or chronic nonradicular low back pain, radicular low back pain, or spinal stenosis, including but not limited to interdisciplinary rehabilitation, exercise (various types), physical modalities (ultrasound, TENS, electrical muscle stimulation, interferential therapy, heat [various forms], and ice), traction tables/devices, back supports/bracing, spinal manipulation, various psychological therapies, acupuncture, massage therapy (various types), yoga, magnets, and low-level lasers?

### Search Strategy

Reviewers searched MEDLINE, the Cochrane Central Register of Controlled Trials, and the Cochrane Database of Systematic Reviews for trials published from January 2008 through April 2015. Searches were updated through November 2016. Studies published before 2008 were identified using the 2007 ACP/APS systematic reviews (10, 11).

### Quality Assessment

Randomized trials were evaluated using methods developed by the Cochrane Back Review Group and the AHRQ (183), and systematic reviews were assessed using AMSTAR (A Measurement Tool to Assess Systematic Reviews) (184).

### Population Studied

Adults with acute, subacute, or chronic nonradicular low back pain, radicular low back pain, or symptomatic spinal stenosis.

### Interventions Evaluated

Oral or topical pharmacologic therapies included NSAIDs, acetaminophen, opioids, tramadol and tapentadol, antidepressants, SMRs, benzodiazepines, corticosteroids, antiepileptic medications, capsaicin, and lidocaine.

Noninvasive, nonpharmacologic therapies included interdisciplinary or multicomponent rehabilitation (physical therapy plus psychological therapy with some coordination), psychological therapies, exercise and related interventions (such as yoga or tai chi), complementary and alternative medicine therapies (spinal manipulation, acupuncture, and massage), passive physical modalities (such as heat, cold, ultrasound, TENS, electrical muscle stimulation, interferential therapy, short-wave diathermy, traction, LLLT, and lumbar supports/braces), and taping.

### Comparators

Interventions were compared with each other or with placebo (drug trials), sham (functionally inert) treatments, or no treatment.

### Outcomes

Outcomes included reduction or elimination of low back pain (including related leg symptoms), improvement in back-specific and overall function, improvement in health-related quality of life, reduction in work disability and return to work, global improvement, number of back pain episodes or time between episodes, patient satisfaction, and adverse effects of interventions.

### Timing

Timing of outcomes was stratified as long-term ( $\geq 1$  year) and short-term ( $\leq 6$  months).

### Setting

Settings included inpatient and outpatient.

**Target Audience**

The target audience includes all clinicians.

**Target Patient Population**

The target patient population includes adults with acute (<4 weeks), subacute (4 to 12 weeks), or chronic (>12 weeks) nonradicular low back pain, radicular low back pain, or symptomatic spinal stenosis. Children or adolescents with low back pain; pregnant women; and patients with low back pain from sources outside the back (nonspinal low back pain), fibromyalgia or other myofascial pain syndromes, and thoracic or cervical back pain are not included.

**Peer Review**

The AHRQ systematic review was sent to invited peer reviewers and posted on the AHRQ Web site for

public comments. The accompanying evidence reviews (7, 8) also underwent a peer review process through the journal. The guideline underwent a peer review process through the journal and was posted online for comments from ACP Regents and ACP Governors, who represent ACP members at the regional level.

**Web-Only References**

183. Agency for Healthcare Research and Quality. Methods Guide for Effectiveness and Comparative Effectiveness Reviews. AHRQ publication no. 10(13)-EHC063-EF. Rockville: Agency for Healthcare Research and Quality; 2014.

184. Shea BJ, Hamel C, Wells GA, Bouter LM, Kristjansson E, Grimshaw J, et al. AMSTAR is a reliable and valid measurement tool to assess the methodological quality of systematic reviews. *J Clin Epidemiol.* 2009;62:1013-20. [PMID: 19230606] doi:10.1016/j.jclinepi.2008.10.009

