Low back pain (LBP) is the worldwide leading cause of disability and a common presentation to medical services, with an average prevalence of 9.4%. LBP is usually benign and self-limiting, but can be the presenting feature of serious spinal pathology, such as malignancy, occurring in 1.4–5% of presentations. Sciatica is often associated with lower back pain. It has been reported to have an annual incidence of 1–5% and a lifetime incidence between 10% and 40%.

Methods

Updated information on LBP with sciatic radiation management is important for family physicians. Here, we review the available literature on sciatica. Relevant articles were identified via a literature search in PubMed by focusing on the following key points: diagnostic and definition criteria, red flags, and therapy. In addition, the authors' clinical experience has been utilised to propose a schema to assist in the assessment and treatment of sciatica in a primary care setting. Sciatica diagnosis is based on a careful history and clinical examination. Imaging is usually not necessary at first; testing with X-ray and MRI are key to diagnosing lumbar instability and herniated discs. Management includes physical conditioning, proper pain management, and surgery as a last resort. Pain treatment includes analgesics, anticonvulsants and muscle relaxants. A more aggressive approach would include epidural infiltrations and radiofrequency.

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Lower back pain with sciatic radiation definition and description

LBP with sciatic radiation, or sciatica, is a condition described as a unilateral pain and/or paresthesia in the distribution of the sciatic nerve or an associated lumbosacral nerve root. Pain is the result of the irritation of the sciatic nerve, with or without motor deficiency. Pain is worsened with flexion of the lumbar spine, twisting, bending, or coughing. Pain can be described or associated with burning, heaviness, or tightness sensations. The degree of the sciatic nerve irritation or damage progresses from pain-paresthesia to motor deficiency, meaning an increase in the nerve damage.

LBP with sciatic radiation management is important for family physicians. Here, we review the available literature on LBP with sciatic radiation. Relevant articles were identified via a literature search in PubMed. Further selection of articles was achieved by focusing on the following key points: diagnostic and definition criteria, differential diagnosis, and therapy. In addition, the authors’ clinical experience on sciatica has been utilised to propose a schema to assist in the assessment and treatment of migraines in a primary care setting.
Like in any case of lower back pain, a careful history and physical examination should be aimed at identifying those patients with greater suspicion of serious pathology.\textsuperscript{[6,7,9]}

The most common causes of LBP with sciatic radiation are:

- Lumbar intervertebral disc hernia
- Lumbar spinal stenosis, in the elderly population
- Spondylolisthesis (vertebra misalignment)
- Pelvic or lumbar muscular spasm and/or inflammation
- Spinal or paraspinal mass.

Physical examination pursues the reproduction of the sciatic pain and nerve function evaluation. Straight leg raise is performed where the patient lies in a supine position, and the painful leg is raised by the examiner from the posterior aspect flexing at the hip joint and keeping the knee in full extension, or keeping the leg straight. Typically, pain is reproduced between 30–70° of hip flexion in cases of lumbar disc herniation. The pain and paresthesia that are felt in the leg are likely due to lateralized disc herniation causing compression of a peripheral nerve. In musculoskeletal causes, pain will typically appear above 70° of flexion and/or below 30° of flexion. Muscle strength in the thigh, hamstrings and foot, along with quadriceps and Aquileal reflexes should be evaluated and compared with the other side. The patient can be sitting with his legs hanging or laying down. Strength should be evaluated against gravity and resistance. Finally, arterial pulses should be felt to complete the evaluation.\textsuperscript{[10]}

LBP with sciatic radiation differential diagnosis\textsuperscript{[9,10]} (not necessarily mutually exclusive) are included in Table 1.

### Diagnostic testing

Diagnostic evaluation always after a careful history and physical examination include:

- Plain lumbar spine films with flexion and extension views
- Computer tomography scan
- Magnetic resonance imaging of the lumbar spine
- Electromyography (EMG)
- Blood test.

Several guidelines have been published to guide the physician diagnostic workout to avoid unnecessary imaging or testing.\textsuperscript{[10–26]} Most of them recommend further studies if symptoms last longer than six weeks or the so-called “red flags” are present [Table 2].

