CDI QUALITY INSTITUTE

APPROPRIATE USE GUIDELINES

Appropriateness of Advanced Imaging Procedures (MRI, CT, Bone Scan/PET) in Patients with Low Back Pain

CDI QUALITY INSTITUTE: PROVIDER LED ENTITY (PLE)

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Contents

Summary:

During the initial visit for patients with low back pain, a focused history and physical examination is performed. The examiner should determine the severity and urgency of the disorder, the chronicity of the disorder, the likelihood of a specific diagnosis and the level of neurologic dysfunction. The patient should be screened for emergent conditions, including cauda equina syndrome, major or progressive neurologic loss, and/or uncontrolled pain. Screening should also be done for urgent conditions, including a clinical suspicion of cancer, infection or fragility fracture.

Plain radiographs are not recommended for routine evaluation; however, they may be obtained in specific instances. They are useful to evaluate for a fracture in patients with significant trauma; patients with minor trauma, if over 50 years of age; patients older than 70 years of age; and patients with a history of osteoporosis or chronic steroid use. Plain radiographs are also useful to evaluate for metastatic disease in patients with new back pain and a history of cancer; and to evaluate for infection in patients with disproportionate pain, fever over 100°F, an elevated white blood cell count (WBC), and/or an elevated erythrocyte sedimentation rate (ESR) or C-reactive protein (CRP).

Early cross-sectional imaging is indicated in patients with emergent or urgent indications. In the absence of red flags, early imaging has not been shown to be of use or to improve outcomes. Advanced imaging in patients with radiculopathy, lumbar spinal stenosis, or non-specific back pain is generally reserved for those who have failed conservative therapy, are planning for injection therapy or are anticipating surgery.

In most instances, MRI is the advanced imaging procedure of choice, as it allows direct visualization of neurologic structures, has a high sensitivity for infection and neoplasm, and does not utilize ionizing radiation. CT and CT myelography are generally reserved for patients who are unable to undergo MRI, who have failed MRI, or who have indeterminate findings on MRI. CT is indicated to evaluate the integrity of a lumbar fusion, often in conjunction with an MRI. CT and CT myelography may also be obtained in addition to MRI for surgical planning.

Low back pain and/or radiculopathy with clinical, radiologic, and/or laboratory suspicion of cancer:

Strong recommendation for imaging:

- MRI

Conditional recommendation for imaging:

- CT in a patient unable to undergo MRI
- CT to evaluate indeterminate MRI findings (to evaluate for osteolysis)
- CT as the initial study (particularly if plain radiographs show an area of osteolysis or to evaluate an area of increased uptake on bone scan)
- Bone scan (to evaluate indeterminate or worrisome findings on MRI or CT, and to evaluate for multiple bone lesions with metastatic disease)

Conditional recommendation against imaging:

- Bone scan without prior MRI or CT
- Bone scan as a primary diagnostic test to evaluate for lesions in patients with known or suspected multiple myeloma
- PET (to evaluate indeterminate lesions on CT or MRI in patients with specific pathologic diagnoses)

Level of Evidence: Moderate

Notes concerning applicability and/or patient preferences: None

Summary of evidence:
There is agreement among multiple guidelines (four out of six guidelines) that imaging and testing are indicated in patients with new onset low back pain when cancer is suspected. Some guidelines prefer MRI, while others assign equal weight to all modalities (radiography, MRI, CT, NM).

Chou et al. (2007) recommends MRI or CT for cancer with impending spinal cord compression (strong recommendation, moderate quality evidence). MRI is generally preferred over CT, as it does not use ionizing radiation and provides better visualization of soft tissue, the vertebral marrow, and the spinal canal. There is, however, insufficient evidence to guide precise recommendations on diagnostic strategies in patients who have risk factors for cancer, but no signs of spinal cord compression. Specific strategies for patients without signs of cord compression include:

- MRI in patients with a history of cancer (the strongest predictor of cancer);
- Delayed imaging at 1 month in patients > 50 years of age without other risk factors; and
- Plain radiographs and erythrocyte sedimentation rate (ESR) (≥ 20mm/hour) (78% sensitivity and 67% specificity for vertebral neoplasm) with MRI reserved for patients with abnormalities on initial testing.

