CHAPTER 9

Red Flags in Musculoskeletal and Neuropathic Pain

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Summary

Red flags in musculoskeletal (MSK) and neuropathic pain represent clinical warning signs that may indicate serious underlying pathology requiring urgent evaluation. Although the majority of back and limb pain presentations are benign and self-limiting, a small but clinically significant proportion are attributable to fracture, infection, malignancy, vascular compromise, or neurologic compression syndromes such as cauda equina. This chapter provides a comprehensive review of red flag indicators across spinal, limb, and neuropathic pain conditions, integrating evidence-based guidelines with practical clinical reasoning. Key historical features, including prior malignancy, unexplained weight loss, fever, immunosuppression, steroid use, and significant trauma, are discussed alongside critical examination findings such as progressive motor deficits, saddle anesthesia, bowel or bladder dysfunction, disproportionate limb pain, and vascular insufficiency. The diagnostic accuracy of individual red flags is examined, highlighting their generally low sensitivity and limited standalone predictive value, while emphasizing the increased utility of clustered findings and context-specific assessment. Differences in application between primary care and emergency settings are explored, underscoring the importance of balancing early detection with avoidance of unnecessary imaging. Early recognition of MSK red flags is critical to avoid delayed diagnosis, irreversible disability, and adverse patient outcomes. A systematic approach combining careful clinical assessment with appropriate investigations supports timely diagnosis, safe referral, and effective management. Vigilance for red flag features also has important ethical and medicolegal implications, underscoring the need for sound clinical judgment in everyday practice.

Keywords

- red flags
- musculoskeletal pain
- neuropathic pain
- cauda equina syndrome
- compartment syndrome

9.1 Introduction

"Red flags" are warning signs in musculoskeletal (MSK) and neuropathic pain suggesting a serious underlying condition. By definition, red flags are clinical features (history or examination findings) that raise suspicion of some potentially severe pathology.[1] Examples include unexplained weight loss, fever, history of cancer or immunosuppression, severe trauma, progressive neurological deficits, or bowel/bladder dysfunction.[2] Although red flags are neither highly sensitive nor specific individually, their recognition is crucial for patient safety. In primary care, clinicians must actively screen for red flags in each new MSK or neuropathic pain patient.[3] In emergency departments (EDs), urgent red flags trigger immediate workup, whereas their absence permits conservative management.[2] This chapter reviews key red flags across spinal, limb, and neuropathic pain conditions, with emphasis on evidence-based guidelines. Recognizing these signs early helps avoid serious diagnostic delays and ethical breaches in patient care.

9.2 Definition and Role of Red Flags

"Red flags" are typically defined as clinical findings (history or examination) that raise suspicion of a serious underlying condition (e.g., fracture, infection, malignancy, cauda equina syndrome) requiring further investigation. Most guidelines and reviews agree on this general concept, but the precise definition varies. Clinical practice guidelines describe red flags as signs/symptoms indicating possible serious pathology that warrant further testing or referral.[3] The lack of a uniform definition leads to inconsistency in how clinicians interpret and act on red flags, especially in settings where primary care clinicians evaluate patients directly. Clinicians must have strong differential diagnostic skills to identify rare but serious mimics of benign MSK pain.

For example, only about 1 to 4% of back pain cases have a specific serious etiology (e.g., fracture, infection, cancer, cauda equina syndrome). By contrast, roughly 90% of low back pain is nonspecific. In primary care and first-contact settings, this means clinicians see mostly benign pain, and serious pathology is rare. Nevertheless, the consequences of missing a serious diagnosis can be severe. Thus, red flag screening is intended to detect the small fraction of cases that need urgent intervention. Therefore, screening tools must be highly sensitive.