Initially imaging is of little value. When recommended, X-ray of the lumbosacral spine may be evaluated for instability, fracture or spondylolisthesis. Non-contrast CT scan may be of aid in cases of fracture. MRI is the imaging of choice after six to eight weeks of pain and no response to conservative management. In cases of acute neurologic deficit or if mass effect is suspected, immediate MRI is warranted.\textsuperscript{[11,27]}

EMG study might be useful when history, exploration and/or imaging are not fully congruent. In case of pain extending beyond 1 dermatome or imaging showing several roots potentially affected, it helps to confirm which is the affected root. It might also help to evaluate the degree of nerve root impairment and its prognosis.\textsuperscript{[28]} Nevertheless, it is not considered a critical test to be done.

Blood tests\textsuperscript{[29]} depends on the differential diagnosis and could include: ANA, sedimentation rate, CK, rheumatoid factor, and C-reactive protein, hemogram, liver panel, kidney function, thyroid function, coagulation, and proteingram. This helps to rule out inflammatory diseases and out low-virulence infections. Also, HbA1c can be measured to check how well-controlled the diabetes is. Long-term diabetes can cause nerve dysfunction that can be pain-generating.

### Table 1: Lower back pain with sciatic irradiation differential diagnosis

| Differential Diagnosis |
|------------------------|
| Degenerative disc disease |
| Facet joint arthropathy and pseudo-radiculopathy |
| Pyramidal syndrome: It is a syndrome caused by the piniform muscle compressing the sciatic nerve as it exists the pelvis, thus producing radiating pain that can be confused with the L5 root compression. |
| Myofascial (muscle spasm) pain |
| Annular tears of the nucleus pulposis |
| Ligamentous pain of the spinal ligaments |
| Herniated nucleus pulposis and radiculopathy (pinched nerve) |
| Bertolotti’s syndrome (lumbar spine) |
| Failed back surgery syndrome |
| Medical (diabetes, hypothyroidism, hypovitaminosis D, etc.) |
| Rheumatologic causes of back pain (ankylosing spondylitis, rheumatoid arthritis, Sjogren’s syndrome etc.) |
| Infectious diseases (Lyme disease, neurosyphilis, etc.) |
| Neoplastic (lymphoma, gammopathy, paraneoplastic syndromes, etc.) |

### Table 2: Most common “red flags”

| Red flags |
|----------|
| Radiculopathy |
| Gait disturbance |
| No response to NSAIDs |
| Raised erythrocyte sedimentation rate |
| Sexual dysfunction |
| Tenderness over the spine |
| Anemia |
| Uveitis |
| Night pain |
| Morning stiffness |
| Non-mechanical pain |
| Systemically unwell |
| Spinal malformations |
| Motor deficits |
| Saddle anesthesia |
| Loss of anal sphincter tone/fecal incontinence |
| Age, under 20 years and over 50 years |
| Fever |
| Steroid use |
| Urinary retention or incontinence |
| Weight loss |
| Neurological impairment |
The following are the most frequent lumbar imaging changes\(^{[29,30]}\):

1. Osteoarthritis, which includes the presence of osteophytes, disc degeneration, and facet degeneration.
2. Herniated disk or disk protrusion, which are of relevance when a nerve root or the spinal cord are compressed. They could be central (medial), left/right (paramedial, the most frequent), or lateral (foraminal).
3. Disk bulge, when the disc protrudes but without compromising the nerve. These findings are usually unrelated to the patient’s symptoms.
4. Spondylolisthesis, when the upper vertebrae slides forward over the one beneath. There are different grades depending on the percentage of the slide: grade 1 (<25%), grade 2 (25–50%), grade 3 (50–75%), and grade 4 (>75%). This listhesis causes narrowing of the spinal canal and thereby, the compression of the exiting nerves passing towards the exit level situated below. It is most frequent at L5/S1 level, followed by L4-L5.

Brinjikji W et al\(^{[30]}\) published a review of imaging features of spinal degeneration in asymptomatic populations, revealing that a large percentage of the population had some type of imaging changes with no symptoms. There was also low correlation between imaging changes, and the extent of the damage and symptoms.