**Appendix Table 1.** Pharmacologic and Nonpharmacologic Treatments for Acute or Subacute Low Back Pain

Intervention	Outcome	Magnitude of Effect	Strength of Evidence (Studies)	Data
<b>Pharmacologic treatments vs. placebo (acute only)</b>				
Acetaminophen				
Pain	No effect	No effect	Low (1 RCT)	0 to 10 scale: Score differences, $\leq 0.20$ point
Function	No effect	No effect	Low (1 RCT)	RDQ: Score differences, $\leq 0.60$ point
NSAIDs				
Pain	Small (pain intensity)	Small (pain intensity)	Moderate (5 RCTs)	0 to 100 scale: WMD, $-8.39$ (95% CI, $-12.68$ to $-4.10$ ; chi-square, 3.47; $P > 0.10$ )
Function	No effect (pain relief)	No effect (pain relief)	Low (2 RCTs)	0 to 24 RDQ: Score differences, 2.4 to 2.9 points; $P < 0.001$
SMRs				
Pain	Small	Small	Moderate (5 RCTs)	0- to 10-point visual analogue scale 2 to 4 d: RR, 1.25 (CI, 1.12 to 1.41) 5 to 7 d: RR, 1.72 (CI, 1.32 to 2.22)
Systemic corticosteroids				
Pain	No effect	No effect	Low (2 RCTs)	No clear difference (single intramuscular injection or a 5-d course of systemic corticosteroids)
Function	No effect	No effect	Low (2 RCTs)	
<b>Nonpharmacologic treatments vs. sham, no treatment, or usual care (acute or subacute)</b>				
Exercise vs. usual care				
Pain	No effect	No effect	Low (6 RCTs)	0 to 100 scale Acute, intermediate-term: WMD, 0.59 (CI, $-11.51$ to 12.69) Subacute: WMD, 1.89 (CI, $-1.13$ to 4.91)
Function	No effect	No effect	Low (6 RCTs)	Acute, short-term: WMD, $-2.82$ (CI, $-15.35$ to 9.71) Acute, intermediate-term: WMD, 2.47 (CI, $-0.26$ to 5.21) Subacute: WMD, 1.07 (CI, $-3.18$ to 5.32)
Acupuncture vs. sham acupuncture				
Pain	Small	Small	Low (2 RCTs)	0 to 100 scale MD, 9.38 (CI, 1.76 to 17.0; $I^2 = 27\%$ ) 3 other trials reported effects consistent with these findings
Function	No effect	No effect	Low (5 RCTs)	No clear effect
Massage vs. sham massage				
Pain	1 wk: Moderate 5 wk: No effect	1 wk: Moderate 5 wk: No effect	Low (2 RCTs)	1 wk: SMD, $-0.92$ (CI, $-1.35$ to $-0.48$ ) There was no significant difference in pain at 5 wk in 1 trial
Function	1 wk: Moderate 5 wk: No effect	1 wk: Moderate 5 wk: No effect	Low (2 RCTs)	1 wk: SMD, $-1.76$ (CI, $-3.19$ to $-0.32$ ) There was no significant difference in function at 5 wk in 1 trial
Spinal manipulation vs. inert treatment				
Pain	No effect	No effect	Low (3 RCTs)	0 to 10 scale at 1 wk: WMD, 0.14 (CI, $-0.69$ to 0.96; $I^2 = 27\%$ ), although 1 trial found spinal manipulation to be associated with better pain relief at 3 mo: MD, $-1.20$ (CI, 2.11 to $-0.29$ )
Function	No effect	No effect	Low (2 RCTs)	1 wk: SMD, $-0.08$ (CI, $-0.37$ to 0.21; $I^2 = 0\%$ ) 3 mo: SMD, $-0.28$ (CI, $-0.59$ to 0.02)
Spinal manipulation vs. sham treatment				
Function	Small	Small	Low (2 RCTs)	Statistically significant in 1 trial
Heat wrap vs. placebo				
Pain	Moderate	Moderate	Moderate (4 RCTs)	0 to 5 scale, 5 d: MD, 1.06 (CI, 0.68 to 1.45)
Function	Moderate	Moderate	Moderate (2 RCTs)	0 to 100 scale, 3 to 4 d: score differences, 16 to 20 points RDQ, 4 d: MD, $-2.10$ (CI, $-3.19$ to $-1.01$ )

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Appendix Table 1—Continued

Intervention	Outcome	Magnitude of Effect	Strength of Evidence (Studies)	Data
<b>Comparative benefits of pharmacologic and nonpharmacologic treatments</b>				
NSAID vs. NSAID				
Pain		No difference	Moderate (21 RCTs)	No reported differences in 15 of 21 trials
Acetaminophen vs. NSAID				
Pain		No difference	Low (4 RCTs)	Pooled SMD, 0.21 (CI, -0.02 to 0.43)
Function		No difference	Low (4 RCTs)	RR, 0.81 (CI, 0.58 to 1.14)
COX-2-selective NSAID vs. traditional NSAID				
Pain		No difference	Low (3 RCTs)	No clear differences
SMR vs. another SMR				
Pain		No difference	Low (2 RCTs)	No differences for carisoprodol vs. cyclobenzaprine or tizanidine vs. chlorzoxazone
Function		No difference	Low (2 RCTs)	
Exercise vs. exercise				
Pain		No difference	Moderate (>20 RCTs)	No clear differences in >20 head-to-head trials of patients
Function		No difference	Moderate (>20 RCTs)	
Lumbar support vs. other active treatments				
Pain		No difference	Low (3 RCTs)	3 trials found no clear differences between lumbar supports vs. other active treatments in pain or function
Function		No difference	Low (3 RCTs)	
Acupuncture vs. NSAIDs				
Overall improvement		Small	Low (5 RCTs)	RR, 1.11 (CI, 1.06 to 1.16; $I^2 = 0\%$ )
Spinal manipulation vs. other active treatments (exercise, physical therapy, or back school)				
Pain		No difference	Moderate (3 RCTs)	0 to 10 scale 1 wk: WMD (CI, -0.53 to 0.65; $I^2 = 0\%$ ) 1 mo: WMD, -0.15 (CI, -0.49 to 0.18; $I^2 = 0\%$ ) 3 to 6 mo: WMD, -0.20 (CI, -1.13 to 0.73; $I^2 = 81\%$ ) 1 y: mean difference, 0.40 (CI, -0.08 to 0.88) Findings were similar for function, with no differences observed at any time point
Function		No difference	Moderate (3 RCTs)	
Heat vs. simple analgesics				
Pain		Small	Low (1 RCT)	0 to 10 scale 1 to 2 d, acetaminophen: MD, 0.90 (CI, 0.50 to 1.30) 1 to 2 d, ibuprofen: MD, 0.65 (CI, 0.25 to 1.05)
Function		Small	Low (1 RCT)	RDQ 1 to 2 d, acetaminophen: MD, 2.00 (CI, 0.86 to 3.14) 1 to 2 d, ibuprofen: MD, 2.20 (CI, 1.11 to 3.29)
Heat vs. exercise				
Pain		No difference	Low (1 RCT)	0 to 10 scale Days 1 to 2: MD, 0.40 (CI, -0.15 to 0.95) Day 7: MD, 0.30 (CI, -0.68 to 1.28)
Function		No difference	Low (1 RCT)	RDQ Day 4: MD, -0.70 (CI, -2.09 to 0.69) Day 7: MD, -0.90 (CI, -2.84 to 1.04)

