



INTERNATIONAL FRAMEWORK FOR RED FLAGS FOR POTENTIAL SERIOUS SPINAL PATHOLOGIES[©]

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Preface

Identifying serious pathology as a cause of a person's musculoskeletal presentation is complex. The use of red flags has historically been used to help clinicians with identification of serious spinal pathology and the majority of guidelines endorse their use. However, there is often variability in guidelines about which red flags should be considered when examining people seeking care for musculoskeletal disorders. This has led to confusion and inconsistency in the management of people with suspicion of serious pathology, and in some cases, to unnecessary and worrying medical tests, or false reassurance that there is no serious pathology. This document aims to provide clinicians with a more standardised and consistent approach to identifying people with potential serious pathology. The framework has been developed by researchers and clinicians to provide a pragmatic approach for clinicians to screen for serious pathology that can masquerade as musculoskeletal spinal conditions. The framework has been informed by available evidence and augmented by a formal consensus process that included academics and clinicians involved in the management of musculoskeletal conditions.

This framework aims to support a variety of health professionals, irrespective of experience, who provide care for people with musculoskeletal spinal conditions. Clinicians working in musculoskeletal services can play an important role in early identification of serious pathology ensuring that people achieve the best possible outcome. The prevalence of serious pathology will vary depending on where the clinician sits within the person's care journey. Spinal surgeons are likely to see more cases of serious pathology than a General Practitioner (GP), and physiotherapists will probably see a number in between the two, depending where on the clinical pathway they work. Those therapists working at an advanced practice level are likely to see more serious pathology as the populations they serve are likely to be more complex. Clinicians will be required to consider the context within which red flags exist and clinically reason the relevance of the information gathered to determine if any action is required.

Person Centred Care

Working with people with possible serious pathology can be challenging for both the individual and clinician involved therefore a collaborative approach is essential. A possible diagnosis of serious pathology can be extremely worrying for people, their families and carers. People must be involved in decision making about their care even when faced with a serious diagnosis. Shared decision making is essential to ensure that individuals are supported to make decisions that are right for them. Using a collaborative process, the clinician should highlight the treatment options, evidence, risks and benefits and together with the person understand how these fit with that person's individual circumstances, goals, values and beliefs <https://www.england.nhs.uk/shared-decision-making/> (NHS England 2020).

Experts by Experience - Feedback on the use of this Framework

Clear and open communication with people with potential serious pathology is vital. People presenting with spinal pain may have no concept that this may affect their bladder or bowel function, or that the spinal pain could be caused by serious pathologies such as infection or malignancy. Providing context as to why you are asking the questions being proposed in the framework is an important aspect of the consultation as some of these questions will seem irrelevant to a person who presents with back pain.

Effective communication about red flags is really important. People can become worried before an appointment, especially if they have;

- *seen something worrying on TV or the internet*
- *heard a story from a friend*
- *experienced medical misdiagnosis*

Clinicians should provide reassurance about why a patient is being assessed for red flags especially if they are at a low risk of something sinister. It isn't just the wording of the questions, but also the body language, tone of voice, and mannerisms etc. of the clinician asking the questions.

Patients need to feel at ease when answering questions and, not judged e.g. intravenous drug use, poor social and environmental factors. Patients should also be given enough time to think through and communicate their answers about something which they may have never considered before e.g. their toilet habits and how they may have changed.

Clinicians should provide support regarding the emotional impact on the patient of being assessed for potentially life-changing conditions and in some cases being sent for further investigations. When asking about subjects such as previous history of cancer it is particularly important to offer appropriate emotional support and, when needed, signpost patients to additional services which can offer further support.

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1: Background and Methods

1.1: Background

This is an internationally agreed framework to aid early assessment and initial management of people who present with potential serious spinal pathology. These conditions, whilst considered rare, can lead to devastating and life changing/life limiting consequences for people. For instance, in relation to metastatic spinal cord compression (MSCC) neurological function and quality of life can be preserved if patients receive an early diagnosis, this can lead to rapid access to appropriate treatment, reduction in nerve damage and maintenance of spinal stability (Greenhalgh & Selfe 2019). In addition, significant litigation costs for healthcare providers can occur if not identified early and managed appropriately. For example, litigation relating to Cauda Equina Syndrome alone accounted for £25m (\$40m) in claims against the National Health Service (NHS) in the UK from 2010-2015 (NHSLA 2016).

This document has been developed on behalf of the International Federation of Orthopaedic Manipulative Physical Therapists (IFOMPT) and has been coordinated by researchers at Manchester Metropolitan University. Due to a paucity of primary evidence, this framework has been developed by expert clinicians interpretation of the highest quality evidence available. Red flags are signs and symptoms that raise suspicion of serious spinal pathology, but until now there has been little guidance on their use and they have been left to individual interpretation. In the literature 163 signs and symptoms have been reported as red flags for spinal pathology (Greenhalgh and Selfe 2019);