The characteristics of the symptoms and the findings of the clinical examination are the most important features for a correct diagnosis, to make decisions about the type of treatment and for the prognosis. Diagnostic tests are used to rule out other problems and only provide additional information.\(^{[4]}\) In many cases they do not offer information about the origin of the symptoms. The information they offer must be integrated with the rest of the clinical data.

## Treatment options

### Nonpharmacological intervention

Physio-exercise therapy program in a low impact environment to improve core strength, core mechanics and flexibility.\(^{[32]}\) Lumbar spine physio-exercise program should be the first step towards recovery, by increasing fitness, strength and flexibility.\(^{[33]}\)

Spinal stabilization and core muscle strengthening are essential.\(^{[34]}\) Daily isometric strengthening exercises will be helpful in stabilizing the spine.\(^{[35]}\) Ultra low-impact exercise such as pool exercise is ideal, followed by any machine exercise. Higher impact exercise, especially running and standing weights, should be avoided. Deep tissue release massage therapy and biofeedback may be helpful adjuvant treatments.\(^{[36]}\)

Range of motion, stretching, and attention to proper posture are critical.\(^{[33]}\) Addressing any kinetic, postural, or ergonomic issues will be a helpful adjunct. Inciting activities during prolonged sitting/standing and practicing good, erect posture are key. Ergonomic considerations would be to use appropriate back and arm supports on the chair, proper seating height, and avoidance of prolonged abnormal postures at work.

Avoid smoking cigarettes\(^{[9]}\) as smoking has been shown to accelerate the degenerative process and decreases muscle of oxygenation.

Staying in a proper body mass index (BMI) is also important, especially if a surgical intervention would be needed.\(^{[29]}\)

It will likely take the patient several months to begin to see improvement and perhaps 6–12 months to see total relief. It is important to stay with low impact exercises on a long-term basis to prevent a recurrence and to prevent ongoing degenerative disc changes. Conditioning should be taken to its limit, with special attention to strengthening the core muscles, avoiding impact exercises.

The psychological sphere must be promptly assessed when managing these cases. Psychological factors, also referred to as “yellow flags” [Table 3], indicate a poor prognosis and must be properly managed to prevent chronicity of the LBP and long-term disability.\(^{[36]}\) Waddell signs revealed during physical examination [Table 4] can provide prognostic outcomes of chronic LBP.

### Pharmacological therapy

Medical therapies include medications such as non-steroidal anti-inflammatory drugs (NSAIDs), muscle relaxant medications, and neuropathic pain medication such as gabapentin, pregabalin or duloxetine.\(^{[6,30]}\) Try several NSAIDs in succession to find one that is most effective and tolerable for the patient.\(^{[36]}\) Cyclobenzaprine and tizanidine are reasonable options as muscle relaxants. The membrane-stabilizing drugs such as gabapentin and pregabalin are useful for neuropathic sciatic pain. Narcotic analgesics remain an option to control peaks of high intensity pain, but they are not

### Table 3: Psychosocial Factors (Yellow Flags)

| Factor                                                                 | Description                                                                 |
|-----------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Belief that pain and activity are harmful (fear avoidance)             | Belief that pain and activity are harmful (fear avoidance)                    |
| Pain somatization                                                     | Pain somatization                                                           |
| Psychiatric comorbidities, maladaptive coping, or catastrophizing     | Psychiatric comorbidities, maladaptive coping, or catastrophizing           |
| Baseline functional impairment                                         | Baseline functional impairment                                               |
| Higher physical work demands                                          | Higher physical work demands                                                 |
| Lack of work satisfaction                                              | Lack of work satisfaction                                                    |
| Already on or seeking disability compensation                          | Already on or seeking disability compensation                                |
| Demographic factors (age, sex, race, education, smoking, weight, history of previous back pain) | Demographic factors (age, sex, race, education, smoking, weight, history of previous back pain) |
| Prior episodes of LBP                                                 | Prior episodes of LBP                                                        |
| Belief that pain and activity are harmful (fear avoidance)             | Belief that pain and activity are harmful (fear avoidance)                    |