The *American College of Radiology* (*ACR* (Patel et al. 2016)) recommends MRI with and without contrast (8), MRI without contrast (7) and CT (6) for the evaluation of low back pain patients with suspicion of cancer. MRI with IV contrast is superior for the detection of intradural disease. MRI without contrast is more specific than bone scanning. FDG-PET scanning can be useful in differentiating benign from malignant fractures and may be of benefit in patients unable to undergo MRI.

Clinical notes:

- Immediate imaging is indicated in patients with a clinical suspicion of cancer, impending cord impingement and/or a major or progressive neurological deficit.
- Immediate imaging can be considered in patients with moderate to severe new onset low back pain and a history of cancer. "History of cancer" is the strongest risk factor for spinal neoplasm, with a likelihood ratio of about 15. Based on this likelihood ratio, a history of cancer would increase the incidence of cancer in the tested population to about 9% (Chou et al., 2011; Henscke et al., 2007).
- In patients with other risk factors (age ≥ 50 years, unexplained weight loss, and failure to improve after one month), imaging could be deferred for several weeks (Chou et al., 2011). These risk factors are weaker, with positive likelihood ratios of 2.7-3.0 (Chou et al., 2011). In patients with any one of these three risk factors, the likelihood of cancer only increases to approximately 1.2%.
- MRI can also be reserved for patients with abnormal radiographs and/or ESR (≥20mm/hour). Abnormalities on plain radiographs and an elevated ESR have a 78% sensitivity and 67% specificity for neoplasm on MRI (Chou et al., 2007).
- The risk of cancer is increased when a combination of red flags is present (Henschke et al., 2013).
- STIR, T2 fat saturation and/or diffusion-weight images may increase the conspicuity and sensitivity for vertebral neoplasm.
- CT myelography is indicated to evaluate for intradural neoplasm or intradural metastases in patients who cannot undergo MRI.

Evidence update (2010-present):
There were no new studies which significantly affected the conclusions and recommendations from the guidelines noted above. Specific studies of interest are summarized below.

Downie et al. (2013) – Of the red flags for malignancy, "history of cancer" increased the probability of malignancy to between 7% and 33%, while older age, unexplained weight loss, and failure to improve after one month had post-test probabilities below 3%. The results support the approach taken in the *American College of Physicians* guideline, which provides a more focused list of red flags than other guidelines. Many red flags in current guidelines provide virtually no change in probability of fracture or malignancy, or have untested diagnostic accuracy (high level of evidence).

Henschke et al. (2013) - Prevalence of spinal malignancy in primary care is very low (< .66%). Of the seven primary red flag signs for spinal neoplasm or metastasis in primary care patients with low back pain (age > 50, previous history of cancer, unexplained weight loss, neurological symptoms, insidious onset, no improvement after 1 month, tried bed rest), only previous history

of cancer (4.6%) increased the post-test probability of disease above 2% (moderate). "Red flags" such as insidious onset of pain, age > 50, and failure to improve after one month have high false positive rates, suggesting that the uncritical use of these "red flags" as a trigger to order further investigations may lead to unnecessary investigations that are themselves harmful. While the lack of evidence to support or refute the use of "red flags" is recognized, a more pragmatic solution is to consider the possibility of spinal malignancy (in light of its low prevalence in primary care) when a combination of recommended "red flags" are found to be positive" (moderate level of evidence).

van Rijn et al. (2012) – Systematic review found no studies addressing the accuracy of CT for vertebral infection, neoplasm, and fracture (moderate level of evidence).

Exclusions: Evaluation of primary osseous spine tumors

Low back pain and/or radiculopathy with clinical, radiologic, and/or laboratory suspicion of infection:

Strong recommendation for imaging:

- MRI

Conditional recommendation for imaging:

- CT in patients unable to undergo MRI
- CT in patients with indeterminate findings on MRI (to evaluate for endplate destruction or poorly demarcated endplate erosions)
- CT as the initial study (particularly with evidence of endplate erosions on plain radiographs)

Conditional recommendation against imaging:

- Bone scan

Recommendation against imaging:

- PET

Level of Evidence: Moderate

Notes concerning applicability and/or patient preferences: None

Summary of evidence:
There is agreement among multiple high-quality guidelines (five out of seven guidelines) that imaging is indicated when spine infection is suspected. The majority of guidelines recommend MRI as the preferred imaging modality.