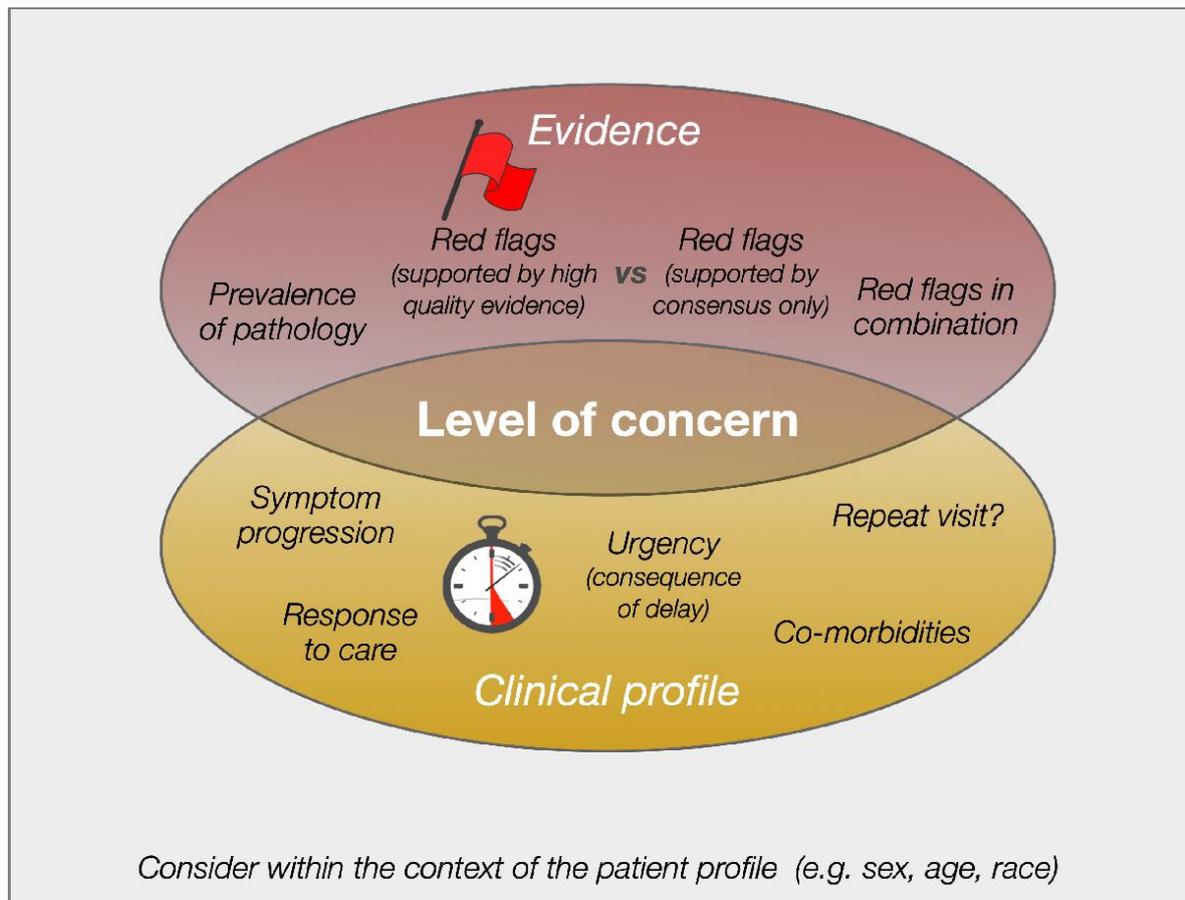
- 119 symptoms from the individual's history.
- 44 signs from the physical examination.

The high number of red flags presents a challenge in terms of their every-day practical utility, additionally, few red flags, when used in isolation are informative. Red flags used in combination demonstrate promise (Henschke et al 2009), but further validation studies are required. A recent pan-European study using clinical vignettes highlighted the challenges facing final year undergraduate physiotherapy students in making accurate clinical decisions related to serious critical medical conditions and benign musculoskeletal problems (Lackenbauer et al. 2017). The informativeness of red flags is also problematic as there is a lack of high-quality evidence for diagnostic accuracy (Henschke et al. 2013, Downie et al. 2013) and the evidence that does exist supports only a limited number of red flags to raise suspicion of serious pathology. In addition, there is no consensus on which red flags are most useful in the identification of serious spinal pathology or on how they should be used in the clinical setting (Verhagen et al. 2016). However, red flags remain the the best tools that healthcare practitioners have to raise suspicion of serious spinal pathology when used within the context of a thorough subjective patient history and an appropriate physical examination. Serious spinal pathology is associated with increasing age, although it should be noted that serious pathology can affect all ages. Populations around the world are ageing rapidly which presents challenges as people with increased medical complexity and morbidities are presenting more often to musculoskeletal services. Consequently, there will be an increase in the incidence of serious pathology leading to more therapists seeing more patients with serious pathology. The paucity of evidence has led to this framework being built on multiple perspectives including synthesising the current research data, expert

consensus and opinion, and steering group consensus. The framework is intended to provide clinicians with a clear clinical reasoning pathway clarifying the role of red flags.

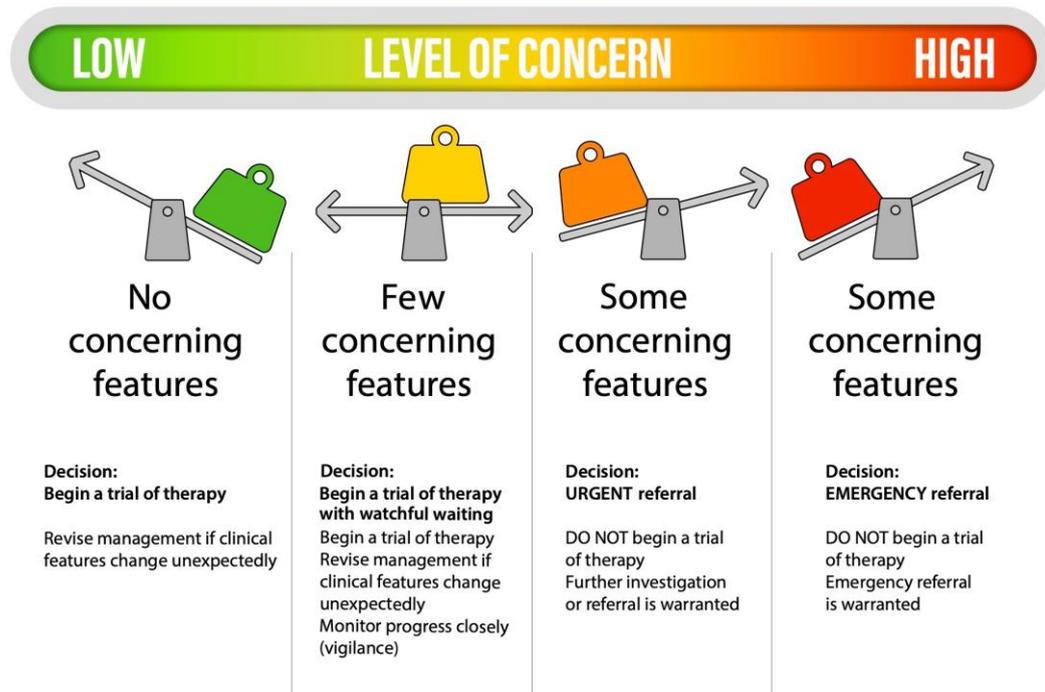
1.2 Decision tool for early identification of potential serious spinal pathology