9.3 Screening for Red Flags: Outpatient and Emergency Settings

In outpatient clinics, history-taking and physical examination should explicitly address red flag queries. Clinicians ask about systemic symptoms (e.g., unexplained fever, night sweats, weight loss), risk factors (e.g., cancer, steroid use, intravenous [IV] drug use), and neurologic warning signs.[2]

In the ED, red flag screening emphasizes acute deterioration. ED evaluation typically begins with a focused history/neurologic examination: If no red flags are found, one may manage conservatively and advise return precautions.[4] If any red flag is present, immediate investigation is warranted. Guidelines emphasize that positive red flags necessitate imaging or specialist consult, but negative responses do not entirely exclude serious pathology.[5] For instance, retrospective data found around 64% of spinal malignancy cases had no apparent red flags, so clinicians should maintain suspicion.[5] In summary, whether in the outpatient department or the ED, a structured screening, often via checklists, is used: Affirmative responses to any red flag question trigger prompt further workup (**Fig. 9.1**).[5]

9.3.1 Common Red Flags

Typical red flags include a mix of patient history factors, symptoms, and examination findings. Reviews and guidelines list dozens of potential red flags; common red flag items include advanced age (e.g., >50 or >70), history of cancer or systemic disease, severe or progressive neurological signs (e.g., saddle anesthesia, motor weakness, bowel/bladder dysfunction), history of trauma, night pain or severe unremitting pain, unexplained weight loss, fever or recent infection, corticosteroid use or immunosuppression, and more.[6] Spinal infection often presents with the "classic triad" of severe back pain, fever, and neurological dysfunction.[7]

9.3.2 Spinal Red Flags

Back and neck pain are among the most common complaints, but clinicians must identify signs of serious spine pathology. Key spinal red flags include the following:

- **Trauma/fracture:** Major trauma (e.g., fall from height, car accident) or minor trauma in an osteoporotic patient, age >50 years, long-term steroid use, or conditions like osteoporosis[8] suggest possible vertebral fractures. Guidelines recommend screening for vertebral fracture if patients have severe or prolonged low back pain plus any of these risk factors.[8] Reviewers note that older age and steroid use are repeatedly endorsed red flags for fracture, though their diagnostic accuracy alone is modest.
- **Cancer/metastasis:** A history of cancer is a high-risk red flag. New-onset spinal pain in a patient with known malignancy, especially with unexplained weight loss or night pain (severe pain at rest or sleep), should trigger evaluation for metastatic disease. Merck manuals note that bone

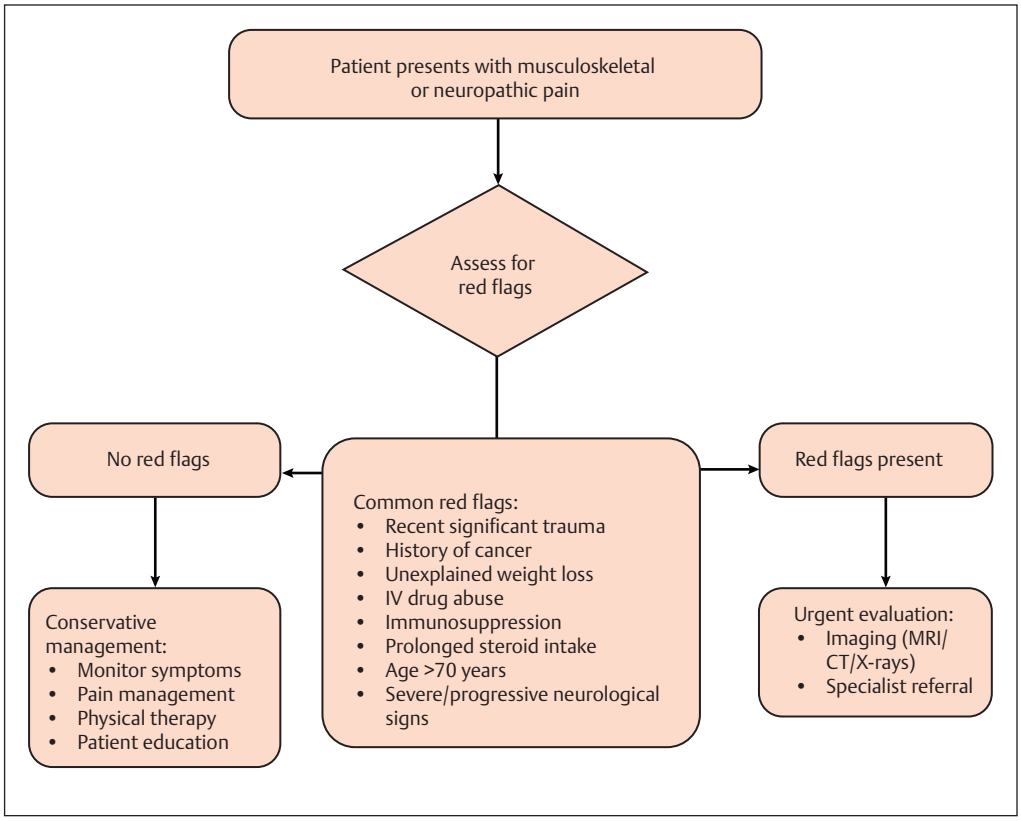


Fig. 9.1 Flowchart for red flag screening in musculoskeletal (MSK)/neuropathic pain.