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Appendix Table 1—Continued

Intervention	Outcome	Magnitude of Effect	Strength of Evidence (Studies)	Data
<b>Combination therapy treatments vs. monotherapy treatments or no treatment (acute or subacute)</b> SMR + NSAID vs. NSAID alone Pain		Inconsistent benefit	Low (3 RCTs)	Estimate from 3 trials favored combination therapy: RR, 1.56 (CI, 0.92 to 2.70; $I^2 = 84\%$ ), but another trial found no effect
Massage vs. other treatments (manipulation, exercise therapy, relaxation therapy, acupuncture, or physiotherapy) vs. other treatment alone (subacute to chronic)				
Pain		Small	Moderate (9 RCTs)	0 to 10 scale, short-term: Better effects in 7 of 9 trials (MDs, -0.6 to -0.94 points)
Function		Small	Moderate (4 RCTs)	Short-term: Better effects on short-term function in 3 of 4 trials
Massage plus another active treatment (exercise, exercise and education, or usual care) vs. the other treatment alone (subacute to chronic)				
Pain		Improved	Low (5 RCTs)	Short-term: Superior to other intervention without massage; effects stronger when massage combined with exercise
Function		Improved	Low (5 RCTs)	Long-term: Few differences
Spinal manipulation plus exercise or advice vs. exercise or advice alone				
Function		1 wk: Small 1 or 3 mo: No difference	Low (4 RCTs)	1 wk: SMD, -0.41 (CI, -0.73 to -0.10; $I^2 = 18\%$ ) 1 mo: SMD, -0.09 (CI, -0.39 to 0.21; $I^2 = 37\%$ ) 3 mo: SMD, -0.22 (CI, -0.61 to 0.16; $I^2 = 41\%$ )
Heat plus exercise vs. exercise alone				
Pain		Small	Low (1 RCT)	0 to 10 scale: MD, 1.40 (CI, 0.69 to 2.11)
Function		Small	Low (1 RCT)	RDQ at 7 d: MD, -3.20 (CI, -5.42 to 0)
LLLT + NSAID vs. sham + NSAID				
Pain		Large	Low (1 RCT)	0 to 100 scale at 3 wk: Mean change, -30.0 vs. -15.7 vs. -20.8
Function		Moderate	Low (1 RCT)	ODI at 3 wk: Mean change, -12.0 vs. -6.5 vs. -10.0
Lumbar support plus education vs. education				
Pain		No difference	Low (1 RCT)	No reported differences after 1 y
Function		No difference	Low (1 RCT)	

COX-2 = cyclooxygenase-2; LLLT = low-level laser therapy; MD = mean difference; NSAID = nonsteroidal anti-inflammatory drug; ODI = Oswestry Disability Index; RCT = randomized, controlled trial; RDQ = Roland Morris Disability Questionnaire; RR = relative risk; SMD = standardized mean difference; SMR = skeletal muscle relaxant; WMD = weighted mean difference.

