Low Back Pain
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
1. Murray CJ, Lopez AD. Measuring the global burden of disease. *N Engl J Med.* 2013;369(5):448-457.	Review/Other-Dx	N/A	A review article on measuring the global burden of disease.	No results stated in abstract.	4
2. Chou R, Qaseem A, Snow V, et al. Diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of Physicians and the American Pain Society. *Ann Intern Med.* 2007;147(7):478-491.	Review/Other-Dx	N/A	Practice guideline by American College of Physicians and the American Pain Society on diagnosis and treatment of LBP.	Recommendations are mentioned include: Clinicians should not routinely obtain imaging or other diagnostic tests in patients with nonspecific LBP (strong recommendation, moderate-quality evidence). Clinicians should perform diagnostic imaging and testing for patients with LBP when severe or progressive neurologic deficits are present or when serious underlying conditions are suspected on the basis of history and physical examination (strong recommendation, moderate-quality evidence). Clinicians should evaluate patients with persistent LBP and signs or symptoms of radiculopathy or spinal stenosis with MRI (preferred) or CT only if they are potential candidates for surgery or epidural steroid injection (for suspected radiculopathy) (strong recommendation, moderate-quality evidence).	4
3. Chou R, Qaseem A, Owens DK, Shekelle P. Diagnostic imaging for low back pain: advice for high-value health care from the American College of Physicians. *Ann Intern Med.* 2011;154(3):181-189.	Review/Other-Dx	N/A	A report based on a systematic review conducted for a 2007 LBP in guideline and a subsequent meta-analysis to help clinicians practice high-value health care by following a more rational and cost-conscious diagnostic approach.	Good evidence indicates that routine back imaging is not associated with clinically meaningful benefits and exposes patients to unnecessary harms, but imaging remains overused. More evidence-based approach to imaging is needed.	4
4. Goertz M, Thorson D, Bonsell J, et al. Institute for Clinical Systems Improvement. Adult Acute and Subacute Low Back Pain. Updated November 2012.	Review/Other-Dx	N/A	Guideline on the management of acute and subacute LBP in adults.	N/A	4
5. Jarvik JG, Hollingworth W, Martin B, et al. Rapid magnetic resonance imaging vs radiographs for patients with low back pain: a randomized controlled trial. *Jama.* 2003;289(21):2810-2818.	Experimental-Dx	380 total patients: 190 – radiograph, 190 – rapid MRI	Randomized trial to determine the clinical and economic consequences of replacing spine radiographs with rapid MRI for primary care patients.	Rapid MRIs and radiographs resulted in nearly identical outcomes for primary care patients with LBP. The rapid MRI strategy had a mean cost of $2,380 vs $2,059 dollars for the radiograph strategy.	1
6. Modic MT, Obuchowski NA, Ross JS, et al. Acute low back pain and radiculopathy: MR imaging findings and their prognostic role and effect on outcome. *Radiology.* 2005;237(2):597-604.	Experimental-Dx	246 total patients: 150 with LBP and 96 with radiculopathy	Randomized prospective study of prognostic role of MRI findings and effect on outcome in patients with uncomplicated acute LBP or radiculopathy.	MRI does not have measurable value in conservative management of patients with typical uncomplicated LBP or radiculopathy.	1