tumors (primary or metastatic) classically cause deep, constant, often nocturnal pain with focal tenderness. Similarly, nonspecific systemic signs like fever or night sweats may indicate spinal infection or malignancy.

- **Infection:** Risk factors for spinal infection include IV drug use, immunosuppression (human immunodeficiency virus [HIV], diabetes, steroids), recent infection (e.g., urinary tract infection [UTI]), or spinal procedures (e.g., epidural injections). Patients often have fever, elevated inflammatory markers, and severe pain (often worse at night) that may progress rapidly. Clinical red flags for spinal epidural abscess or vertebral osteomyelitis include fever + back pain + focal tenderness on percussion. Any suspicion warrants urgent imaging (magnetic resonance imaging [MRI]).[7]
- **Cord compression/cauda equina:** Neurologic deficits in the lower limbs or saddle region are red flags for spinal cord or cauda equina compression. Symptoms include bilateral leg weakness or numbness, saddle anesthesia, urinary retention or incontinence, and loss of anal sphincter tone.[9] The American College of Emergency Physicians (ACEP) guidelines explicitly list "bowel/bladder/erectile dysfunction, saddle anesthesia, progressive bilateral leg weakness" as cauda equina red flags.[9] These warrant immediate MRI and neurosurgical consultation. Even isolated painless urinary retention is ominous.[9] Early recognition is vital, as delayed decompression in cauda equina syndrome leads to poor outcomes and medicolegal risk (**Fig. 9.2**).
- **Vascular emergencies:** Severe spinal or back pain with circulatory signs may indicate

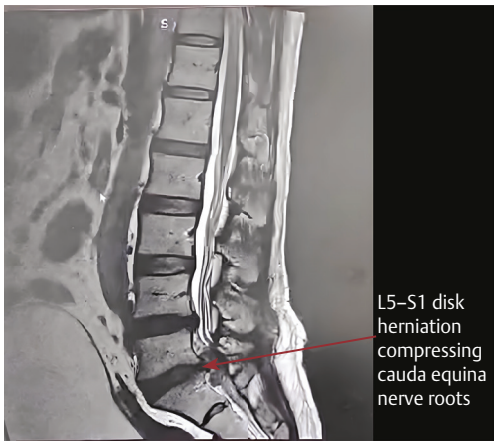


Fig. 9.2 Magnetic resonance imaging (MRI) finding: cauda equina syndrome.

vascular compromise, for example, aortic aneurysm or dissection. Aortic pathology can present as back or flank pain radiating to the groin; pulses may be unequal. History of vascular disease and acute onset of tearing pain are red flags. Clinicians should consider an aortic aneurysm in older patients with cardiovascular risk factors. Likewise, spinal epidural hematoma is a rare but critical cause of acute cord compression, often in patients on anticoagulation or with coagulopathy.[10]

9.3.3 Limb and Extremity Red Flags

Red flags also apply to extremity pain. Examples include the following:

- **Fracture:** Acute significant trauma, inability to bear weight or use the limb, obvious deformity, or osteoporosis suggests a fracture. Even in low-energy injuries, consider fractures in the elderly or osteoporotic patients. Limb swelling, deformity, and tenderness on bony palpation are clues.[11]
- **Compartment syndrome:** Severe limb pain out of proportion to examination, pain on passive stretch, tense swelling, and paresthesias signal compartment syndrome. This is a surgical emergency (**Fig. 9.3**).[11]
- **Vascular compromise:** Sudden onset of severe limb pain with pallor, pulselessness, coolness, and paresthesias are classic for acute arterial occlusion. Merck notes that sudden, severe pain plus signs of distal ischemia (cool, pale, absent pulses) are red flags that require immediate vascular imaging/intervention. Risk factors include cardiac embolic sources or known peripheral vascular disease.[4]
- **Infection (soft tissue/bone):** Deep soft tissue infection (necrotizing fasciitis) presents with severe, disproportionate pain, tense edema, erythema, fever, and systemic toxicity (delirium, shock).[4] Cellulitis with rapid progression or an open wound in an immunocompromised patient is concerning. Bone infection (osteomyelitis) often causes deep, constant, nocturnal bone pain and fever, especially in those with risk factors (e.g., diabetes, IV drug use). Chronic infections or ulcerations also count as red flags.[4]
- **Neurologic deficit:** Limb weakness, loss of reflexes, or sensory loss outside a simple strain or sprain is a red flag. For example, unexplained foot drop or progressive hand weakness with burning pain merits neuroimaging and electrodiagnostics. Any new focal neurologic deficit (motor or sensory) in a limb warrants investigation.[11]
- **Tumor:** Primary bone tumors or metastases often present insidiously. Clues include deep, constant bone or joint pain (often worse at night), a palpable mass, or known cancer history. Unexplained bone pain at rest or weight loss suggests malignancy. In children, consider leukemia in diffuse limb pain with systemic symptoms.[4]
- **Vascular stasis/thrombosis:** Sudden leg pain/swelling without trauma raises deep vein thrombosis (DVT) suspicion (red flag: risk factors, leg swelling, erythema). Though not directly related to pain management, leg DVT can cause pain and must be ruled out when risk factors are present.[4]

9.3.4 Summary Checklist of Red Flags

- **History:** Age <18 or >50 years, history of cancer, unexplained weight loss, prolonged corticosteroid use, IV drug use or immunosuppression, recent fever or infection, recent significant trauma, pain

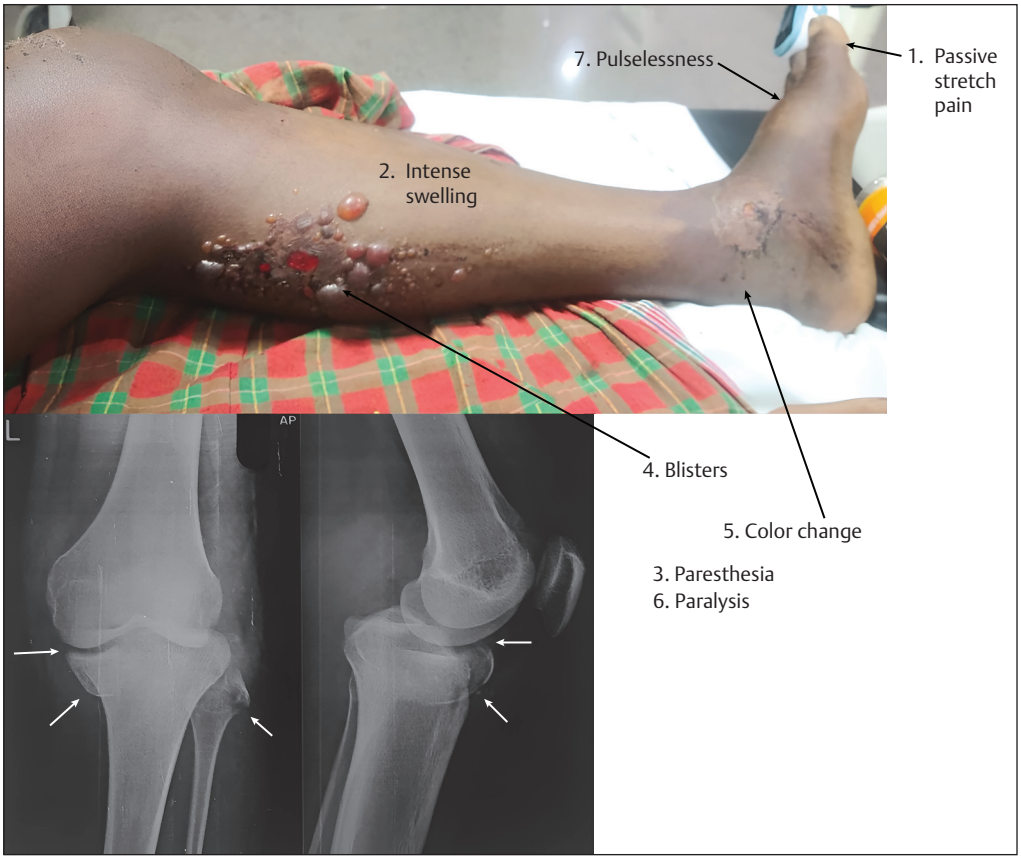


Fig. 9.3 Clinical red flags in limb vascular compromise/compartment syndrome. (The *white arrows* denote the fracture.)

at night/rest, bowel/bladder changes, and severe headache or vomiting (for neck pain).