Step 1: Determine level of concern. Clinicians should consider both the evidence to support red flags and the individual profile of the persons' health determinants e.g. age, sex, to decide level of concern (index of suspicion) for presence of serious pathology.



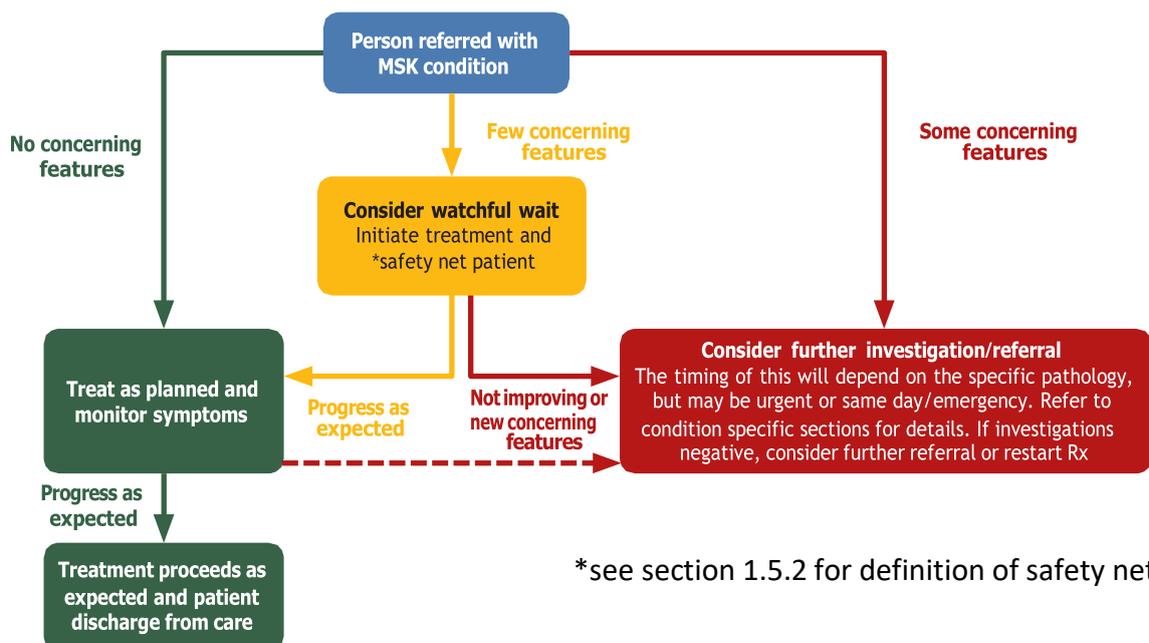
Step 2: Decide clinical action. The choice of clinical action should be based on the level of concern determined in step 1.

Decision model



Step 3: Consider the pathway for emergency/ urgent onward referral

Clinicians will need to be aware of their local referral pathways and access to specialist care when indicated.



*see section 1.5.2 for definition of safety net

1.3 : Key clinical messages

- There is a lack of evidence to support the informativeness of the majority of red flags commonly used in clinical practice.
- Few red flags, when used in isolation are informative. Combinations of red flags demonstrate promise but this work requires further validation.
- Red flags remain the the best tools that healthcare practitioners have to raise suspicion of serious spinal pathology when used within the context of a thorough subjective patient history and physical examination.
- Clinicians should consider both the evidence to support red flags and the individual profile of the persons' determinants e.g. age, sex, to decide level of concern (index of suspicion) for presence of serious pathology.

1.4: Priority Serious Spinal Pathologies

The need for further discussion and research on red flags was identified following a consultation of the member organizations of IFOMPT, a sub group of the World Confederation for Physical Therapy (WCPT) in 2016, four key areas were identified as priorities; these form the focus of this clinical framework (prevalence data for these are presented in Table 1):

- Cauda Equina Syndrome (CES)
- Spinal fracture
- Malignancy
- Spinal infection

Each of these is presented with a short introduction of the relevant pathology, information on the literature used and consensus process, followed by tables containing information on the red flags for that pathology. The tables are split into the following; risk factors, symptoms, signs and initial investigations. Each section concludes with a series of clinical reasoning cases/scenarios.