Low Back Pain
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
7. Bigos SJ, Bowyer OR, Braen GR, et al. Acute Low Back Problems in Adults. Clinical Practice Guideline No. 14. AHCPR Publication No. 95-0642. Rockville, MD: Agency for Health Care Policy and Research, Public Health Service, U.S. Department of Health and Human Services. December 1994.	Review/Other-Dx	N/A	Findings and recommendations on the assessment and treatment of adults with acute low back problems are presented in this practice guideline.	N/A	4
8. Jarvik JG, Gold LS, Comstock BA, et al. Association of early imaging for back pain with clinical outcomes in older adults. *Jama.* 2015;313(11):1143-1153.	Observational-Dx	5,239 patients	To compare function and pain at the 12-month follow-up visit among older adults who received early imaging with those who did not receive early imaging after a new primary care visit for back pain without radiculopathy.	Among the 5,239 patients, 1,174 had early radiographs and 349 had early MRI/CT. At 12 months, neither the early radiograph group nor the early MRI/CT group differed significantly from controls on the disability questionnaire. The mean score for patients who underwent early radiography was 8.54 vs 8.74 among the control group (difference, -0.10 [95% CI, -0.71 to 0.50]; mixed model, *P*=0.36). The mean score for the early MRI/CT group was 9.81 vs 10.50 for the control group (difference,-0.51 [-1.62 to 0.60]; mixed model, *P*=0.18).	3
9. Boden SD, Davis DO, Dina TS, Patronas NJ, Wiesel SW. Abnormal magnetic-resonance scans of the lumbar spine in asymptomatic subjects. A prospective investigation. *J Bone Joint Surg Am.* 1990;72(3):403-408.	Review/Other-Dx	67 patients, 3 reviewers	To prospectively examine MRI results in patients with no history of LBP, sciatica or neurogenic claudication.	Abnormalities on MRI must be strictly correlated with age and any clinical signs and symptoms before operative treatment is contemplated.	4
10. Brinjikji W, Luetmer PH, Comstock B, et al. Systematic literature review of imaging features of spinal degeneration in asymptomatic populations. *AJNR Am J Neuroradiol.* 2015;36(4):811-816.	Review/Other-Dx	33 articles	To estimate the prevalence, by age, of common degenerative spine conditions by performing a systematic review studying the prevalence of spine degeneration on imaging in asymptomatic individuals.	33 articles reporting imaging findings for 3,110 asymptomatic individuals who met the study inclusion criteria. The prevalence of disk degeneration in asymptomatic individuals increased from 37% of 20-year-old individuals to 96% of 80-year-old individuals. Disk bulge prevalence increased from 30% of those 20 years of age to 84% of those 80 years of age. Disk protrusion prevalence increased from 29% of those 20 years of age to 43% of those 80 years of age. The prevalence of annular fissure increased from 19% of those 20 years of age to 29% of those 80 years of age.	4