**Appendix Table 2. Pharmacologic and Nonpharmacologic Treatments for Chronic Low Back Pain**

Intervention	Outcome	Magnitude of Effect	Strength of Evidence (Studies)	Data
<b>Pharmacologic treatments vs. placebo</b>				
NSAIDs				
Pain		Small to moderate	Moderate (6 RCTs)	0 to 100 scale, 12 wk: WMD, -12.40 (95% CI, -15.53 to -9.26; chi-square, 1.82; $P > 0.5$ ) 0 to 10 scale, 12 to 16 wk: Score changes, 0.41 to 0.59 ≥30% pain relief: 56.8% vs. 31.7% and 37% vs. 27% RDC: MDs, ~0.02 to 2.00 points
Function		Small to no effect	Low (4 RCTs)	
Strong opioids				
Pain		Small	Moderate (10 RCTs)	0 to 10 scale: SMD, -0.43 (CI, -0.52 to -0.33; $I^2 = 0\%$ ; MD, ~1 point)
Function		Small	Moderate (8 RCTs)	RDC: SMD, -0.26 (CI, -0.37 to -0.15; $I^2 = 0\%$ ; MD, ~1 point)
Tramadol				
Pain		Moderate	Moderate (7 RCTs)	0 to 10 scale: SMD, -0.55 (CI, -0.66 to -0.44; $I^2 = 86\%$ ; MD, ≤1 point)
Function		Small	Moderate (7 RCTs)	RDC: SMD, -0.18 (CI, -0.29 to -0.07; $I^2 = 0\%$ ; MD, ~1 point)
Opioids: buprenorphine patch or sublingual (subacute or chronic)				
Pain		Small	Low (3 RCTs)	0 to 10 scale: Score difference, ~1 point
Tetrazepam				
Pain		Lower likelihood of failure to improve	Low (2 RCTs)	5 to 7 d: RR, 0.82 (CI, 0.72 to 0.94)
Overall improvement		Lower likelihood of failure to improve	Low (2 RCTs)	10 to 14 d: RR, 0.71 (CI, 0.54 to 0.93)
TCAs				
Pain		No effect	Moderate (4 RCTs)	SMD, -0.10 (CI, -0.51 to 0.31; $I^2 = 32\%$ )
Antidepressants				
Function		No effect	Low (2 RCTs)	SMD, -0.06 (CI, -0.40 to 0.29; $I^2 = 0\%$ )
SSRI				
Pain		No effect	Moderate (3 RCTs)	SMD, 0.11 (CI, -0.17 to 0.39; $I^2 = 0\%$ )
Duloxetine				
Pain		Small	Moderate (3 RCTs)	0 to 10 scale: Mean between-group difference, 0.58 to 0.74
Function		Small	Moderate (3 RCTs)	RDC: Mean change from baseline, -2.69 vs. -2.22; $P = 0.26$
<b>Nonpharmacologic treatments vs. sham, no treatment, or usual care</b>				
Exercise vs. no exercise				
Pain		Small	Moderate (19 RCTs)	0 to 100 scale: WMD, 10.0 (CI, 1.31 to 19.09)
Function		Small	Moderate (18 RCTs)	0 to 100 scale: Not statistically significant; WMD, 3.0 (CI, -0.53 to 6.48)
Exercise vs. usual care				
Pain		Small	Moderate (3 RCTs)	0 to 100 scale Treatment end: WMD, -9.23 (CI, -16.02 to -2.43) Long-term: MD, -4.94 (CI, -10.45 to 0.58)
Function		Small	Moderate (18 RCTs)	0 to 100 scale Treatment end: WMD, -12.35 (CI, -23.0 to -1.69) Long-term: MD, -3.17 (CI, -5.96 to -0.38)
MCE vs. minimal intervention				
Pain		Moderate	Low (2 RCTs)	0 to 100 scale Short-term: WMD, -12.48 (CI, -19.04 to -5.93) Intermediate-term: WMD, -10.18 (CI, -16.64 to -3.72) Long-term: WMD, -13.32 (CI, -19.75 to -6.90)
Function		Small	Low (3 RCTs)	0 to 100 scale Short-term: WMD, -9.00 (CI, -15.28 to -2.73) Intermediate-term: WMD, -5.62 (CI, -10.46 to -0.77) Long-term: WMD, -6.64 (CI, -11.72 to -1.57)
Tai chi vs. wait list or no tai chi				
Pain		Moderate	Low (2 RCTs)	0 to 10 scale: MDs, 0.9 and 1.3
Function		Small	Low (1 RCT)	RDC: MD, 2.6 (CI, 1.1 to 3.7)