Table 1: Prevalence Estimates for Key Pathologies when Presenting with Back Pain

Estimated point prevalence (incidence where indicated)				
	Primary	Secondary	Tertiary (ED)	Tertiary (spine centre)
CES	<u>Estimated incidence (UK):</u> 0.002% (Greenhalgh et al 2018) <u>Back pain:</u> 0.04% (Deyo, Rainville and Kent 1992)			<u>LBP:</u> 0.4% (Premkumar et al 2018)
Fracture (OCF)	<u>LBP:</u> 0.7% (Henschke et al 2009) 3.0% (Scavone, Latshaw and Rohrer 1981) 4.0% (Jarvik and Deyo 2002) 4.1% (van den Bosch et al 2004) 4.5% (Deyo and Diehl 1986)	<u>L^o X-Ray</u> 2.6% (Roman et al 2010)	<u>Back pain:</u> 6.5% (Gibson and Zoltie 1992) <u>L^o X-Ray:</u> 7.3% (Patrick et al 1983) 11.0% (Reinus, Strome and Zwemer 1998)	<u>LBP:</u> 5.6% (Premkumar et al 2018)
Fracture: (traumatic)	<u>LBP:</u> <1% (Jarvik and Deyo 2002)			
Malignancy	<u>LBP:</u> 0.0 % (Henschke et al 2009) 0.1 % (Donner-Banzhoff et al 2006) 0.2 % (Khoo et al 2003) 0.2% (Frazier et al 1989) 0.6 % (Deyo and Diehl 1986) 0.7 % (Deyo and Diehl 1988) Non-mechanical: 0.7% (Jarvik and Deyo 2002)	<u>MSK pain:</u> 7.0% (Jacobson 1997)	<u>LBP:</u> 0.1% (Reinus, Strome and Zwemer 1998)	<u>LBP:</u> 1.6% (Premkumar et al 2018) <u>Lumbar restriction:</u> 6.0% (Cook et al 2012)
Infection	<u>Infective spondylitis: all settings</u> 0.0004% (Tyrell, Cassar-Pullicino and McCall 1999; Duarte and Vaccaro 2013) in developed countries			
Infection	<u>Non-mechanical LBP:</u> 0.01% (Jarvik and Deyo 2002)			<u>LBP:</u> 1.2% (Premkumar et al 2018) (postprocedural discitis represents up to 30 % of all cases of pyogenic spondylodiscitis) (Duarte and Vaccaro 2013).

1.5 Abbreviations and definitions of terms used in this Framework Document

1.5.1 Abbreviations

- **BOS:** Bristol Online Survey
- **CES:** Cauda Equina Syndrome
- **CRP:** C-reactive protein
- **CT scan:** Computerized tomography scan
- **ESR:** Erythrocyte sedimentation rate
- **HAS:** Haute Autorité de Santé
- **MBD:** Metastatic bone disease.
- **MSCC:** Metastatic spinal cord compression
- **MRI:** Magnetic resonance imaging
- **SI:** Spinal infection
- **TB:** Tuberculosis

1.5.2 Definitions

- **Clinical risk / Index of suspicion:** Relates to clinical risk factors and presenting clinical features. Once the index of suspicion passes a critical threshold, the therapist will become concerned about the underlying cause of the persons complaint (Greenhalgh & Selfe 2010).
- **Emergency Referral:** This would need to reflect local pathways but as a guide on the same day
- **Experts by experience:** Patient representatives
- **GP review:** Follow up by medical practitioner, onward medical management to be carried out by the General Practitioner.
- **High level of evidence:** Evidence supported by the literature
- **Investigations:** Refers to requesting of imaging or ordering blood tests to aid diagnosis
- **Low level of evidence:** Evidence supported by consensus and steering group
- **Red flag:** Goodman and Synder (2013) define red flags as features of the individual's medical history and clinical examination thought to be associated with a high risk of serious disorders such as infection, inflammation, cancer or fracture. Red flags are clinical prediction guides they are not diagnostic tests and they are not necessarily predictors of diagnosis or prognosis. The main role of red flags is that when combined they help to raise the clinicians index of suspicion. Unfortunately, with a few exceptions, the prognostic strength of individual red flags or combinations of red flags is not known (Greenhalgh & Selfe 2010).
- **Safety netting:** Safety netting is a management strategy used for people that may present with possible serious pathology. These strategies should include advice on what signs and symptoms to look out for, what action to take if symptoms deteriorate and the timeframe within which action should be taken (Hirst et al 2018).

- **Shared decision making:** Shared decision- making (SDM) is the conversation that happens between a person and clinician to reach a healthcare choice together.
- **Urgent Referral:** This would need to reflect local pathways but as a guide within 5 days.
- **Watchful waiting:** the act of close surveillance, whilst undergoing treatment as required, but allowing time to pass before medical intervention or therapy is used. (Cook et al 2018).

1.6 Method: Haute Autorité de santé (HAS) consensus method

This framework combines an evidence synthesis and international expert consensus, and followed the Haute Autorité de santé (HAS) recommendations for the development of clinical guidelines (HAS, 2010).

Phase 1: Review of systematic reviews (SRs) and other key papers summarising available evidence related to red flags in one or more of the four key spinal pathologies (see appendix 1 for evidence summary tables). This led to the formulation of 4 international expert consensus questionnaires, 1 for each key pathology.

Phase 2: Bristol Online Survey (BOS) was used to deliver the four separate questionnaires developed in phase 1. In total the international expert group, comprised of N=100 experts from N=19 countries, they were invited to rate red flag statements based on the evidence presented (phase 1) and their own experience. Each section reports separately how many experts were involved in the consensus process for that section. Anonymised responses were returned online using a rating scale between 1-9 (1 being totally inappropriate, 9 being totally appropriate). All results were reviewed by the steering committee. The median score for each statement was calculated. Statements that gained a median score of 7 or above were classed as appropriate and those which gained a median score of 3.5 or less were classed as inappropriate, according to the HAS method. Any remaining items, which did not gain consensus at this point, were reviewed by the steering committee and a consensus decision was then taken to either include or exclude these items in the draft framework.

Phase 3: Draft framework was developed by the steering group based on a synthesis of the results from phases 1 and 2.

Phase 4: The draft framework was presented to an international peer review group (N = 70 individuals) for opinion on the content. The International peer review group was invited to rate the content via an online questionnaire. The review group rated each section of the framework based on its

- **Applicability:** Relevance to your clinical practice

- Acceptability: Clinical usefulness or helpfulness
- Readability: Is it easy to read

They were also able to offer suggestions on changes/improvements. This peer review group included chiropractors, osteopaths, physiotherapists, experts by experience and Member Organisation delegates of IFOMPT. The response rate of 41% included individuals from 13 countries. The median score for each section was calculated. All sections gained a median score of 7 or above and were therefore classed as appropriate according to the HAS method. All comments were reviewed by the steering committee and relevant changes made to the framework.