Low Back Pain
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
11. Carragee E, Alamin T, Cheng I, Franklin T, van den Haak E, Hurwitz E. Are first-time episodes of serious LBP associated with new MRI findings? *Spine J.* 2006;6(6):624-635.	Observational-Dx	200 total patients; 51 had 67 MR scans, 2 independent and blinded readers	Prospective observational study to determine if new and serious episodes of LBP are associated with new and relevant findings on MRI.	Findings on MRI within 12 weeks of serious LBP inception are highly unlikely to represent any new structural change. Most new changes (loss of disc signal, facet arthrosis, and end plate signal changes) represent progressive age changes not associated with acute events. Primary radicular syndromes may have new root compression findings associated with root irritation.	3
12. Williams AL, Gornet MF, Burkus JK. CT evaluation of lumbar interbody fusion: current concepts. *AJNR Am J Neuroradiol.* 2005;26(8):2057-2066.	Review/Other-Dx	N/A	Review of surgery, instrumentation, and imaging of interbody fusion.	CT provides better evaluation of fusion progression and status than dynamic radiography and is becoming the preferred method of monitoring patients who have undergone interbody fusion.	4
13. Autio RA, Karppinen J, Niinimaki J, et al. Determinants of spontaneous resorption of intervertebral disc herniations. *Spine (Phila Pa 1976).* 2006;31(11):1247-1252.	Review/Other-Dx	Patients rescanned at 2 months (n = 74) and after 12 months (n = 53)	To assess the determinants of resorption of herniated nucleus pulposus.	Significant resorption of herniated nucleus pulposus occurred from baseline to 2 months, although the resorption rate was more pronounced over the whole 1-year follow-up. Higher baseline scores of rim enhancement thickness, higher degree of herniated nucleus pulposus displacement in the Komori classification, and age category 41–50 years were associated with a higher resorption rate. Thickness of rim enhancement was a stronger determinant of spontaneous resorption than extent of rim enhancement. Clinical symptom alleviation occurs concordantly with a faster resorption rate.	4
14. Last AR, Hulbert K. Chronic low back pain: evaluation and management. *Am Fam Physician.* 2009;79(12):1067-1074.	Review/Other-Dx	N/A	Article reviews the evaluation and management of chronic LBP.	Most patients with chronic LBP will not benefit from surgery. A surgical evaluation may be considered for select patients with functional disabilities or refractory pain despite multiple nonsurgical treatments.	4
15. Kobayashi A, Kobayashi T, Kato K, Higuchi H, Takagishi K. Diagnosis of radiographically occult lumbar spondylolysis in young athletes by magnetic resonance imaging. *Am J Sports Med.* 2013;41(1):169-176.	Observational-Dx	200 consecutive young athletes	To evaluate the usefulness of MRI in diagnosing active spondylolysis early and in determining the prevalence of active spondylolysis in cases where findings were not detected on plain radiography. In addition, specific clinical features to aid in the early detection of active spondylolysis were evaluated.	97 (48.5%) patients showed evidence of active spondylolysis on MRI, findings that had been missed by radiography. These pars defects were organized into the following categories based on CT findings: nonlysis stage, 52; very early stage, 37; late early stage, 22; progressive stage, 10; and terminal stage, 0. No significant physical examination factors were identified that could assist in the early detection of active spondylolysis.	3

Low Back Pain
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
16. Jarvik JG, Deyo RA. Diagnostic evaluation of low back pain with emphasis on imaging. *Ann Intern Med.* 2002;137(7):586-597.	Review/Other-Dx	N/A	Summary review (1966-2001) of articles relevant to accuracy of clinical and radiographic examination of LBP patients.	Sensitivity for cancer was highest for MRI (0.83 to 0.93) and radionuclide scanning (0.74 to 0.98); specificity was highest for MRI (0.9 to 0.97) and radiography (0.95 to 0.99). MRI was the most sensitive (0.96) and specific (0.92) test for infection. The sensitivity and specificity of MRI for herniated discs were slightly higher than those for CT but very similar for the diagnosis of spinal stenosis. Support for 1994 Agency for Health Care Policy and Research guidelines: symptomatic therapy without imaging for adults <50years old without evidence of systemic disease; plain radiography and lab tests can reliably rule out systemic disease; and reserve advanced imaging for surgical candidates or strong suspicion of systemic disease.	4
17. American College of Radiology. ACR Appropriateness Criteria®: Suspected Spine Trauma. Available at: https://acsearch.acr.org/docs/69359/Narrative/. Accessed September 30, 2015.	Review/Other-Dx	N/A	Evidence-based guidelines to assist referring physicians and other providers in making the most appropriate imaging or treatment decision for a specific clinical condition.	N/A	4
18. Jung HS, Jee WH, McCauley TR, Ha KY, Choi KH. Discrimination of metastatic from acute osteoporotic compression spinal fractures with MR imaging. *Radiographics*. 2003;23(1):179-187.	Observational-Dx	27 patients with metastatic compression fractures and 55 patients with acute osteoporotic compression fractures	To determine which MRI findings are useful in discrimination between metastatic compression fractures and acute osteoporotic compression fractures of the spine.	MRI findings suggestive of metastatic compression fractures were as follows: a convex posterior border of the vertebral body, abnormal signal intensity of the pedicle or posterior element, an epidural mass, an encasing epidural mass, a focal paraspinal mass, and other spinal metastases. MRI findings suggestive of acute osteoporotic compression fractures were as follows: a low-signal-intensity band on T1- and T2-weighted images, spared normal bone marrow signal intensity of the vertebral body, retropulsion of a posterior bone fragment, and multiple compression fractures. The signal intensity on fast spin-echo T2-weighted images obtained without fat suppression played little role in distinguishing between metastatic compression fractures and acute osteoporotic compression fractures.	2