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Appendix Table 2—Continued

Intervention	Outcome	Magnitude of Effect	Strength of Evidence (Studies)	Data
Yoga vs. usual care				
Pain		Moderate	Low (1 RCT)	0 to 100 VAS, 24 wk: Mean scores, 24 vs. 37 ( $P < 0.0001$ )
Function		Moderate	Low (1 RCT)	0 to 100 ODI, 24 wk: Mean scores, 18 vs. 21 ( $P < 0.01$ )
Yoga vs. education				
Pain		Short-term: Small Long-term: No difference	Low (5 RCTs)	Short-term: SMD, $-0.45$ (CI, $-0.63$ to $-0.26$ ; $I^2 = 0\%$ ) Long-term: Not statistically significant; SMD, $-0.28$ (CI, $-0.58$ to $-0.02$ ; $I^2 = 47\%$ )
Function		Small	Low (5 RCTs)	Short-term: SMD, $0.45$ (CI, $-0.65$ to $-0.25$ ; $I^2 = 8\%$ ) Long-term: SMD, $0.39$ (CI, $-0.66$ to $-0.11$ ; $I^2 = 40\%$ )
Mindfulness-based stress reduction vs. usual care				
Pain		Improved	Moderate (3 RCTs)	0 to 10 scale, 26 wk: Score difference, $-0.64$ $\geq 30\%$ improvement: RR, $1.64$ (CI, $1.15$ to $2.34$ )
Function		Improved	Moderate (3 RCTs)	RDO, 26 wk: score difference, $-1.37$ $\geq 30\%$ improvement: RR, $1.37$ (CI, $1.06$ to $1.77$ )
Progressive relaxation vs. wait-list control				
Pain		Moderate	Low (3 RCTs)	0 to 100 VAS: MD, $-19.77$ (CI, $-34.0$ to $-5.20$ ; $I^2 = 57\%$ )
Function		Moderate	Low (3 RCTs)	SMD, $-0.88$ (CI, $-1.36$ to $-0.39$ ; $I^2 = 0\%$ )
Electromyography biofeedback vs. wait-list control or placebo				
Pain		Moderate	Low (3 RCTs)	SMD, $-0.80$ (CI, $-1.32$ to $-0.28$ ; $I^2 = 0\%$ )
Function		No effect	Low (3 RCTs)	No clear effect
Operant therapy vs. wait-list control				
Pain		Small	Low (3 RCTs)	0 to 100 VAS or 0 to 78 McGill: SMD, $-0.43$ (CI, $-0.75$ to $-0.11$ ; $I^2 = 0\%$ )
Function		No effect	Low (2 RCTs)	0 to 100 Sickness Impact Profile: MD, $-1.18$ (CI, $-3.53$ to $1.18$ )
CBT vs. wait-list control				
Pain		Moderate	Low (5 RCTs)	0 to 100 VAS or 0 to 78 McGill: SMD, $-0.60$ (CI, $-0.97$ to $-0.22$ ; $I^2 = 40\%$ )
Function		No effect	Low (4 RCTs)	Sickness Impact Profile: Not statistically significant; SMD, $-0.37$ (CI, $-0.87$ to $0.13$ ; $I^2 = 50\%$ )
Multidisciplinary rehabilitation vs. usual care				
Pain		Short-term: Moderate Long-term: Small	Moderate (9 RCTs)	0 to 10 scale <3 mo: SMD, $-0.55$ (CI, $-0.83$ to $-0.28$ ) or $\sim 1.4$ -point MD Long-term: SMD, $-0.21$ (CI, $-0.37$ to $-0.04$ ) or $\sim 0.5$ -point MD
Disability		Small	Moderate (9 RCTs)	RDO <3 mo: SMD, $-0.41$ (CI, $-0.62$ to $-0.19$ ) or $\sim 2.5$ -point MD Long-term: SMD, $-0.23$ (CI, $-0.40$ to $-0.06$ ) or $\sim 1.4$ -point MD
Return to work		No effect	Moderate (7 RCTs)	Short-term: OR, $1.07$ (CI, $0.60$ to $1.90$ ) Long-term: OR, $1.04$ (CI, $0.73$ to $1.47$ )
Multidisciplinary rehabilitation vs. no multidisciplinary rehabilitation				
Pain		Moderate	Low (3 RCTs)	0 to 10 scale: SMD, $-0.73$ (CI, $-1.22$ to $-0.24$ ; $I^2 = 64\%$ ) or $\sim 1.7$ -point MD
Disability		Small	Low (3 RCTs)	RDC: Pooled SMD, $-0.49$ (CI, $-0.76$ to $-0.22$ ; $I^2 = 0\%$ ) or $\sim 2.9$ -point MD
Acupuncture vs. sham acupuncture				
Pain		Moderate	Low (9 RCTs)	Immediately at the end of treatment: WMD, $-16.76$ (CI, $-33.3$ to $-0.19$ ; $I^2 = 90\%$ ) 12 wk: WMD, $-9.55$ (CI, $-16.5$ to $-2.58$ ; $I^2 = 40\%$ )
Function		No effect	Low (9 RCTs)	No reported differences
Acupuncture vs. no acupuncture				
Pain		Moderate	Moderate (4 RCTs)	Immediately: SMD, $-0.72$ (CI, $-0.94$ to $-0.49$ ; $I^2 = 51\%$ )
Function		Moderate	Moderate (3 RCTs)	Immediately: SMD, $-0.94$ (CI, $-1.41$ to $-0.47$ ; $I^2 = 78\%$ )