Phase 5: Based upon the Phase 4 feedback, the steering group developed the final version of the clinical framework.

2: Cauda Equina Syndrome (CES)

Anatomically, the Cauda Equina is made up of 20 nerve roots that originate from the conus medullaris at the base of the spinal cord. Cauda Equina Syndrome (CES) occurs as a result of compression of these neural structures. CES is a challenging condition to diagnose and manage in a timely manner. It may present in any clinical setting and it is imperative that clinicians are able to effectively and efficiently reason through their findings in order that the person with potential CES is managed in a timely manner. Timely diagnosis is essential to avoid life changing outcomes such as on-going bladder, bowel and sexual dysfunction, along with psychosocial consequences.

2.1 Literature and International Consensus

The 3 key source papers used to formulate the international consensus questionnaire for this section on CES were Dionne et al. (2019), Germon (2015) and Greenhalgh et al. (2018) (Appendix 1). The questionnaire was sent to 23 international experts and contained 25 items (Table 2.0).

Table 2.0 Number of CES red flags gaining consensus

	Number of Red flags
Questionnaire sent to 23 international experts	25 items reviewed <ul style="list-style-type: none"> • 18 items reached consensus as appropriate • 2 items reached consensus as inappropriate • 5 items with no consensus
Steering committee review of results	20 Items included in framework (Tables 2.1-2.4) (2 items combined) 4 items excluded (Appendix 2)

The incidence of CES in the population is estimated in the UK at 0.002% (Greenhalgh et al 2018). The overall prevalence of CES is estimated to range from 1 in 33, 000 to 1 in 100,000 persons (Long et al, 2020). Point prevalence of CES as a cause of LBP in primary care is estimated at 0.04% (Deyo et al 1992) and 0.4% (Premkumar et al 2018) in tertiary care. CES is a complication of approximately 2% of all herniated discs (Dionne et al, 2019). The incidence of postoperative CES is estimated to be between 0.08% and 0.2% (Jensen, 2004,). Twenty three percent of litigation claims for spinal surgery in England relate to CES ('Getting it right first time' GIRFT) assessment of litigation claims in England between 2013/15 - 15/16, (Hutton, 2019)). Compression of the Cauda Equina usually occurs as a result of a disc prolapse (Dionne et al, 2019). However, any space occupying lesion could cause Cauda Equina compression. Relevant symptoms which can be a precursor to CES are:

- Unilateral or bilateral radicular pain
- And/or dermatomal reduced sensation
- And/or myotomal weakness

If symptoms progress from the precursors described above, with any suggestion of changes in bladder or bowel function or saddle sensory disturbance, CES should be suspected. Careful questioning requires good communication skills for early identification. The use of clinical cue cards and credit card size patient information handouts can aid communicating

sensitive, sometimes subtle but important symptoms and should form the basis of the clinicians questioning (<https://www.eoemskservice.nhs.uk/advice-and-leaflets/lower-back/cauda-equina>).

If CES is suspected, a full neurological assessment should be performed to establish if any dermatomal sensory loss, myotomal weakness or reflex change is present (Germon et al, 2015). A digital rectal examination (DRE) is currently no longer considered essential in a primary care setting in the UK. It is still however deemed necessary in secondary care to evaluate loss of anal sphincter tone. Sensation to light touch and pin prick throughout the saddle region including buttocks, inner thighs and perianal region however, is seen as a necessary test in any clinical situation. These 'intimate' objective tests must only be performed by an appropriately trained clinician with a chaperone for the benefit of both the person and the clinician. Testing of this nature should be conducted in line with cultural sensitivities, local pathways, medicolegal frameworks and state regulation. People should be sent for an emergency MRI (positive findings are likely to be accompanied by an ultrasound of the bladder) and surgical opinion. It is important to know your local care pathway so that people are managed appropriately. Where a person does not currently have CES but there is a suspicion that they may later develop CES, it is essential that they are 'safety netted' i.e. the person is informed on what to look out for and crucially what to do if symptoms of CES develop.

Table 2.1 Risk Factors for CES

2.1 Risk Factors	Context	Further questions	Low clinical suspicion	High clinical suspicion
Herniated intervertebral disc <i>Level of evidence: low</i>	<p>The most common cause arises from a large central disc herniation at L4/5 or L5/S1 level (Mukherjee et al. 2013)</p> <p>Under 50 years of age carries a higher risk as does obesity</p> <p>Relevant symptoms which can be a precursor to CES are:</p> <ul style="list-style-type: none"> • Unilateral or bilateral radicular pain • And/or dermatomal reduced sensation • And/or myotomal weakness <p>(Comer et al, 2019)</p>	<p>How old are you?</p> <p>Do you have any leg pain?</p> <p>Where exactly is the pain in your legs (above or below knees)?</p> <p>Is the pain down both legs at the same time?</p> <p>Do you have any pins and needles or numbness in your legs, inner thighs, bottom or genitals?</p> <p>Do you feel any weakness in your legs?</p>	<p>No leg pain and normal neurology and no CES symptoms</p>	<p>Unilateral or bilateral radicular pain</p> <ul style="list-style-type: none"> • And/or dermatomal reduced sensation • And/or myotomal weakness • Reduced saddle sensation (subjective or objective pin prick) • Bladder disturbance • Bowel disturbance • Reduced anal tone/absent squeeze • Sexual disturbance <p>(Greenhalgh et al, 2018)</p> <p>Presentations that increase the probability of acute threatened Cauda Equina:</p> <p>Back Pain with:</p> <ul style="list-style-type: none"> • Presence of new saddle anaesthesia, bladder or bowel disturbance. • Age < 50 • Unilateral onset progressing to bilateral leg pain • Alternating leg pain • Presence of new motor weakness