### Table 4: Waddell’s Physical Examination Findings

| Factor                                      | Description                                                      |
|---------------------------------------------|------------------------------------------------------------------|
| Superficial or nonanatomic tenderness       | Superficial or nonanatomic tenderness                            |
| Non-reproducibility of pain with distraction| Non-reproducibility of pain with distraction                     |
| Regional weakness or sensory change         | Regional weakness or sensory change                               |
| Overreaction or exaggerated pain response   | Overreaction or exaggerated pain response                        |
recommended as chronic therapy. A narcotic analgesic (such as tramadol) should be avoided in cases of chronic pain as they tend to become less effective over time due to tolerance and may result in paradoxical “wind up” of pain symptoms or so-called opioid hypersensitivity.\[^{37}\] Narcotics taken over the long term induce a state of enhanced perception of pain called “opioid-induced hyperalgesia.” This is because narcotics aggravate the “central sensitization” in the brain and spinal cord.\[^{37}\]

\section*{Pain specialist management or Interventional therapy}

Pain injection procedures such as facet, and lumbar epidural steroid injections, report a good temporary improvement.\[^{38,39}\] Spinal infiltrations can be used for diagnostic or therapeutic purposes. When they are diagnostic, local anesthetic is applied to the structure suspected to be the source of pain (mainly the facets, epidural, or the root exiting the foramen), and a positive response is considered predictive of good response to other maneuvers applied to that area. When the injections are meant to be therapeutic, they are usually done with a combination of corticosteroid and local anesthetic such as mepivacaine or bupivacaine. This intervention does not pursue to cure, but may serve to reduce pain and inflammation so that patients can make gains in core stabilization therapy.

Rhizotomies (injury to the pain-conducting nerve fiber)\[^{40}\]: Neurolysis or rhizolysis is a neurodestructive procedure intended for long-term relief of chronic pain. Permanent neurolysis can be achieved by injection of ethanol or phenol, or by thermal injury (radiofrequency). Radiofrequency ablation is mainly used to achieve facet denervation, although it can also be used to treat root ganglions at the neural foramina to palliate or cure chronic unresolved radiculitis.

Implantation of epidural electrodes\[^{39}\]: Spinal cord stimulation consists of implanting epidural electrodes and connecting them to a generator, which might be internalized in a subcutaneous pocket during a second procedure, if the test stimulation is successful, or directly during the first surgery.

The primary indications for spinal cord stimulation are failed back surgery syndrome (FBSS) and complex regional pain syndromes type I and type II. Although there are ongoing studies, there are no current indications for upfront implantation of epidural electrodes for the treatment of low back pain (LBP) of spondylotic origin. This therapy is expensive, and its cost-effectiveness is always an issue.

\section*{Surgery}

Surgery should only be considered if medical and physical treatments have failed to improve the symptoms to a level that does not limit daily activities. As a general rule, surgical interventions should be kept to the lesser option that can set the patient’s symptoms to a level that allows the patient to carry on with his normal daily activities. Only in cases where neurological deficits are present due to compression of a neural structure (either nerve root or spinal cord), and especially if the deficit is progressive, the surgical option must be considered upfront.\[^{38}\]

As far as surgical options are concerned, they can be grouped under 1) neural tissue decompression and 2) neural tissue decompression and segment stabilization (also called spinal fusion). Symptoms of radiating pain, or neural claudication should be addressed by decompressing the affected structures. On the other hand, mechanical LBP, or spinal instability demonstrated in the imaging tests (lateral standing X-ray are critical at this point) should be addressed by performing a stabilization procedure.

1. Nerve decompression: In the lumbar spine, the roots are compressed often as they exit the intervertebral foramen. They are pinched either anteriorly by the bulging disc or posteriorly by the facet joints (or both). This region can be addressed from anterior, lateral, or posterior approaches.\[^{41}\] Anteriorly, the approach, even if performed in a minimally invasive way, requires moving aside the abdominal contents. It also carries the risk of injuring big vessels (such as Iliac arteries and veins), and the presacral plexus, which can cause retrograde ejaculation in the male. Posteriorly, the root can be addressed through a classic micro-discectomy and foraminotomy (widening the foramen that the nerve travels). If the spinal canal is narrow, a decompressive laminectomy can be performed by this route. These are the most common operations performed in the lumbar spine. For the lateral approach, minimally invasive approaches such as an endoscopic transforal approach are gaining popularity, although their results so far lack solid scientific evidence.