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Appendix Table 2—Continued

Intervention	Outcome	Magnitude of Effect	Strength of Evidence (Studies)	Data
Massage vs. usual care Pain		No effect	Low (1 RCT)	1 trial found no difference between foot reflexology vs. usual care in pain or function, and 1 trial found structural or relaxation massage to be associated with better function (mean, 2.5 to 2.9 points on the RDQ) vs. usual care at 10 wk; effects were less pronounced at 52 wk
Spinal manipulation vs. sham treatment Pain		No effect	Low (4 RCTs)	0 to 100 scale, 1 mo: WMD, -3.24 (CI, -13.62 to 7.15)
Spinal manipulation vs. inert treatment Pain		Small	Low (7 RCTs)	0 to 10 scale: MD, 0.9 (CI, 0.1 to 1.7)
Ultrasound vs. sham ultrasound Pain		No effect	Low (5 RCTs)	0 to 100 scale Immediately: MD, -7.12 (CI, -18.0 to 3.75; $I^2 = 77%$ ) 4 wk: No reported differences in 2 trials
Ultrasound vs. no ultrasound Pain		No effect	Low (5 RCTs)	0 to 100 scale: MD, -2.16 (CI, -4.66 to 0.34; $I^2 = 0%$ )
Function		No effect	Low (5 RCTs)	0 to 100 scale: MD, -0.41 (CI, -3.14 to 2.32)
TENS vs. sham treatment Pain		No effect	Low (4 RCTs)	0 to 100 scale: WMD, -4.47 (CI, -12.84 to 3.89)
Disability		No effect	Low (2 RCTs)	0 to 100 scale: WMD, -1.36 (CI, -4.38 to 1.66)
LLLT vs. sham laser Pain		Small	Low (3 RCTs)	3 of 4 trials showed improvement
Function		Small	Low (1 RCT)	1 trial showed improvement
Kinesio taping vs. sham taping Function		No effect	Low (2 RCTs)	No effect on back-specific function at 5 or 12 wk
<b>Comparative benefits of pharmacologic and nonpharmacologic treatments</b>				
NSAID vs. NSAID Pain		No difference	Moderate (6 RCTs)	No reported differences in 6 of 6 trials
Long-acting opioids vs. long-acting opioids Pain		No difference	Moderate (4 RCTs)	No clear differences (oral morphine vs. transdermal fentanyl or oxycodone vs. oxycodone or morphine vs. oxycodone)
Function		No difference	Moderate (4 RCTs)	
Long-acting opioids vs. short-acting opioids* Pain		No difference	Low (6 RCTs)	No clear differences
SMR vs. another SMR Pain		No difference	Low (2 RCTs)	No reported differences (pridinolol vs. thiocolchicoside)
Diazepam vs. cyclobenzaprine Muscle spasms		No difference	Low (2 RCTs)	No clear difference
MCE vs. general exercise Pain		Small	Low (6 RCTs)	0 to 100 scale Short-term: WMD, -7.80 (CI, -10.95 to -4.65) Intermediate-term: WMD, -6.06 (CI, -10.94 to -1.18) Long-term: Not statistically significant; WMD, -3.10 (CI, -7.03 to 0.83)
Function		Small	Low (6 RCTs)	0 to 100 scale Short-term: WMD, -4.65 (CI, -6.20 to -3.11) Long-term: WMD, -4.72 (CI, -8.81 to -0.63)
MCE vs. multimodal physical therapy Pain		Moderate	Low (4 RCTs)	0 to 100 scale, intermediate-term: WMD, -14.20 (CI, -21.23 to -7.16)
Function		Moderate	Low (2 RCTs)	0 to 100 scale, intermediate-term: WMD, -12.98 (CI, -19.49 to -6.47)

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**Appendix Table 2—Continued**

<b>Intervention</b>	<b>Outcome</b>	<b>Magnitude of Effect</b>	<b>Strength of Evidence (Studies)</b>	<b>Data</b>
Exercise vs. exercise Pain		No difference	Moderate (>20 RCTs)	No clear differences in >20 head-to-head trials of patients
Function		No difference	Moderate (>20 RCTs)	
Pilates vs. usual care + physical activity		Small to no effect	Low (7 RCTs)	Small (MD, -1.6 to -4.1 points) to no effect on pain
Pain		No effect	Low (7 RCTs)	No clear effects
Pilates vs. other exercise		No difference	Low (3 RCTs)	No clear differences
Pain		No difference	Low (3 RCTs)	
Function		Moderate	Low (1 RCT)	Backward walking or jogging through 6 mo: MDs, -0.7 and -0.8 Swimming: No reported differences (MD, -0.1 at 3 and 6 mo)
Tai chi vs. other exercise				
Pain				
Yoga vs. exercise		Small	Low (5 RCTs)	Lower pain intensity vs. exercise in most trials, although effects were small and differences were not always statistically significant
Pain		No difference	Low (6 RCTs)	No clear differences
Psychological therapies vs. exercise or physical therapy		No difference	Moderate (10 RCTs)	No clear differences
Pain		No difference	Moderate (10 RCTs)	
Function		Short-term: Small Long-term: Moderate	Moderate (13 RCTs)	0 to 10 NRS Short-term: SMD, -0.30 (CI, -0.54 to -0.06) or ~0.6-point MD Long-term: SMD, -0.51 (CI, -1.04 to 0.01) or ~1.2-point MD
Multidisciplinary rehabilitation vs. physical therapy		Short-term: Small Long-term: Moderate	Moderate (13 RCTs)	0 to 10 NRS, short-term: SMD, -0.39 (CI, -0.68 to -0.10) or ~1.2 point MD RDC, long-term function: SMD, -0.68 (CI, -1.19 to -0.16) or ~4.0-point MD Greater likelihood of return to work: OR, 1.87 (CI, 1.39 to 2.53)
Function				
Acupuncture vs. medications (NSAIDs, muscle relaxants, and analgesics)		Small	Low (3 RCTs)	0 to 100 scale, immediately: WMD, -10.56 (CI, -20.34 to -0.78)
Pain		Small	Low (3 RCTs)	0 to 100 scale, immediately: SMD, -0.36 (CI, -0.67 to -0.04)
Function		No difference	Moderate (6 RCTs)	0 to 100 scale Short-term: WMD, -2.76 (CI, -5.19 to -0.32; $I^2 = 27%$ ) 6 mo: WMD, -3.07 (CI, -5.42 to -0.71; $I^2 = 0%$ ) 12 mo: WMD, -0.76 (CI, -3.19 to 1.66; $I^2 = 0%$ )
Spinal manipulation vs. other treatments (exercise, usual care, medications, or massage)		No difference	Moderate (6 RCTs)	1 mo: SMD, -0.17 (CI, -0.29 to -0.06) 6 mo: SMD, -0.12 (CI, -0.23 to 0.00) 12 mo: SMD, -0.06 (CI, -0.16 to 0.05)
Pain		No difference	Low (4 RCTs)	Short-term: SMD, 0.15 (CI, -0.33 to 0.63) Long-term: SMD, 0.32 (CI, -0.33 to 0.96)
Function		No difference	Low (4 RCTs)	No clear differences
Lumbar supports vs. other active treatments (traction, spinal manipulation, exercise, physiotherapy, or TENS)		No difference	Low (4 RCTs)	
Pain		No difference	Low (4 RCTs)	
Function		No difference	Low (4 RCTs)	