2.1 Risk Factors	Context	Further questions	Low clinical suspicion	High clinical suspicion
Lumbar spinal stenosis (LSS) <i>Level of evidence: low</i>	<p>The degenerative changes in the lumbar spine that are responsible for lumbar spinal stenosis have the potential to lead to a gradual compromise of the cauda equina nerve roots. This can result in slow-onset grumbling CES being overlooked or dismissed in older people (Comer et al, 2019)</p> <p>CES symptoms associated with degenerative LSS is generally much less clear than with herniated disc- claudication. A range of typical leg symptoms e.g. aching, cramping, tingling, and heaviness, provoked by walking and eased by sitting should be considered as important in LSS (Genevay & Atlas, 2010)</p>	<p>Can you describe any worsening symptom including your level of pain or symptoms in your legs?</p> <p>If zero is no pain and 10 is the worst pain you have ever had; How low does the pain go? How high does the pain go?</p> <p>What makes it worse?</p> <p>What makes it better?</p>	Stable or no neuropathic leg symptoms	<p>Recurring and insidiously but increasing back pain with gradual onset of unilateral or bilateral lower limb sensory disturbance and/or motor weakness</p> <p>Incomplete bladder emptying, urinary hesitancy, incontinence, nocturia or urinary tract infections. Bladder and/or bowel dysfunction may progress gradually over time (Comer et al, 2019)</p>

2.1 Risk Factors	Context	Further questions	Low clinical suspicion	High clinical suspicion
Spinal surgery <i>Level of evidence: low</i>	CES is a risk with any lumbar spine surgical intervention		N/A	<p>Nerve injuries and paralysis can be caused by a number of problems, including:</p> <ul style="list-style-type: none"> • bleeding inside the spinal column (extradural spinal haematoma) • leaking of spinal fluid (incidental durotomy) • accidental damage to the blood vessels that supply the spinal cord with blood • accidental damage to the nerves when they're moved during surgery <p>(NHS Risks lumbar decompression surgery, 2018)</p>

Table 2.2 Symptoms of CES

2.2 Symptoms (subjective)	Context	Further questions	Low clinical suspicion	High clinical suspicion
Sensory change (lower limbs) <i>Level of evidence: low</i>	History of symptoms, pattern, progression and timescale Consider existing comorbidities e.g. MS, diabetes	When did the sensation problems in your leg (s) start? Where did they begin and how did those symptoms change as time went on? Exactly where in your legs do you feel the symptoms? Do you have any other medical conditions?	Normal neurology	Sensory change (lower limbs)
Motor weakness (lower limbs) <i>level of evidence: low</i>	Timescales of perceived weakness and progression important to establish Consider existing comorbidities e.g. Aortic Aneurism	When did the weakness problems in your leg (s) start? Where did the weakness begin and how did those symptoms change as time went on? Do you have any other medical conditions?	As above	Motor weakness (lower limbs)

2.2 Symptoms (subjective)	Context	Further questions	Low clinical suspicion	High clinical suspicion
Saddle sensory disturbance <i>Level of evidence: low</i>	Precise extent of pins and needles and/or numbness e.g. difference between bicycle/horse saddle Previous history Trauma/surgery Other potential Pudendal nerve compression e.g. cycling	See CES cue card for relevant questions that need to be asked including the following; Exactly where do you feel the numbness in your bottom, inner thighs or genitals? Where did it start and how has the numbness and/or pins and needles changed over time? Do you have normal sensation when you wipe after toileting? How long has this been present? What hobbies do you have? Were any interventions used during child birth? (where appropriate) Have you had any previous surgery?	N/A	Saddle sensory disturbance
Change in ability to achieve an erection or ejaculate <i>Level of evidence: low</i>	History of symptoms, progression and timescale Comorbidities e.g. Diabetes Side effects from pharmacology (neuropathics, codeine) Age: Older people may have spinal stenosis & are less likely to have acute CES	See CES cue card for relevant questions that need to be asked including the following; When did these symptoms begin? If some time ago are these symptoms different? Do you have any other medical conditions? Have you started any new medication? Were the symptoms present before you began this medication or after?	N/A	Recent change in ability to achieve an erection or ejaculate

2.2 Symptoms (subjective)	Context	Further questions	Low clinical suspicion	High clinical suspicion
Change in ability to achieve an erection or ejaculate (continued) <i>Level of evidence: low</i>	Functional symptoms: Psychosocial presentation and healthcare utilisation	Ask routine questions related to psychosocial distress		
Loss of sensation in genitals during sexual intercourse <i>Level of evidence: low</i>	Previous history of sexual dysfunction? Is this different?	See CES cue card for relevant questions that need to be asked including the following; When did these symptoms begin? If some time ago are these symptoms different? Do you have any other medical conditions? Ask routine questions related to psychosocial distress	N/A	Loss of sensation in genitals during sexual intercourse
Urinary function (e.g. frequency) <i>Level of evidence: low</i>	Previous history of bladder disturbance Establish precise change in function such as hesitancy, change in stream, loss of sensation passing urine, inability to feel when bladder full or empty, sensation of incomplete voiding	See CES cue card for relevant questions that need to be asked including the following; When did the changes begin? Describe the changes in urine function? Do you have any other medical conditions? Have you started any new medication? Were the symptoms present before you began this medication or after?	N/A	Urinary function e.g. frequency