- **Pain characteristics:** Severe/worsening pain unrelieved by rest or analgesics; "worst ever" or different from past; pain with cough/strain, which suggests spinal pathology; and pain out of proportion (for compartment or infection).
- **Neurologic:** New onset motor weakness, sensory deficit (especially bilateral or dermatomal), diminished reflexes, saddle anesthesia, ataxia, and cranial nerve changes.
- **Vascular/other:** Cold, pale limb; absent pulses in extremity; focal erythema/swelling/infection signs; and chest pain or dyspnea associated with pain (referred myocardial/peripheral ischemia).

Positive responses to any of the above items warrant imaging or specialist referral (**Table 9.1**).

9.4 Diagnostic Accuracy and Predictive Value

Despite their widespread use, the evidence on diagnostic performance of red flags is generally weak. Multiple systematic reviews have found that single red flag findings are poor screening tests by themselves. For example, nearly all red flag historical and examination features for serious spinal pathology had negative likelihood ratios (−LR) close to 1.0, meaning a negative finding does not effectively rule out disease.[12] Cook et al similarly argued that, contrary to textbook teaching, most red flags neither rule out nor rule in serious pathology. In their narrative review, Cook et al point out that routine red flag screening lacks evidence for improving diagnosis and may lead to unnecessary testing. They conclude that clinicians should consider watchful waiting and value-based care, rather than relying on poor-performing screens.[13]

Table 9.1 Checklist of red flag screening questions

Domain	Screening question/ clinical finding	Possible underlying condition	Recommended action
History: trauma	Recent significant trauma or fall?	Vertebral or limb fracture	X-ray/CT imaging
	Minor trauma in osteoporotic or elderly patient?	Compression fracture	Spine imaging
History: cancer	Known malignancy?	Spinal or bone metastasis	MRI ± oncology referral
	Unexplained weight loss?	Malignancy	MRI and systemic evaluation
History: infection	Fever, night sweats, IV drug use, and recent infection?	Spinal infection/epidural abscess	Urgent MRI + labs
	Immunosuppression (HIV, steroids, and diabetes)?	Infection or pathological fracture	Infection workup
Age/risk factors	Age >50 y with new/ worsening pain?	Compression fracture/ malignancy	Imaging recommended
Pain characteristics	Severe, constant, or nocturnal pain?	Cancer, infection, and fracture	Imaging evaluation
	Pain at rest, not relieved by analgesics?	Malignancy/infection	Further investigation
	Pain out of proportion to examination?	Compartment syndrome/ deep infection	Emergency surgical evaluation
	Progressive pain >6 wk unexplained?	Tumor/chronic infection	Advanced imaging
Neurologic: motor	Progressive weakness or focal motor deficit?	Nerve root or cord compression	Urgent MRI
Neurologic: sensory	Saddle anesthesia?	Cauda equina syndrome	Emergency MRI
	Bilateral leg numbness or weakness?	Cord compression	Immediate imaging
Bowel/bladder	Urinary retention, incontinence, and fecal dysfunction?	Cauda equina syndrome	Emergency MRI + neurosurgical consult
Vascular: limb	Sudden severe limb pain + pallor, pulselessness, and cold limb?	Acute arterial ischemia (6 Ps: pain, paresthesia, pallor, poikilothermia, paralysis, pulselessness)	Immediate vascular consult
Limb: compartment	Tense swelling and pain on passive stretch?	Compartment syndrome	Urgent fasciotomy evaluation
Limb: infection	Rapidly progressive swelling, erythema, and systemic toxicity?	Necrotizing fasciitis	Emergency surgical referral
Limb: tumor	Deep persistent bone pain (especially nocturnal)?	Bone tumor/metastasis	MRI + oncology referral
Neuropathic (unilateral)	Rapidly progressive unilateral neuropathic pain with weakness?	Tumor/mass lesion	MRI + neurology referral
Systemic symptoms	Persistent fever, fatigue, and weight loss?	Serious systemic disease	Full systemic workup

Abbreviations: CT, computed tomography; HIV, human immunodeficiency virus; IV, intravenous; MRI, magnetic resonance imaging.