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Appendix Table 2—Continued

Intervention	Outcome	Magnitude of Effect	Strength of Evidence (Studies)	Data
Kinesio taping vs. exercise therapy				
Pain		No difference	Low (2 RCTs)	No clear differences
Function		No difference	Low (2 RCTs)	
<b>Combination therapy treatments vs. monotherapy treatments or no treatment</b>				
MCE plus exercise vs. exercise alone				
Pain		No difference	Low (2 RCTs)	No clear differences
Psychological therapy + exercise or physiotherapy vs. exercise or physiotherapy alone				
Pain		No difference	Low (6 RCTs)	No clear differences
Function		No difference	Low (6 RCTs)	
Spinal manipulation plus another active treatment vs. the other treatment alone				
Pain		Small	Low (3 RCTs)	0 to 100 scale 1 mo: WMD, -5.88 (CI, -10.85 to -0.90) 3 mo: MD, -7.23 (CI, -11.72 to -2.74) 12 mo: MD, -3.31 (CI, -6.60 to -0.02)
Function		Improved	Low (3 RCTs)	0 to 100 scale 1 mo: SMD, -0.40 (CI, -0.73 to -0.07) 3 mo: SMD, -0.22 (CI, -0.38 to -0.06) 12 mo: SMD, -0.21 (CI, -0.34 to -0.09)
Lumbar support plus exercise vs. exercise alone (muscle strengthening)				
Pain		No difference	Low (1 RCT)	No difference in short-term (8 wk) or long-term (6 mo)
Function		No difference	Low (1 RCT)	

CBT = cognitive behavioral therapy; LLLT = low-level laser therapy; MCE = motor control exercise; MD = mean difference; NSAID = nonsteroidal anti-inflammatory drug; NRS = numerical rating scale; ODI = Oswestry Disability Index; OR = odds ratio; RCT = randomized, controlled trial; RDQ = Roland Morris Disability Questionnaire; RR = relative risk; SMD = standardized mean difference; SMR = skeletal muscle relaxant; SSRI = selective serotonin reuptake inhibitor; TCA = tricyclic antidepressant; TENS = transcutaneous electrical nerve stimulation; VAS = visual analogue scale; WMD = weighted mean difference.

\* Although some RCTs found that long-acting opioids were associated with greater pain relief, patients randomly assigned to long-acting opioids also received higher doses.

**Appendix Table 3.** Pharmacologic and Nonpharmacologic Treatments for Radicular Low Back Pain

Intervention	Outcome	Magnitude of Effect	Strength of Evidence (Studies)	Data
<b>Pharmacologic treatments vs. placebo</b>				
Diazepam (acute or subacute radicular pain)				
Pain		Lower likelihood of $\geq 50\%$ improvement	Low (1 RCT)	5 mg twice daily for 5 d: 41% vs. 79%; RR, 0.5 (95% CI, 0.3-0.8)
Function		No effect	Low (1 RCT)	RDQ: No difference through 1 y of follow-up
Systemic corticosteroids				
Pain		No effect	Moderate (6 RCTs)	No clear effect
Function		Small to no effect	Moderate (6 RCTs)	
<b>Nonpharmacologic treatments vs. sham, no treatment, or usual care (acute or subacute)</b>				
Exercise vs. usual care				
Pain		Small	Low (3 RCTs)	Favored exercise, although effects were small
Function		Small	Low (3 RCTs)	
<b>Comparative benefits of pharmacologic and nonpharmacologic treatments</b>				
Traction vs. other treatments				
Pain		No difference	Low (15 RCTs)	No clear differences
Function		No difference	Low (15 RCTs)	
Traction vs. other type of traction				
Pain		No difference	Low (5 RCTs)	No clear differences
Function		No difference	Low (5 RCTs)	
<b>Combination therapy vs. monotherapy or no treatment</b>				
Traction + physiotherapy vs. physiotherapy alone				
Pain		No difference	Low (5 RCTs)	No clear differences
Function		No difference	Low (5 RCTs)	

RCT = randomized, controlled trial; RDQ = Roland Morris Disability Questionnaire; RR = relative risk.