Low Back Pain
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
19. Henschke N, Maher CG, Ostelo RW, de Vet HC, Macaskill P, Irwig L. Red flags to screen for malignancy in patients with low-back pain. *Cochrane Database Syst Rev*. 2013;2:CD008686.	Review/Other-Dx	8 cohort studies	To assess the diagnostic performance of clinical characteristics identified by taking a clinical history and conducting a physical examination ("red flags") to screen for spinal malignancy in patients presenting with LBP.	The authors included 8 cohort studies of which 6 were performed in primary care (total number of patients; n = 6,622), 1 study was from an accident and emergency setting (n = 482), and 1 study was from a secondary care setting (n = 257). In the 6 primary care studies, the prevalence of spinal malignancy ranged from 0% to 0.66%. Overall, data from 20 index tests were extracted and presented, however only 7 of these were evaluated by more than 1 study. Because of the limited number of studies and clinical heterogeneity, statistical pooling of diagnostic accuracy data was not performed. There was some evidence from individual studies that having a previous history of cancer meaningfully increases the probability of malignancy. Most "red flags" such as insidious onset, age >50, and failure to improve after 1 month have high false positive rates. All of the tests were evaluated in isolation and no study presented data on a combination of positive tests to identify spinal malignancy. The authors conclude that for most "red flags," there is insufficient evidence to provide recommendations regarding their diagnostic accuracy or usefulness for detecting spinal malignancy. The available evidence indicates that in patients with LBP, an indication of spinal malignancy should not be based on the results of 1 single "red flag" question.	4
20. Algra PR, Bloem JL, Tissing H, Falke TH, Arndt JW, Verboom LJ. Detection of vertebral metastases: comparison between MR imaging and bone scintigraphy. *Radiographics*. 1991;11(2):219-232.	Observational-Dx	71 patients; 4 independent observers	Prospective, double blinded study to compare the sensitivity of bone scintigraphy and MRI in detection of vertebral metastases.	Bone scintigraphy permitted identification of 499 abnormal vertebrae and MRI, 818 abnormal vertebrae. MRI depicted additional abnormal vertebrae in 49 patients. The authors conclude that MRI is more sensitive than bone scintigraphy in detection of vertebral metastases.	1

Low Back Pain
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
21. Bredella MA, Essary B, Torriani M, Ouellette HA, Palmer WE. Use of FDG-PET in differentiating benign from malignant compression fractures. *Skeletal Radiol.* 2008;37(5):405-413.	Observational-Dx	33 patients with 43 compression fractures	To evaluate the use of FDG-PET in differentiating benign from malignant compression fractures.	There were 14 malignant and 29 benign compression fractures, including 5 acute benign fractures. On FDG-PET, 5 benign fractures were falsely classified as malignant (false-positive). 3 of these patients underwent prior treatment with bone marrow-stimulating agents. There were 2 false-negative results. Sensitivity, specificity, PPV, NPV, and accuracy of FDG-PET in differentiating benign from malignant compression fractures were 86%, 83%, 84%, 71%, and 92% respectively. The difference between standardized uptake values of benign and malignant fractures was statistically significant (1.9 +/- 0.97 for benign and 3.9 +/- 1.52 for malignant fractures, P<0.001). Standardized uptake values of benign acute and chronic fractures were not statistically significant.	3
22. Jarvik JG. Imaging of adults with low back pain in the primary care setting. *Neuroimaging Clin N Am.* 2003;13(2):293- Imaging of adults with low back pain in the primary care 305.	Review/Other-Dx	N/A	Review imaging modalities used in adults with LBP in the primary care setting.	MRI is likely in most cases to offer the greatest sensitivity and specificity for systemic diseases, and its performance is superior to that of radiographs and comparable with CT and radionuclide bone scans for most conditions causing neurologic compromise.	4
23. Fardon DF, Milette PC. Nomenclature and classification of lumbar disc pathology. Recommendations of the Combined task Forces of the North American Spine Society, American Society of Spine Radiology, and American Society of Neuroradiology. *Spine (Phila Pa 1976).* 2001;26(5):E93-E113.	Review/Other-Dx	N/A	Nomenclature that addresses contour, content, integrity, organization, and spatial relationships of the lumbar disc; and serves a system of classification and reporting built upon that nomenclature.	Recommendations mentioned present diagnostic categories and subcategories, intended for classification and the reporting of imaging studies.	4