9.4.1 Key Findings on Accuracy

- **Low sensitivity:** Most red flags are individually less sensitive. Patients can have serious pathology without any classic red flag. For example, a patient may harbor spinal infection or cancer and still initially present without fever or weight loss.
- **Low negative predictive value:** Because serious pathology is rare, even normal findings (no red flags) cannot fully rule it out when pretest probability is not zero.
- **Positive predictive value depends on context:** A red flag has more predictive value in a high-risk setting (e.g., ED) than in a low-risk setting (routine care). For instance, Shaw et al studied 1,000 ED back pain patients and found 69% had at least one red flag, but only 3.3% had a serious spinal disease, and 14.6% had other serious pathology. Thus, even common red flags mostly occurred in benign cases.[10]

Red flags with strong associations: Nonetheless, some studies have quantified high-risk flags. In Shaw et al's cohort, several red flags showed high positive likelihood ratios (LR+) for serious pathology[10]:

- Fever had an LR+ of 68.8, meaning fever greatly increased the chance of any serious spinal/nonspinal pathology.
- History of tuberculosis had an LR+ of 13.8 for any serious pathology and an LR+ of 9.8 specifically for serious spinal disease.
- Known history of nephrolithiasis or abdominal aortic aneurysm carried an LR+ of 10.2 for any serious pathology and 13.8 for thoracic pathology.
- Unexplained weight loss (LR+ of 9.2) and flank pain (LR+ of 5.2) were also strong predictors.
- For serious spinal pathology, Shaw et al found saddle anesthesia (LR+ of 11.0), acute urinary retention (LR+ of 6.4), loss of anal tone (LR+ of 6.3), IV drug use (LR+ of 6.9), and tuberculosis (TB) history (LR+ of 9.8) among the most predictive pathologies.

These high LR+ values indicate that when these red flags are present, the probability of serious disease is significantly raised. However, even in Shaw et al's high-prevalence ED sample, the absolute risk remained moderate because serious diagnoses were still uncommon overall.

Combining red flags: The diagnostic accuracy of red flags as a self-contained screening tool was low, while the combination of multiple red flags together increased the probability of identifying serious pathologies. Clustering red flags (e.g., fever + neurological deficit + weight loss) improves predictive power. This is consistent with common clinical reasoning: No single symptom is definitive, but patterns (especially with multiple red flags) warrant action.[6] In summary, the predictive value of red flags is mixed: Some flags (especially systemic symptoms or severe neuro signs) markedly raise odds of disease, but many flags are weak. Guidelines generally advise using red flags as triggers for further assessment, not as standalone tests.

9.5 Clinical Implications in Different Settings

Primary care: In nonacute outpatient settings, clinicians see primarily benign pain syndromes. Despite low prevalence, early detection of serious disease is critical for patient safety. Sizer et al emphasized that clinicians should perform region-appropriate history and examination to uncover any potential red flags, interpreting each test in context.[12]

Rigid adherence to red flag checklists may lead to over-referral and overtreatment. Storari et al caution that ambiguous definitions of red flags hamper consistent decision-making in such settings. Clinicians are advised to use clinical reasoning: Consider patient risk factors, combine findings, and possibly watch and wait with judicious safety-netting when red flags are absent.[3]

Emergency department: In the ED, the prevalence of serious spinal and nonspinal pathology among back pain patients is higher than in community settings. ED clinicians often encounter worrisome red flags more frequently. In practice, this leads to a high rate of imaging:

In Shaw et al's study, most flagged patients underwent MRI or computed tomography (CT) scans. Their data suggest that certain flags (e.g., fever, neurological deficits) should strongly trigger urgent workup. Conversely, many patients with isolated mild red flags (e.g., age >50 years alone) can be safely observed. Emergency guidelines typically list specific indications for imaging; Shaw et al's results help prioritize which red flags are most predictive in that setting.[10]

In summary, context matters. A red flag in a young patient with no risk factors and subacute pain likely means less than the same flag in an elderly patient with systemic symptoms. Clinicians should consider pretest probability; for example, some red flags (cough/hemoptysis) may be very predictive in high-TB areas but not elsewhere. No guidelines currently quantify risk by region, so local epidemiology must inform suspicion.