2. Nerve root decompression and segment stabilization: The aim of this surgery is to achieve a nerve decompression and a solid fusion between the vertebrae considered instable.

The typical indication for this procedure is spondylolisthesis. Again, the area can be approached anteriorly, laterally, or posteriorly.\[^{42}\] Lateral approach is becoming more common for the high lumbar levels (L3 and above). Below L4, the laterally-placed iliac crest could pose a technical challenge. Anterior approach requires the removal of the intervertebral disc and its substitution for an interbody device aimed at achieving solid fusion. For the posterior approach, different techniques are available. They all include the use of some hardware (transpedicular screws are the most common by far) and bone graft to achieve a solid fusion. No surgical technique (open, minimally invasive, aimed at achieving intertransverse fusion or intersomatic fusion, etc) has proven unquestionably to be superior to the others. The patient’s individual characteristics, imaging findings, and the surgical team experience usually guide the choice. They all are good choices as long as they achieve a good decompression and fusion.

\section*{Summary for Family Physicians}

- Diagnosis: anamnesis and careful physical examination
- Additional testing: spine films with flexion/extension views, MRI, electromyographic study, blood test work up
- Management:
  - Nonpharmacological intervention: lifestyle, posture

\[\text{Aguilar-Shea, et al.: Sciatica for family physicians}\]
education, weight lifting education, avoid smoking and obesity, and core strength and stretching

- Pharmacological therapy:
  - Non-steroidal anti-inflammatory drugs: ibuprofen, naproxen, diclofenac, celecoxib, etoricoxib. The most effective and tolerable for the patient should be chosen.
  - Muscle relaxant medications: cyclobenzaprine and tizanidine
  - Neuropathic pain medication: gabapentin, pregabalin, or duloxetine.
  - Narcotic analgesics, of preference step 2 step such as tramadol or codeine to control peaks of high-intensity pain.

**Message for the clinic**

Sciatica pain is one of the most frequent consultations in primary care. Careful anamnesis and physical examination are key for its diagnosis. Imaging testing with X-ray and MRI are key to diagnose lumbar instability and herniated discs. Treatment is based on nonpharmacological physiotherapy and core strengthening approach; pharmacological interventions and surgery act as a last resort.