Chou et al. (2007) recommends imaging MRI or CT for patients who are suspected of having a vertebral infection (strong recommendation, moderate quality evidence). MRI is generally preferred over CT, as it does not use ionizing radiation and provides better visualization of soft tissue, the vertebral marrow, and the spinal canal.

The *ACR* (Patel et al. 2016) recommends MRI with and without contrast (8), MRI without contrast (7), and CT (6) for the evaluation of low back pain patients with suspicion of infection. MRI is preferred because of its high sensitivity and specificity. MRI allows for the diagnosis of infection prior to the appearance of bone destruction on CT or plain radiographs. MRI provides anatomic detail not provided on radioisotope scanning.

Clinical notes:

- Immediate imaging is recommended in patients when features suggest vertebral infection (Chou et al., 2011). Timely diagnosis may prevent serious sequelae with this entity.

- MRI for infection should be considered in patients with the onset of new and severe back pain, with or without fever, following an invasive spine procedure (*panel consensus opinion*).
- Clinical features predicting the presence of vertebral infection have not been well studied, but may include fever above 38°C (100.4°F) for greater than 48 hours; new moderate or severe pain following an invasive spine procedure (Chou et al., 2007; *Institute for Clinical Systems Improvement* ((*ICSI*) Goertz et al., 2012); and disproportionate back pain (*panel consensus opinion*).
- Risk factors for spinal infection include intravenous drug use, immunosuppression, recent infection, and history of tuberculosis or active tuberculosis (Chou et al., 2007; *ICSI*, (Goertz et al., 2012)).
- ESR and/or C-reactive protein (CRP) can be useful to direct care in patients with indeterminate findings on MRI and/or CT. The ESR is elevated in 88-100% of patients with confirmed spine infections and shows a correlation with epidural abscess (Beronius et al., 2001; Bettini et al., 2009; Carragee, 1997; Chelsom & Solberg, 1998; Hopkinson et al., 2001 – see supplemental evidence table). The CRP is less sensitive, but more specific.
- The ESR and CRP can be normal in patients with vertebral osteomyelitis and Foquet et al. (1996) state that their "experience suggests that magnetic resonance imaging should be performed in every patient with radiographic or clinical manifestations suggestive of infectious discitis, irrespective of whether there is a history of invasive procedures on the spine".
- STIR or T2 fat saturation images are useful to identify marrow edema and paraspinous/ epidural edema, phlegmon, or abscess.
- Diffusion-weight imaging (the "claw sign") may help differentiate inflammatory disc degeneration from vertebral spondylodiscitis (Patel et al., 2014).
- Imaging with IV contrast is useful to differentiate phlegmon from abscess (*ACR* (Patel et al. 2016)).

<u>Evidence update (2010-present):</u>
There were no new studies which significantly affected the conclusions and recommendations from the guidelines noted above. Specific studies of interest are summarized below.

van Rijn et al. (2012) – Systematic review found no studies addressing the accuracy of CT for vertebral infection, neoplasm, and fracture (moderate level of evidence).

Ledbetter et al. (2016) - In a retrospective case control study of 50 patients who underwent MRI for suspected infection, MRI was 98% accurate for lumbar discitis/osteomyelitis. High positive likelihood ratios, which indicate an increase in the probability of disease with a positive result, were identified with epidural phlegmon (15.8), psoas abscess (14.9), diffuse vertebral body enhancement (12.1), and psoas T2 hyperintensity (11.5) (moderate level of evidence).

Exclusions: WBC scan/Ga scan

Cauda equina syndrome and major or progressive neurological deficit:

Strong recommendation for imaging:

- MRI

Conditional recommendation for imaging:

- CT myelography patients unable to undergo MRI
- CT myelography to evaluate indeterminate findings on MRI
- CT myelography in a patient undergoing planning for surgery with or without prior MRI

Conditional recommendation against imaging:

- Plain CT for cauda equina

Recommendation against imaging

- Bone scan, PET

Level of Evidence: Moderate

Notes concerning applicability and/or patient preferences: None

Summary of evidence:
There is agreement among three high-quality guidelines that imaging is indicated when cauda equina is clinically suspected. The majority of guidelines recommend MRI as the preferred imaging modality.