9.6 Ethical and Patient Safety Considerations

Recognizing red flags early is an ethical imperative to ensure patient safety. Missing a red flag can lead to delayed diagnosis of conditions like cancer or cord compression, with grave consequences. Conversely, over-imaging every patient with minor red flag findings can waste resources and cause harm; clinical judgment is needed to balance risk. Practitioners should document red flag screening thoroughly. Diligent history and examination to elicit red flags align with the ethical duties of beneficence and nonmaleficence.

9.7 Controversies and Future Directions

Several authors have questioned the blanket use of red flag screening. Cook et al dubbed red flag screening "nothing to see here" in low back pain, highlighting that guidelines promoting red flags have scant evidence. They argue that some red flag symptoms may be more prognostic (predicting poor outcome) than diagnostic. Others worry that extensive red flag lists (e.g., >160 possible items for spine pain) are impractical.[13]

Nonetheless, red flags remain integral to education and practice. Yusuf et al note that despite limited evidence, "red flags are still seen as the most reliable clinical indicator for potential serious pathology." Many clinicians consider red flags a fundamental part of assessment, guiding the "keep versus refer" decision. What is needed, as multiple reviews conclude, is a more standardized, evidence-based approach.[7]

9.8 Conclusion

Red flag screening is a critical part of MSK and neuropathic pain management. Defined as warning signs for serious pathology, red flags (e.g., cancer history, neurologic deficits, infection symptoms) should prompt immediate investigation. Outpatient and emergency clinicians alike must maintain a low threshold for further workup when red flags are present. Using structured checklists and remaining aware of patterns (such as combinations of red flags) enhances detection. Ultimately, timely recognition of red flags can prevent misdiagnosis or treatment delays, improving outcomes and patient safety.

Case Scenarios

Case 1

Cauda Equina Syndrome

A 55-year-old man with chronic low back pain develops new bilateral leg numbness and urinary retention. He reports perineal numbness "saddle anesthesia" and recent difficulty initiating urination. On examination, he has diminished ankle reflexes and reduced pinprick sensation in the saddle area. These red flags (bowel/bladder change and saddle anesthesia) immediately raised suspicion for cauda equina syndrome. An urgent MRI confirmed a massive L4–L5 disk herniation compressing the cauda equina. He underwent emergency decompressive laminectomy, illustrating how prompt recognition of red flags, particularly neurologic deficits and sphincter disturbance, prevents permanent disability.

Clinical reasoning and key learning points

The combination of bilateral radicular symptoms, saddle anesthesia, and bladder dysfunction represents a neurosurgical emergency until proven otherwise. MRI should be obtained

without delay, and urgent spinal surgical referral is mandatory. Delay in diagnosis or decompression beyond the recommended window significantly increases the risk of permanent neurological deficits, bladder and bowel dysfunction, and medicolegal consequences.

Case 2

Spinal Metastasis

A 68-year-old woman with a history of breast cancer (in remission) presents with progressively worsening mid-back pain over 3 months. She notes night pain that awakens her from sleep and has unintentionally lost 10 kg. There is focal mid-thoracic tenderness, but strength and sensation are normal. The red flags here were her cancer history, weight loss, and intractable nocturnal pain. Spine MRI revealed vertebral metastatic lesions from recurrent cancer. This case underscores that unexplained systemic symptoms and risk factors, such as cancer history in a patient with back pain, mandate imaging, even absent neurologic deficits.

Clinical reasoning and key learning points

Persistent nocturnal pain, unexplained weight loss, and a prior history of malignancy should immediately raise suspicion for metastatic spinal disease. Although neurological examination may initially be normal, early MRI is essential to identify vertebral involvement before spinal cord compression develops. Prompt oncologic and spinal specialist referral improves functional outcomes and pain control.