**Appendix Table 4.** Adverse Events for Treatments for Acute, Chronic, and Radicular Low Back Pain

Interventions	Data on Adverse Events (Quality of Evidence; Studies)	Adverse Effects
<b>Adverse events reported for pharmacologic treatments</b>		
Acetaminophen	Versus placebo: No difference in risk for serious adverse events (moderate quality; 1 RCT) Versus NSAIDs: A systematic review found that acetaminophen was associated with lower risk for adverse events; RR, 0.57 (95% CI, 0.36-0.89) (moderate quality; 3 RCTs)	Thrombocytopenia, agranulocytosis, pancytopenia, hemolytic anemia, methemoglobinemia, hypoglycemia, hypothermia, pancreatitis, nephrotoxicity, hepatotoxicity (with overdose), hepatic necrosis, pneumonitis, rash, and hypersensitivity
NSAIDs	Versus placebo: NSAIDs associated with more adverse effects; RR, 1.35 (CI, 1.09-1.68) (moderate quality; 10 RCTs)	Abdominal pain or cramps, dyspepsia, diarrhea, gastrointestinal bleeding, gastrointestinal perforation, dizziness, headache, edema, rash, heartburn, tinnitus, and pruritus
COX-2-selective NSAIDs	Versus nonselective NSAIDs: COX-2-selective NSAIDs associated with lower risk for adverse effects; RR, 0.83 (CI, 0.70-0.99) (moderate quality; 4 RCTs)	Abdominal pain, diarrhea, dizziness, dyspepsia, edema, flatulence, headache, nausea, rash, upper respiratory tract infection, influenza-like illness, and musculoskeletal and connective tissue signs and symptoms (back pain, muscle spasms, and musculoskeletal pain)
Opioids	Versus placebo: Short-term use associated with higher risk; risks higher in trials that did not use an enriched enrollment and withdrawal design; trials were not designed to assess risks for overdose, abuse, and addiction or long-term harms (moderate quality; 16 studies)	Short-term use: Nausea, dizziness, constipation, vomiting, somnolence, and dry mouth Long-term use: Addiction, abuse, overdose, fractures, cardiovascular events, sexual dysfunction, and motor vehicle accidents
SMRs	Versus placebo (any adverse event): SMRs associated with increased risk; RR, 1.50 (CI, 1.14-1.98) (moderate quality; 8 RCTs) Versus placebo (central nervous system events): SMRs associated with increased risk (primarily sedation); RR, 2.04 (CI, 1.23-3.37) (moderate quality; 8 RCTs)	Sedation, drowsiness, and dizziness
Benzodiazepines	Versus placebo: Central nervous system adverse events reported more frequently with benzodiazepines, although harms were not reported well; no trial was designed to evaluate risks with long-term use (low quality; 9 RCTs)	Somnolence, fatigue, lightheadedness, addiction, abuse, overdose, and fractures
Antidepressants	Versus placebo: Antidepressants associated with higher risk for any adverse events but no differences in rates of specific adverse events or serious adverse events (moderate quality; 12 RCTs) Duloxetine associated with nausea and increased risk for withdrawal due to adverse event	Drowsiness, dizziness, dry mouth, constipation, sexual dysfunction, and nausea
Systemic corticosteroids	Versus placebo: Trials did not report serious adverse events, but adverse events were not reported well in some trials (low quality; 12 RCTs)	Hyperglycemia requiring medical treatment, facial flushing, infection, and gastrointestinal bleeding
<b>Adverse events reported for nonpharmacologic treatments*</b>		
Exercise, Tai chi, massage, and spinal manipulation: Harms typically related to muscle soreness and/or small increases in pain were reported.		
Yoga: Reporting was suboptimal, but almost all adverse events were classified as mild to moderate.		
TENS: Evidence was limited but suggests an increased risk for skin reactions without an increased risk for serious adverse events.		
Heat: Heat was not associated with increased risk for skin flushing vs. no heat or placebo in 2 trials.		

COX-2 = cyclooxygenase-2; NSAID = nonsteroidal anti-inflammatory drug; RCT = randomized, controlled trial; RR = relative risk; SMR = skeletal muscle relaxant; TENS = transcutaneous electrical nerve stimulation.

\* Harms were poorly reported in most trials of nonpharmacologic interventions. No serious adverse events were reported.