Chou et al. (2007) recommends imaging with MRI or CT when patients have clinical signs or symptoms consistent with cauda equina, or when severe or progressive neurologic deficits are present (strong recommendation, moderate quality evidence). MRI is generally preferred over CT, as it does not use ionizing radiation and provides better visualization of soft tissue, the vertebral marrow, and the spinal canal.

ACR (Patel et al., 2016) recommends urgent MRI (9) or CT/x-ray myelography (6) in patients with suspected cauda equina syndrome (new onset urinary incontinence with low back and/or radicular pain); in patients with multifocal neurologic deficits; and in patients with progressive neurological deficits. The imaging study of choice is MRI because of its ability to accurately evaluate soft tissue abnormalities, the vertebral marrow spaces, and the central canal. CT myelography or x-ray myelography can be used as an alternative in patients with contraindications to MRI.

Clinical notes:

- Immediate imaging is recommended in patients when features suggest cauda equina syndrome (CES), or for severe or progressive neurologic deficits at one or multiple levels (Chou et al., 2011). Timely diagnosis may prevent serious sequelae with these entities.
- Key signs of cauda equina syndrome include new urine retention/overflow incontinence, saddle anesthesia, fecal incontinence, and bilateral leg weakness/parasthesias. Patients

should be examined for decreased anal tone, bilateral leg weakness, and perineal numbness (*ICSI* (Goertz et al., 2012); Ahad et al., 2015; Balasubramanian et al., 2010). A combination of signs and symptoms may increase the specificity for CES.

- Urinary retention of more than 500 ml alone, or with bilateral sciatica and rectal incontinence, are more accurate predictors of CES. Pre- and post-void bladder ultrasound could help with the clinical assessment for cauda equina syndrome (Balasubramanian et al., 2010).

Evidence update (2010-present):
There were no new studies which significantly affected the conclusions and recommendations from the guidelines noted above. Specific studies of interest are summarized below.

Ahad et al. (2015) - Retrospective study of 79 patients with suspected cauda equina syndrome found no association between specific clinical features (fecal incontinence, urinary retention, bladder incontinence, constipation, saddle anesthesia) and the presence of CES on MRI (low level of evidence). Findings included decreased anal tone 7.6% (p=0.282), fecal incontinence 3.8% (p=0.648), urinary retention 7.6% (p=0.510), bladder incontinence 8.9% (p=0.474), constipation 2.5% (p+0.011), and saddle anesthesia 8.9% (p=0.368) (low).

Balasubramanian et al. (2010) - Retrospective study of 80 patients in a tertiary neurosurgical practice found only saddle anesthesia to have a statistically significant association with CES (p = 0.03) (low level of evidence). The authors conclude: "however, no symptom or sign has an absolute predictive value in excluding CES. MRI is the widely accepted standard for the rapid and complete evaluation of a patient with clinically significant spinal pathology and should be obtained emergently when the diagnosis of CES is suspected. Therefore, all patients with features arousing a reasonable clinical suspicion of CES must undergo urgent MRI."

Exclusions: Major trauma to detect or exclude fracture

Low back pain with suspected fragility fracture in patients with abnormal or indeterminate x-rays:

Strong recommendation for imaging:

- MRI

Conditional recommendation for imaging:

- CT (to evaluate cases which are indeterminate on MRI or to evaluate for vertebroplasty)
- CT or MRI in a patient with a normal x-ray (consider follow-up x-ray)
- Bone scan (unable to differentiate from degenerative changes)

Recommendation against imaging:

- PET

Level of Evidence: Moderate

Notes concerning applicability and/or patient preferences: None

Summary of evidence:
Four out of five guidelines recommend imaging to exclude fracture in patients with trauma, osteoporosis, and/or chronic steroid use. Three out of four guidelines recommend initial evaluation with radiography. There is no concordance on when CT or MRI should be used following evaluation with radiography.

Chou et al. (2011) recommends plain x-ray for the initial evaluation of high-risk patients with suspected vertebral compression fractures.

The *ACR* (Patel et al., 2016) recommends x-ray (7) as the initial imaging study, especially in patients with osteoporosis or chronic steroid use. It recommends CT (7) if there is persistent concern for vertebral body fracture and MRI (7) to evaluate for ligamentous injury or worsening neurologic deficit.