Case 3

Limb Ischemia

A 60-year-old man with atrial fibrillation on anticoagulation comes to the ED with sudden onset of severe, aching pain in his left foot and calf. The foot is pale and cool, and the left dorsalis pedis pulse is absent. This clinical picture (acute pain out of proportion, pulselessness, and pallor) is classic for acute limb ischemia. Doppler ultrasound confirmed an arterial embolus. Urgent surgical embolectomy was performed. Here, the key red flags of sudden pain with vascular signs triggered lifesaving intervention; failure to recognize them could lead to limb loss.

Clinical reasoning and key learning points

The presence of the classical vascular red flags (pain, pallor, pulselessness, coolness, and threatened limb viability) necessitates immediate vascular assessment without waiting for extensive investigations. Anticoagulation should be initiated promptly unless contraindicated, followed by urgent revascularization. Delayed recognition markedly increases the risk of irreversible tissue necrosis and amputation.

Case 4

Neuropathic Tumor

A 45-year-old man reports a 2-week history of burning pain in his right forearm and hand, accompanied by new forearm muscle weakness. He has no trauma or diabetes. On examination, he has right forearm flexor weakness and numbness in the median nerve distribution. This unilateral, rapidly progressive neuropathic syndrome is a red flag. MRI of the brachial plexus revealed a nerve sheath tumor compressing the median nerve. The vignette illustrates that one-sided neuropathic symptoms with motor involvement warrant neuroimaging to exclude tumor or other mass lesion.

Clinical reasoning and key learning points

Rapidly progressive unilateral neuropathic pain associated with objective motor weakness should not be attributed to common entrapment neuropathies without further evaluation. Cross-sectional imaging is indicated to exclude space-occupying lesions, particularly when symptoms progress despite conservative measures or are accompanied by neurological deficits. Early diagnosis facilitates timely surgical management and improves neurological recovery.

References

1. Finucane LM, Downie A, Mercer C, et al. International framework for red flags for potential serious spinal pathologies. J Orthop Sports Phys Ther 2020;50(7):350–372
2. Doneddu PE, Pensato U, Iorfida A, et al.; Study and Research Center of the Italian Society of Emergency Medicine (SIMEU). Neuropathic pain in the emergency setting: diagnosis and management. J Clin Med 2023;12(18):6028
3. Storari L, Piai J, Zitti M, et al. Standardized definition of red flags in musculoskeletal care: a comprehensive review of clinical practice guidelines. Medicina (Kaunas) 2025;61(6):1002
4. Thompson AD, Shea MJ. Limb pain. In: Merck Manual Professional Edition. 2024. Accessed September 15, 2026 at: https://www.merckmanuals.com/professional/cardiovascular-disorders/symptoms-of-cardiovascular-disorders/limb-pain
5. Sikina M, Kiel MJ. Re-evaluating red flags for back pain. ACEP Sports Medicine Section Newsroom. 2022. Accessed September 15, 2026 at: https://www.acep.org/sportsmedicine/newsroom/newsroom-articles/august2022/re-evaluating-red-flags-for-back-pain/
6. Maselli F, Palladino M, Barbari V, Storari L, Rossettini G, Testa M. The diagnostic value of red flags in thoracolumbar pain: a systematic review. Disabil Rehabil 2022;44(8):1190–1206
7. Yusuf M, Finucane L, Selfe J. Red flags for the early detection of spinal infection in back pain patients. BMC Musculoskelet Disord 2019; 20(1):606
8. Hancock MJ, Downie AS, Whitehurst DG, et al. Red flags to screen for vertebral fracture in patients presenting with low back pain. Cochrane Database Syst Rev 2022;CD013527
9. Rider LS, Marra EM. Cauda Equina and Conus Medullaris Syndromes. Treasure Island, FL: StatPearls Publishing; 2023
10. Shaw B, Kinsella R, Henschke N, Walby A, Cowan S. Back pain "red flags": which are most predictive of serious pathology in the emergency department? Eur Spine J 2020;29(8): 1870–1878
11. Kim YJ. Red flag rules for knee and lower leg differential diagnosis. Ann Transl Med 2019; 7(Suppl 7):S250
12. Sizer PS Jr, Brismée JM, Cook C. Medical screening for red flags in the diagnosis and management of musculoskeletal spine pain. Pain Pract 2007;7(1):53–71
13. Cook CE, George SZ, Reiman MP. Red flag screening for low back pain: nothing to see here, move along: a narrative review. Br J Sports Med 2018;52(8):493–496