2.2 Symptoms (subjective)	Context	Further questions	Low clinical suspicion	High clinical suspicion
Urinary retention <i>Level of evidence: low</i>	<p>Previous history of bladder disturbance</p> <p>Most of these people will not have critical CES compression. However, in the absence of reliably predictive symptoms and signs, there should be a low threshold for investigation with an emergency MRI scan (Germon, 2015)</p> <p>Age: Older people may have spinal stenosis & are less likely to have acute CES.</p> <p>Functional symptoms: Psychosocial presentation and healthcare utilisation</p> <p>Be aware of an increase in health seeking behaviour</p>	<p>See CES cue card for relevant questions that need to be asked including the following;</p> <p>When did the changes begin?</p> <p>When did you last pass urine?</p> <p>Have you started any new medication?</p> <p>Were the symptoms present before you began this medication or after?</p> <p>Do you have any other medical conditions?</p> <p>Have you attended any other health care setting (GP surgery, clinic, hospital etc) because of this problem?</p> <p>If so, who did you see and when?</p>	N/A	Urinary retention
Urinary incontinence <i>Level of evidence: low</i>	<p>Previous history of bladder disturbance</p>	<p>See CES cue card for relevant questions that need to be asked including the following;</p> <p>When did the changes begin?</p> <p>When did you last pass urine?</p> <p>Have you started any new medication?</p> <p>Were the symptoms present before you began this medication or after?</p>	N/A	Urinary incontinence

2.2 Symptoms (subjective)	Context	Further questions	Low clinical suspicion	High clinical suspicion
Urinary incontinence (continued) Level of evidence: low		Do you have any other medical conditions? Have you attended any other health care setting (GP surgery, clinic, hospital etc) because of this problem? If so, who did you see and when?		
Bowel incontinence <i>Level of evidence: low</i>	Previous history of bowel disturbance	See CES cue card for relevant questions that need to be asked including the following; When did the changes begin? When did you last open your bowels? Have you started any new medication? Were the symptoms present before you began this medication or after? Do you have any other medical conditions? Have you attended any other health care setting (GP surgery, clinic, hospital etc) because of this problem? If so, who did you see and when?	N/A	Bowel incontinence

2.2 Symptoms (subjective)	Context	Further questions	Low clinical suspicion	High clinical suspicion
Constipation <i>Level of evidence: low</i>	Previous history of bowel disturbance History of symptoms and timescale Side effects from pharmacology (neuropathics, codeine) Age: Older people may have spinal stenosis & are less likely to have acute CES Functional symptoms: Psychosocial presentation and healthcare utilisation	See CES cue card for relevant questions that need to be asked including the following; When did the changes begin? When did you last pass a stool? Have you started any new medication? Were the symptoms present before you began this medication or after? Do you have any other medical conditions? Have you attended any other health care setting (GP surgery, clinic, hospital etc) because of this problem? If so, who did you see and when?		Constipation
Unilateral/ bilateral leg pain <i>Level of evidence: low</i>	Unilateral radicular leg pain progressing to bilateral radicular leg pain is a concerning presentation. The prevalence of bilateral leg pain in primary care is not known. Consider other causes of leg pain e.g. <ul style="list-style-type: none"> • Smoker • Cardiovascular disease Lesion higher in the spine	When did the pain progress from one leg to two? How far down each leg does the pain go? Do you have any conditions that affect your heart or circulation?	No CES symptoms	Unilateral/ bilateral leg pain

2.2 Symptoms (subjective)	Context	Further questions	Low clinical suspicion	High clinical suspicion
Low back pain <i>Level of evidence: low</i>	Presentations that increase the probability of acute threatened Cauda Equina Back Pain with: <ul style="list-style-type: none"> • Presence of new saddle anaesthesia, bladder or bowel disturbance • Age < 50 • Unilateral onset progressing to bilateral leg pain • Alternating leg pain • Presence of new motor weakness • Obesity 	History of symptoms and timescale When did your back pain begin? How has it progressed? Do you or have you had leg symptoms? If so where exactly is your leg pain? Consider questions on CES card if symptoms progressing	See context	Low back pain

Table 2.3 Signs of CES

2.3 Signs (objective)	Context	Objective Tests	Low clinical suspicion	High clinical suspicion
Sensory deficit in saddle to light touch and pinprick <i>Level of evidence: low</i>	This examination would only be carried out if CES is suspected from the subjective history in any clinical setting Normal examination findings would not exclude the possibility of CES Consider previous Trauma/surgery to perineum	Objective light touch and pin prick carried out by a suitably trained clinician with a chaperone present	N/A	N/A
Abnormal lower limb neurology <i>Level of evidence: low</i>	Establish time frame of progression of neurology Other causes e.g. Upper motor condition, peripheral neuropathy etc	Myotomes, dermatomes and reflexes Consider tone, proprioception, clonus	Normal neurology	Abnormal and progressing neurological deficit Management depends on the degree of neurological deficit- if gross motor weakness (< 3/5), or deteriorating neurology
Reduced anal tone <i>Level of evidence: low</i>	This examination would only be carried out if CES is suspected from the subjective history in a secondary care setting Normal examination findings would not exclude the possibility of CES Consider previous Trauma/surgery to perineum	Digital rectal examination should be carried out by a suitably trained clinician with a chaperone present	N/A	N/A

Table 2.4 Initial Investigations for CES

2.4 Modality	Context
MRI	MRI is the gold standard investigation to confirm CES diagnosis. Most guidelines recommend that people presenting with any of these key clinical signs and symptoms should be referred urgently (Dionne et al, 2019)
CT scan	If there are contraindications for MRI.

2.2 CES clinical reasoning cases/scenarios

1) A woman is urgently referred to you with back pain. Within the wider detailed subjective and objective examination, there are no positive items on the CES cue card.



LBP no leg pain

No symptoms of CES

Clinical Action = Begin a trial of therapy.

2) The woman has back and leg pain. The pain in her leg is getting worse and is now radiating distally below the knee and she has started to notice pain in the other leg. Nothing on CES questioning is positive and there is no existing neurological deficit.

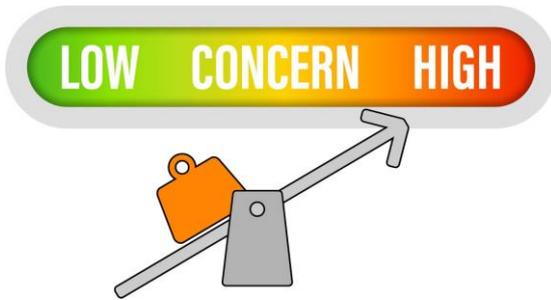


Leg pain worsening

Signs of bilateral leg pain

Clinical Action = Safety Net. The important thing in this case is to discuss and document a clear strategy to follow if symptoms deteriorate (safety net), ensuring the person is aware she needs to act immediately if things get worse.