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**References**

1. Stubbs PW, Verhagen AP. Estimating prevalence of serious spinal pathology in patients presenting to the emergency department with low back pain: Misrepresentation of prospective studies. Am J Med 2020;133:e613.
2. Galliker G, Scherer DE, Trippolini MA, Rasmussen-Barr E, LoMartire R, Wertz MM. Low back pain in the emergency department: Prevalence of serious spinal pathologies and diagnostic accuracy of red flags. Am J Med 2020;133:60-72.e14.
3. Wong CK, Mak RY, Kwok TS, Tsang JS, Leung MY, Funabashi M, et al. Prevalence, incidence, and factors associated with non-specific chronic low back pain in community-dwelling older adults aged 60 years and older: A systematic review and meta-analysis. J Pain 2021;15:26-5900 (21) 00316-3. doi: 10.1016/j.jpain.2021.07.012.
4. Alexander CE, Varacallo M. Lumbosacral Radiculopathy. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2021.
5. Oliveira CB, Amorim HE, Coombs DM, Richards B, Reedyk M, Maher CG, et al. Emergency department interventions for adult patients with low back pain: A systematic review of randomised controlled trials. Emerg Med J 2021;38:59-68.
6. Koumtouzoua S, Higgins S. Evaluating and managing the patient with back pain. Med Clin North Am 2021;105:1-17.
7. Schwill C. Rückenschmerzen in der Hausarztpraxis: Der spezifische Rückenschmerz [Back pain in the primary care setting: Specific back pain]. Internist (Berl) 2021;62:34-46. German.
8. Urrutia J, Besa P, Meissner-Haecker A, Gonzalez R, Gonzalez J. Management of patients with low back pain in the emergency department: Is it feasible to follow evidence-based recommendations? Emerg Med Australas 2020;32:1001-7.
9. Luites JWH, Kuiper PPFM, Hulshof CTJ, Kok R, Langendam MW, Oosterhuis T, et al. The Dutch multidisciplinary occupational health guideline to enhance work participation among low back pain and lumbosacral radicular syndrome patients. J Occup Rehabil 2021. doi: 10.1007/s10926-021-09993-4.
10. Machado GC, Ghinea N, Rogan E, Day RO, Maher CG. Emergency department care for low back pain: Should we adopt recommendations from primary care guidelines? Emerg Med Australas 2020;32:890-2.
11. Wang KY, Yen CJ, Chen M, Variyam D, Acosta TU, Reed B, et al. Reducing inappropriate lumbar spine MRI for low back pain: Radiology support, communication and alignment network. J Am Coll Radiol 2018;15:116-22.
12. Baxter GD, Chapple E, Ellis R, Hill J, Liu L, Mani R, et al. Six things you need to know about low back pain. J Prim Health Care 2020;12:195-8.
13. Tahvonen P, Oikarinen H, Niimimaki J, Luukkonen E, Mattila S, Tervonen O. Justification and active guideline implementation for spine radiography referrals in primary care. Acta Radiol 2017;58:586-92.
14. Tacy RM, Donaworth S, Ballman K. Application of primary care guideline for chronic low back pain in the emergency department. Adv Emerg Nurs J 2017;39:123-40.
15. Strudwick K, McPhee M, Bell A, Martin-Khan M, Russell T. Review article: Best practice management of low back pain in the emergency department (part 1 of the musculoskeletal injuries rapid review series). Emerg Med Australas 2018;30:18-35.
16. Siddiq MAB, Clegg D, Hasan SA, Rasker JJ. Extra-spinal sciatica and sciatica mimics: A scoping review. Korean J Pain 2020;33:305-17.
17. Mohammad N, Farahmand F, Hadizadeh Kharazi H, Mojdehipanah H, Karampour H, Nojomi M. Appropriateness of physicians' lumbosacral MRI requests in private and public centers in Tehran, Iran. Med J Islam Repub Iran 2016;30:415.
18. Liu C, Desai S, Krebs LD, Kirkland SW, Keto-Lambert D, Rowe BH, et al. Effectiveness of interventions to decrease image ordering for low back pain presentations in the emergency department: A systematic review. Acad Emerg Med 2018;25:614-26.
19. Lee SS, Choi Y, Pransky GS. Extent and impact of opioid prescribing for acute occupational low back pain in the emergency department. J Emerg Med 2016;50:376-84.e1-2.
20. Jauregui JE, Nutt RJ, Margolis AM. Frequency of opioid prescribing for acute low back pain in a rural emergency department. Adv Emerg Nurs J 2020;42:210-4.
21. Balasubramanaya R, Selvarajan SK. Lumbar Spine Imaging. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2021.
22. Poppe JA, McStay C, Sun BC, Capp R. Emergency department attending physician variation in opioid prescribing in low acuity back pain. West J Emerg Med 2017;18:1135-42.
23. Lavi ES, Pal A, Bleicher D, Kang K, Sidani C. MR imaging of the spine: Urgent and emergent indications. Semin Ultrasound CT MR 2018;39:551-69.
24. Chenot JF, Greitemann B, Kladyt B, Petzke F, Pfingsten M,
Schorr SG. Non-specific low back pain. Dtsch Arztebl Int 2017;114:883-90.

25. Berezin L, Thompson C, Rojas-Luengas V, Bongerdvaag B, McLeod SL. Lumbosacral spinal imaging for patients presenting to the emergency department with nontraumatic low back pain. J Emerg Med 2020;58:269-74.