Low Back Pain
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
24. Arana E, Royuela A, Kovacs FM, et al. Lumbar spine: agreement in the interpretation of 1.5-T MR images by using the Nordic Modic Consensus Group classification form. *Radiology.* 2010;254(3):809-817.	Observational-Dx	53 patients, 5 reviewers from 3 hospitals twice interpreted lumbar MR examination	To evaluate intra- and interobserver agreement for the interpretation of lumbar 1.5-T MRIs in a community setting.	Endplate erosions and spondylolisthesis were observed in <10% of images. Intraobserver reliability was almost perfect for spinal stenosis; substantial for Modic changes, Schmorl nodes, disk degeneration, annular tears, and disk contour; and moderate for osteophytes. Interobserver reliability was moderate for Modic changes, Schmorl nodes, disk degeneration, annular tears, and disk contour; fair for osteophytes; and poor for spinal stenosis. In conditions close to those of clinical practice, there was only moderate interobserver agreement in the reporting of findings at 1.5-T lumbar MRI.	3
25. Jarvik JG, Haynor DR, Koepsell TD, Bronstein A, Ashley D, Deyo RA. Interreader reliability for a new classification of lumbar disk disease. *Acad Radiol.* 1996;3(7):537-544.	Observational-Dx	34 consecutive patients, 3 blinded readers	To determine inter-reader reliability for a new classification of lumbar disk disease.	Weighted kappa values showed fair-to-moderate agreement. Kappas for the dichotomous decision of extrusion present or absent were more variable, ranging from 0 to .78. Major disagreements (greater than a single category) occurred with 6.2% of all comparisons and in 10/34 volunteers; 5 involved extrusions. Overall, readers achieved moderate agreement for this new nomenclature. However, agreement for the presence or absence of an extrusion was less reliable.	2
26. Manchikanti L, Benyamin RM, Singh V, et al. An update of the systematic appraisal of the accuracy and utility of lumbar discography in chronic low back pain. *Pain Physician.* 2013;16(2 Suppl):SE55-95.	Review/Other-Dx	160 studies	To systematically assess and re-evaluate the diagnostic accuracy of lumbar discography.	Over 160 studies were considered for inclusion. Of these, 33 studies compared discography with other diagnostic tests, 30 studies assessed the diagnostic accuracy of discography, 22 studies assessed surgical outcomes for discogenic pain, and 3 studies assessed the prevalence of lumbar discogenic pain. The quality of the overall evidence supporting provocation discography based on the above studies appears to be fair. The prevalence of internal disc disruption is estimated to be 39% to 42%, whereas the prevalence of discogenic pain without assessing internal disc disruption is 26%.	4