The *panel consensus opinion* was that MRI was the most appropriate initial imaging modality (after the initial x-ray), as the detection of marrow edema is paramount to determining the chronicity of fracture deformities. CT is only indicated to plan for vertebroplasty/kyphoplasty or to differentiate benign from pathologic fractures if indeterminate on MRI. Pathologic fractures typically show decreased bone density or osteolysis adjacent to the involved endplate on CT, while benign fractures show increased bony density. In patients with more substantial trauma, CT is indicated for the initial evaluation.

Clinical notes:

- Risk factors for fragility fracture are osteoporosis, chronic steroid use, and age > 55. The *panel consensus opinion* was that disproportionate pain was a sign of fracture.
- Repeat x-ray should be considered if moderate or severe pain persists at 2-4 weeks.

- MRI examinations should include sagittal STIR or T2 fat saturation images to evaluate for marrow edema.
- Consider inclusion of T1, T2, or STIR coronal MRI images through the spine and sacrum to evaluate for sacral insufficiency fractures, which also occur frequently in this patient group.

Evidence update (2010-present):
There were no new studies which significantly affected the conclusions and recommendations from the guidelines noted above. Specific studies of interest are summarized below.

Downie et al. (2013) – A red flag for fracture (older age, prolonged steroid use, trauma, and contusion or abrasion) increased the probability of fracture to between 10% and 33%, while the presence of multiple red flags increased the probability of fracture to between 42% and 90 % (high level of evidence).

Williams et al. (2013) - These tests (prolonged use of corticosteroids, significant trauma and age > 74 years) taken from a patient's presenting history, all showed a range of LR+ that appeared meaningful (point estimate: 3.97-48.50; 3.42 - 12.85; 3.69 - 9.39) (moderate level of evidence).

van Rijn et al. (2012) – Systematic review found no studies addressing the accuracy of CT for vertebral infection, neoplasm, and fracture (moderate level of evidence).

Exclusions: none

Low back pain (including patients with uncomplicated* radiculopathy and/or stenosis) with no red flags and no conservative therapy:

Conditional recommendation against imaging:

- MRI
- CT
- Bone scan

Recommendation against imaging:

- PET

*Including patients with sensory and mild motor symptoms, single muscle group involvement, or mild weakness.

Level of Evidence: High

Notes concerning applicability and/or patient preferences: Patient education is essential to patient acceptance (*ICSI*, (Goertz et al., 2012); Chou et al., 2007) (strong recommendation, moderate quality evidence).

Summary of evidence:
Nine out of ten guidelines recommend against any form of imaging in patients with low back pain who have not first attempted conservative care.

Chou et al. (2007) states that "clinicians should not routinely obtain imaging or other diagnostic tests in patients with non-specific low back pain" (strong recommendation, moderate quality evidence).

Similarly, both *ACR* (Patel et al., 2016) and *ICSI* (Goertz et al., 2012) state that clinicians should not recommend imaging for patients with non-specific low back pain, without red flags, prior to an appropriate course of conservative care (*ICSI* with strong recommendation, moderate quality evidence).

Clinical notes:

- Red flags include a clinical or radiographic suspicion of cancer or infection; significant trauma; and major, progressive, or multilevel neurological deficit.
- This does not include patients who are candidates for urgent or immediate surgical intervention.
- Conservative therapy may include manipulation, exercise, physical therapy, pharmacological therapy, or time (if the patient is unable or unwilling to undergo available non-invasive treatments).
- High-quality studies have shown that early imaging does not improve outcome and does not result in psychological benefits. Routine imaging is ineffective because acute low

back pain has a favorable natural history and shows significant improvement in most patients in the first 4 weeks (Chou et al., 2011).

- Practitioners should emphasize that acute low back pain is nearly always benign; generally resolves within 1-6 weeks (*Institute of Health Economics*, 2011); and the first-line treatment for low back pain is conservative care (*ACR* (Patel et al., 2016)).
- Most clinical guidelines recommend an interval of 4-6 weeks of conservative care prior to imaging.

Evidence update (2010-present):
New studies reinforce the guideline recommendations noted above and increase the level of evidence to high.