26. Debnath UK. Lumbar spondyloysis—Current concepts review. J Clin Orthop Trauma 2021;21:101535.

27. Zafar HM, Ip IK, Mills AM, Raja AS, Langlotz CP, Khorasani R. Effect of clinical decision support—generated report cards versus real-time alerts on primary care provider guideline adherence for low back pain outpatient lumbar spine MRI orders. AJR Am J Roentgenol 2019;212:386-94.

28. Franco D, Mahtabfar A, Hines K, Sabourin V, Stefanelli A, Harrop J. Neurosurgical evaluation for patients with chronic lower back pain. Curr Pain Headache Rep 2020;24:58.

29. Soares LO, Ferreira GE, Costa LOP, Nogueira LC, Meziat-Filho N, Reis FJJ. Meditation for adults with non-specific low back pain: A systematic review and meta-analysis. Scand J Pain 2021. doi: 10.1515/sjpain-2021-0096.

30. Brinjikji W, Luetmer PH, Comstock B, Bresnahan BW, Chen LE, Deyo RA, et al. Systematic literature review of imaging features of spinal degeneration in asymptomatic populations. AJNR Am J Neuroradiol 2015;36:811-6.

31. Strudwick K, McPhee M, Bell A, Martin-Khan M, Russell T. Re: Limited evidence for screening for serious pathologies using red flags in patients with low back pain presenting to the emergency department. Emerg Med Australas 2018;30:437-8.

32. Kim HS, Ciolino JD, Lancki N, Strickland KJ, Pinto D, Stankiewicz C, et al. A prospective observational study of emergency department-initiated physical therapy for acute low back pain. Phys Ther 2020;101 (3):pzaa219. doi: 10.1093/ptj/pzaa219.

33. Quentin C, Bagheri R, Ugbohie UC, Coudeyre E, Pelissier C, Descatha A, et al. Effect of home exercise training in patients with nonspecific low-back pain: A systematic review and meta-analysis. Int J Environ Res Public Health 2021;18:8430.

34. Gianola S, Barger S, Del Castillo G, Corbetta D, Turola A, Andreano A, et al. Effectiveness of treatments for acute and subacute mechanical non-specific low back pain: A systematic review with network meta-analysis. Br J Sports Med 2021;56:41-50.

35. Oliveira CB, Franco MR, Maher CG, Tiedemann A, Silva FG, Damato TM, et al. The efficacy of a multimodal physical activity intervention with supervised exercises, health coaching and an activity monitor on physical activity levels of patients with chronic, nonspecific low back pain (Physical Activity for Back Pain (PAYBACK) trial): Study protocol for a randomised controlled trial. Trials 2018;19:40.

36. Friedman BW, Irizarry E, Chertoff A, Feliciano C, Solorzano C, Zias E, et al. Ibuprofen plus acetaminophen versus ibuprofen alone for acute low back pain: An emergency department-based randomized study. Acad Emerg Med 2020;27:229-35.

37. Hayden JA, Ellis J, Asbridge M, Ogilvie R, Merdad R, Grant DAG, et al. Prolonged opioid use among opioid-naive individuals after prescription for nonspecific low back pain in the emergency department. Pain 2021;162:740-8.

38. Baroncini A, Maffulli N, Eschweiler J, Knobe M, Tingart M, Migliorini F. Management of facet joints osteoarthritis associated with chronic low back pain: A systematic review. Surgeon 2021;19:e512-8.

39. Seo JH, Baik SW, Ko MH, Won YH, Park SH, Oh SW, et al. Comparing the efficacy of combined treatment with medial branch block and facet joint injection in axial low back pain. Pain Res Manag 2021;2021:1343891.

40. Peckham ME, Hutchins TA, Shah LM. Conventional image-guided procedures for painful spine. Neuroimaging Clin N Am 2019;29:539-51.

41. Donnally IC, Hanna A, Varacallo M. Lumbar Degenerative Disk Disease. StatPearls; 2021.

42. Lang SAJ, Bohn T, Barleben L, Pumberger M, Roll S, Buttner-Janz K. Advanced meta-analyses comparing the three surgical techniques total disc replacement, anterior stand-alone fusion and circumferential fusion regarding pain, function and complications up to 3 years to treat lumbar degenerative disc disease. Eur Spine J 2021;30:3688-701.