Low Back Pain
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
27. Bartynski WS, Lin L. Lumbar root compression in the lateral recess: MR imaging, conventional myelography, and CT myelography comparison with surgical confirmation. *AJNR Am J Neuroradiol.* 2003;24(3):348-360.	Observational-Dx	26 patients	To assess the accuracy of MRI, conventional myelography, and postmyelography CT (CT myelography) of the lumbar level in identifying degenerative lateral recess root compression with surgical confirmation.	MRI underestimated root compression in 28% to 29% of the cases in which root impingement was surgically confirmed. Conventional myelography underestimated root compression in only 5% to 7% of the cases and correctly predicted impingement in 93% to 95%. CT myelography underestimated root compression in 38% of the surgically confirmed cases.	3
28. Fraser S, Roberts L, Murphy E. Cauda equina syndrome: a literature review of its definition and clinical presentation. *Arch Phys Med Rehabil.* 2009;90(11):1964-1968.	Review/Other-Dx	105 articles	To review the current evidence for the signs and symptoms of CES.	There are marked inconsistencies in the current evidence base surrounding the etiology and clinical presentation of CES, with 17 definitions identified. Subclassifications of the definition of CES are ambiguous and should be avoided. From reviewing 105 articles, a single definition of CES is proposed. For a diagnosis of CES, 1 or more of the following must be present: (1) bladder and/or bowel dysfunction, (2) reduced sensation in the saddle area, and (3) sexual dysfunction, with possible neurologic deficit in the lower limb (motor/sensory loss, reflex change).	4
29. Fairbank J, Hashimoto R, Dailey A, Patel AA, Dettori JR. Does patient history and physical examination predict MRI proven cauda equina syndrome? *Evid Based Spine Care J.* 2011;2(4):27-33.	Review/Other-Dx	4 articles	To determine if there are there elements from the history or physical examination that are associated with CES as established by MRI.	The mean prevalence of CES as diagnosed by MRI ranged from 14%–48% of patients. No symptoms or signs reported by more than 1 study showed high sensitivity and specificity, and all likelihood ratios were low. Symptoms included back/LBP, bilateral sciatica, bladder retention, bladder incontinence, frequent urination, decreased urinary sensation, and bowel incontinence; signs included saddle numbness and reduced anal tone. There is low evidence that individual symptoms or signs from the patient history or clinical examination, respectively, can be used to diagnose CES.	4

Low Back Pain
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
30. Bell DA, Collie D, Statham PF. Cauda equina syndrome: what is the correlation between clinical assessment and MRI scanning? *Br J Neurosurg.* 2007;21(2):201-203.	Observational-Dx	23 patients	To assess the ability of neurosurgical residents to predict on clinical grounds in which patients with CES this was due to prolapsed intervertebral disc thereby justifying a request for urgent MRI	MRI was normal in 10 (43%) patients. A disc prolapse causing cauda equina distortion was present in 5 (22%) patients. The diagnostic accuracy of urinary retention, urinary frequency, urinary incontinence, altered urinary sensation and altered perineal sensation were 0.57, 0.65, 0.61, 0.65 and 0.60 respectively.	3

Evidence Table Key

Study Quality Category Definitions

- *Category 1* The study is well-designed and accounts for common biases.
- *Category 2* The study is moderately well-designed and accounts for most common biases.
- *Category 3* There are important study design limitations.
- *Category 4* The study is not useful as primary evidence. The article may not be a clinical study or the study design is invalid, or conclusions are based on expert consensus. For example:
  a) the study does not meet the criteria for or is not a hypothesis-based clinical study (e.g., a book chapter or case report or case series description);
  b) the study may synthesize and draw conclusions about several studies such as a literature review article or book chapter but is not primary evidence;
  c) the study is an expert opinion or consensus document.
- M = Meta-analysis

Dx = Diagnostic

Tx = Treatment

Abbreviations Key

CES = Cauda equina syndrome

CI = Confidence interval

CT = Computed tomography

FDG-PET = Fluorine-18-2-fluoro-2-deoxy-D-glucose-positron emission tomography

LBP = Low back pain

MDP = Methylene diophosphate

MRI = Magnetic resonance imaging

NPV = Negative predictive value

NSAIDs = Nonsteroidal anti-inflammatory drugs

PPV = Positive predictive value