Jarvik et al. (2015) - Prospective cohort of 5239 patients over age 65, with low back pain compared early imaging with radiography and/or MRI/CT to delayed imaging (4-6 weeks) using propensity score matching. There were no clinically significant differences in primary RMDQ pain questionnaire, numerical pain rating, or brief pain inventory at 3, 6 or 12 months. Only one case (0.06%) of cancer (lymphoma) was diagnosed on the early imaging study. Patients who underwent imaging diagnostics early had more fractures detected (2% in the early radiograph group vs 0.6% in the no early or no radiograph group; 0.9% in the early MRI/CT group vs 0% in the no early or no MRI/CT group). Early imaging was not associated with better one-year outcomes (moderate level of evidence).

Srinivas & Berger (2012) - High-quality, consistent evidence shows that imaging patients with acute low back pain of less than 6 weeks' duration and no red flag symptoms results in no clinical benefit, but is associated with harms, including patient labeling, irradiation exposure, and unnecessary surgery (low level of evidence).

Graves et al. (2012) - Prospective study of 1226 workers with disability claims found that early (before 6 week) MRI did not improve patient-centered outcomes (as assessed by RDQ and SF-36), and is in fact associated with an increased likelihood and duration of disability (moderate level of evidence).

Exclusions: Major trauma

Low back pain/radiculopathy with moderate to severe pain and/or dysfunction and:

- **Failure of conservative therapy (including uncontrolled pain and/or marked disability, pain increasing during conservative therapy, and moderate to severe pain and/or dysfunction persisting after an appropriate trial of conservative therapy for a period of 4-6 weeks);**
- **Persistent or recurrent symptoms following discectomy; or**
- **Evaluation for injection therapy or surgery**

Strong recommendation for imaging:

- MRI

Conditional recommendation for imaging:

- CT or CT myelography in a patient unable to undergo MRI
- CT or CT myelography in a patient with discordant MRI findings and symptoms
- CT or CT myelography in a patient undergoing surgical planning following MRI
- CT as the initial study without contraindications to MRI

Conditional recommendation against imaging:

- CT myelography as the initial study without prior MRI and without contraindications to MRI (because of the increased risks with myelography)

Recommendation against imaging:

- Bone scan, PET

Level of Evidence: High

Notes concerning applicability and/or patient preferences: Patient education is essential to patient acceptance (ICSI (Goertz et al., 2012); Chou et al., 2007) (strong recommendation, moderate quality evidence).

Summary of evidence:
Chou et al. (2007) recommends advanced imaging (MRI or CT) in patients with low back pain and clinical signs of radiculopathy only if they are candidates for surgery or epidural steroid injections (strong recommendation, moderate evidence).

The North American Spine Society (*NASS*, 2012) recommends MRI for the diagnosis of disc herniation in patients with history and physical examination consistent with radiculopathy (Grade A). NASS states that CT, myelography, and CT myelography are appropriate to confirm the presence of a lumbar disc herniation in patients with history and physical examination consistent with radiculopathy (Grade A).

The *ACR* (Patel et al., 2016) recommends MRI (8), CT (5) or CT myelography/x-ray myelography (5) for the imaging of patients with persistent or progressive symptoms during or following 6 weeks of conservative care.

ICSI (Goertz et al., 2012) recommends MRI or CT to rule out underlying pathology for those patients considering epidural steroid injections or surgery (strong recommendation, moderate quality evidence).

Clinical notes:

- Clinicians should consider using validated tools to assess and follow pain and disability.
- The natural history of lumbar disc herniation with radiculopathy in most patients is for improvement in the first 4 weeks with non-invasive therapy.
- Early treatment of radiculopathy is non-invasive and may consist of manipulation, exercise therapy, physical therapy, or pharmacologic therapy.
- Failure of conservative care can be defined as moderate to severe persistent symptoms following an appropriate period of conservative care (typically 4-6 weeks), uncontrolled pain, marked limitation of function, increased pain during conservative care, or inability to participate in non-invasive care for an appropriate period of time.
- Findings on MRI and CT are non-specific and require strict correlation of symptoms and findings on physical exam to determine the significance.

Evidence update (2010-present):
There were no new studies which significantly affected the conclusions and recommendations from the guidelines noted above. Specific studies of interest are summarized below.

van Rijn et al. (2012) - Systematic review with six studies evaluating the accuracy of CT for lumbar disc herniation used surgical findings as the reference standard and were considered sufficiently homogenous to carry out a meta-analysis. The pooled summary estimate of sensitivity was 77.4% and specificity was 73.7% (moderate level of evidence).

Wassenaar et al. (2012) - Systematic review with five studies comparing MRI to findings at time of surgery for identifying lumbar disc herniation (HNP). Pooled analysis resulted in a summary estimate of sensitivity of 75% (95% CI 65–83%) and specificity of 77% (95% CI 61–88%) (moderate level of evidence).

el Barzouhi et al. (2013) – Observational study assessed the MRI observer variation in patients with sciatica who are potential candidates for lumbar disc surgery. Excellent agreement was found on the affected disc level (kappa range 0.81-0.86) and the nerve root that most likely caused the sciatic symptoms (kappa range 0.86-0.89). Inter-observer agreement was moderate to substantial for the probability of disc herniation (kappa range 0.57-0.77) and the probability of nerve root compression (kappa range 0.42-0.69) (high level of evidence).

Exclusions: Persistent or recurrent radiculopathy following fusion surgery; major trauma

Lumbar spinal stenosis with neurogenic claudication, moderate or severe standing pain, significant limitations of function and:

- **Inability to perform the activities of daily living;**
- **Failure of conservative therapy (including moderate or severe pain and/or dysfunction persisting following an appropriate trial of non-invasive conservative therapy for 6 weeks);**
- **Evaluation for injection therapy, and/or**
- **Candidate for surgical decompression**

Strong recommendation for imaging:

- MRI

Conditional recommendation for imaging:

- CT/CT myelography in a patient unable to undergo MRI
- CT/CT myelography in a patient with discordant MRI findings and symptoms
- CT/CT myelography in a patient undergoing surgical planning following MRI
- CT as the initial study without prior MRI or without contraindications to MRI

Conditional recommendation against imaging:

- CT myelography as the initial study without prior MRI and without contraindications to MRI

Conditional recommendation against imaging:

- Bone scan, PET

Level of Evidence: High

Notes concerning applicability and/or patient preferences: Patient education is essential to patient acceptance (*ICSI* (Goertz et al., 2012); Chou et al., 2007) (strong recommendation, moderate quality evidence).

Summary of evidence:
Chou et al. (2007) recommends advanced imaging (MRI or CT) in patients with low back pain and clinical signs of lumbar spinal stenosis only if they are candidates for surgery or epidural steroid injections (strong recommendation, moderate quality evidence).

NASS (Goertz et al., 2011) recommends MRI in patients with history and physical examination consistent with lumbar spinal stenosis (Grade B). NASS recommends CT myelography in patients with history and physical examination consistent with lumbar spinal stenosis who cannot undergo MRI, or for whom the MRI is inconclusive (Grade B). *NASS* recommends CT in patients with history and physical examination consistent with lumbar spinal stenosis for whom MRI and CT myelography are contraindicated, inappropriate, or inconclusive (Grade B).

ICSI recommends MRI or CT to rule out underlying pathology for those patients considering

epidural steroid injections or surgery (strong recommendation, moderate quality evidence).

Clinical notes:

- Clinicians should consider using validated tools to assess and follow pain and disability.
- Early non-invasive, conservative treatment of lumbar spinal stenosis may consist of manipulation, exercise therapy, physical therapy or pharmacologic therapy, or time (for patients unable or unwilling to undergo available non-invasive treatments).
- Failure of conservative care can be defined as moderate to severe persistent symptoms following an appropriate period of conservative care (typically 4-6 weeks), uncontrolled pain, marked limitation of function, increased pain during conservative care, or inability to participate in non-invasive care after an appropriate period of time.
- Findings on MRI and CT are non-specific and require strict correlation of symptoms and findings on physical exam to determine the significance.
- The use of well-defined, articulated, and validated criteria for assessing dural sac narrowing on MRI, CT or CT myelography is recommended to improve inter-observer and intra-observer reliability (*NASS*, 2011; Grade B).

Evidence update (2010-present):
There were no new studies which significantly affected the conclusions and recommendations from the guidelines noted above. Specific studies of interest are summarized below.

Wassenaar et al. (2012) Systematic review included two studies describing the accuracy of MRI in the identification of spinal stenosis and using surgery as the reference standard (moderate level of evidence). These studies showed high sensitivities of 87 and 96% and lower specificities of 68 and 75%.

Exclusions: Persistent or recurrent radiculopathy following fusion surgery

Non-specific low back pain (moderate or severe) with significant limitation of function and:

- **Failure of conservative therapy (including uncontrolled pain and/or marked disability, pain increasing during conservative therapy, and moderate to severe pain and/or dysfunction persisting after an appropriate trial of conservative therapy for 8-12 weeks); or**
- **Evaluation for injection therapy or surgery**

Strong recommendation for imaging:

- MRI

Conditional recommendation for imaging:

- CT in a patient unable to undergo MRI
- CT in a patient undergoing surgical planning following MRI
- CT as the initial study without contraindications to MRI

Conditional recommendation against imaging:

- Bone scan in patients with indeterminate or inconclusive MRI or CT scans
- CT myelography without neurogenic claudication and/or radiculopathy
- PET

Level of Evidence: Low

Notes concerning applicability and/or patient preferences: Patient education is essential to patient acceptance (*ICSI* (Goertz et al., 2012); Chou et al., 2007) (strong recommendation, moderate quality evidence).

Summary of evidence:
There is agreement among multiple high-quality guidelines that imaging should not be performed in patients with low back pain, with no red flags or high-risk features, without a period of conservative care. The guidelines reviewed do not specifically address the imaging of patients with moderate to severe non-specific low back pain and dysfunction who have failed an appropriate course of non-invasive therapy. These cases are typically referred to the spine subspecialist. The decisions by the spine subspecialist to image the patient are largely predicated on the need to exclude underlying pathologies, to assess for injection therapy, and to assess for surgery. The recommendations made above are supported by consensus agreement and are predicated on the ability of MRI to visualize soft tissue pathology, marrow abnormalities, neural elements, and the spinal canal. CT is indicated for patients who cannot undergo MRI and for patients who have indeterminate findings on MRI. CT is also useful in patients who have undergone fusion surgery to assess for nonunion, although this body of literature was not reviewed for this version of the guideline.

The *ACR* (Patel et al., 2016) recommends MRI (8), CT (5) or x-ray/CT myelography (5) for patients with acute, subacute, or chronic low back pain who are surgical or intervention candidates with persistent or progressive symptoms during or following a course of conservative

management.

ICSI (Goertz et al., 2012) recommends MRI or CT should be done to rule out underlying pathology or for those who are considering surgery or injection therapy (strong recommendation, moderate quality evidence).

Clinical notes:

- Clinicians should consider using validated tools to assess and follow pain and disability.
- Practitioners should emphasize that acute low back pain is nearly always benign; generally resolves within 1-6 weeks (*Institute of Health Economics*, 2011); and the first-line treatment for low back pain is conservative care (*ACR* (Patel et al., 2016).
- Conservative care may consist of spinal manipulation, exercise therapy, physical therapy, cognitive behavioral therapy, intensive interdisciplinary rehabilitation, massage therapy, acupuncture, yoga, pharmacologic therapy, progressive relaxation, or time (for patients unable or unwilling to undergo available non-invasive treatments) (Chou et al., 2007).
- Clinicians should consider alternative or additional layers of conservative care if the patient is not improving at the time of re-evaluation at 2-6 weeks.
- Clinicians should consider the use of x-ray, depression screening (PHQ-2) and a fear-avoidance survey at the time of re-evaluation at 2-6 weeks.
- In referring patients with non-specific low back pain who have failed non-invasive therapies, other published guidelines suggest referring patients to a spine specialist after a period of 3 months or longer (Chou et al., 2007).

Evidence update (2010-present):
There were no new studies which significantly affected the conclusions and recommendations from the guidelines noted above.

Exclusions: Patients with prior fusion surgery

The material for this guideline was developed by the CDI Quality Institute's Provider Led Entity (PLE) and its Spine Subject Expert Panel. The PLE is federally qualified to develop Appropriate Use Criteria for advanced imaging studies. The criteria was finalized in March, 2017.

This is a guideline, not a policy. It is a summary and distillation of relevant subspecialty guidelines. The purpose of the CDI Quality Institute guidelines is to facilitate and accelerate the integration of medical evidence and best practices into daily clinical practices. Guidelines provide relevant medical evidence to support the development of policies within each individual practice. Guidelines should be adjusted for local standards of care, associated hospital or network policies, hospital versus outpatient settings, different patient populations, availability of resources, different experience levels, individual patient circumstances and different risk-tolerance profiles. Local practice policies should also be modified to account for new information or publications that become available between guideline revisions.

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