3) The woman now has back and increasing leg pain bilaterally. She reports one episode of incontinence 4 weeks ago but not since. Neurological examination is unremarkable.



Back and bilateral leg pain increasing

One episode of incontinence 4 weeks ago

Clinical Action = Urgent MRI and discuss and document a clear strategy to follow if symptoms deteriorate (safety net).

4) The lady has now developed a one week history of some numbness of the left side of the vagina.



LBP and bilateral leg pain increasing

One episode of incontinence 4 weeks ago

One-week history of vaginal numbness

Clinical Action = Emergency MRI /refer onto emergency pathway

2.3 Consider the pathway for emergency/ urgent referral

Refer to clinical decision tool for suggested pathways for emergency / urgent referral (Step 3 of section 1.2).

3 Spinal Fracture

Spinal fractures make up the largest number of serious pathologies in the spine. Whilst these are predominantly a risk for older patients, especially females, clinicians need to be aware of the risk factors and signs and symptoms of spinal fractures and to consider what detailed questions to ask to help with further management.

3.1 Literature and International Consensus

The 5 key source papers used to formulate the international consensus questionnaire for this section on Spinal Fracture were; Williams et al. (2013), NOS (2017), Parreira et al. (2017), Esses et al. (2011) and McCarthy and Davis (2016) (Appendix 1). The questionnaire was sent to N=28 international experts and contained 27 items (Table 3.0).

Table 3.0 Number of Spinal Fracture red flags gaining consensus

	Number of Red flags
Questionnaire was sent to 28 international experts	27 items reviewed 13 items reached consensus as appropriate 14 items no consensus 0 items reached consensus as inappropriate
Steering committee review of results	18 Items included in framework (Tables 3.1-3.4) 9 items excluded (Appendix 2)

Estimates for the point prevalence of osteoporotic compression fracture as a cause of LBP range between 0.7% - 4.5% in the primary care setting (Henschke et al 2009; Scavone et al 1981; Jarvik et al 2002; Van Den Bosch 2004; Deyo and Diehl 1992), and 6.5% in the emergency care setting (Gibson and Zoltie 1992). Low impact or non-traumatic fractures are the most common serious pathology in the spine, with vertebral fractures being the most common osteoporotic fracture. Approximately 12% of women between 50 and 79 years of age have vertebral fractures, and in the over 80 year old age group, this rises to 20% (NOS 2017). Up to 70% of these fractures are undiagnosed and may be found during investigation for other health conditions (McCarthy and Davis 2016). It is important to identify people with vertebral fractures, as they are more likely to sustain hip fractures at a later date, bringing further health consequences and risk for the person. Red flags purported to indicate possible fracture, have been shown to be unhelpful in diagnosing vertebral fracture, with many false positive tests accompanied by low diagnostic accuracy (Williams et al 2013). Acting on single red flags is not recommended, and it is acknowledged that the clinician must consider broader risk factors and differential diagnoses (Williams et al 2013). Osteoporotic fractures have a similar distribution as metastases with 70% in the thoracic region, 20% in the lumbar and 10% in the cervical. Most spinal fractures occur between T8-L4 levels (Patel et al 1991).

There are increasing numbers of younger people affected by insufficiency spinal fractures (fractures caused by normal stresses on weakened bone), due to a range of risk factors. These include; excessive alcohol consumption (risk increases drinking >3 units per day), Vitamin D deficiency, long term corticosteroid use (>5 or 7.5 mg/day over a 3 month period), rheumatoid arthritis, diabetes, smoking (>20 cigarettes per day (Nutti et al 2018)), dietary restriction, eating disorders, absorption problems from the gut (e.g. Crohn's disease (Berg et al 2008; SIGN 2015)). It is important that a full subjective patient history is taken to establish the presence or otherwise of these risk factors. People commonly present with sudden onset of pain, mostly located in the thoraco-lumbar region following low impact trauma such as a slip or trip or lifting something whilst in a flexed position. The pain varies in presentation, but is often severe, and mostly localised to the area of the fracture (Hippisley-Cox and Coupland 2009). Weight bearing activities and active movements are restricted and painful, and the person may require strong analgesia, particularly in the early stages. On physical examination, the person may have an increased prominence of the spinous process at the affected level, and an increased kyphosis. They may be tender to percussion at the affected level, though absence of this should not reassure the clinician that there is no fracture (McCarthy and Davis 2016). People with a suspected fracture should have an x-ray in the first instance to determine whether a fracture is present, and to grade and define the nature of the fracture.

The clinician should also consider possible differential diagnoses for spinal fracture. These include metastatic spinal disease (see section 4: Spinal Malignancy) and multiple myeloma, both of which can cause healthy bone to be replaced by tumour. In the case of metastatic disease, 60% of metastases occur in the anterior half of the vertebral body, thus potentially weakening this area and leading to a wedge fracture. These fractures may look very similar on x-ray, so the clinician needs to take close account of the subjective history and to explore any relevant risk factors for each type of pathology. Fractures from myeloma may also look very similar to osteoporotic fractures on x-ray, depending on the location. People with myeloma may present at a slightly earlier age than those with osteoporosis and metastases, but further imaging would be required to establish the cause of a fracture if there were no clear indications from the person's subjective history.

Table 3.1 Risk Factors for Spinal Fracture

3.1 Risk Factors	Context	Further questions	Low clinical suspicion	High clinical suspicion
History of osteoporosis <i>Level of evidence: high</i>	<p>A personal history of osteoporosis increases the risk of fracture</p> <p>A family history of osteoporosis will also increase the risk of osteoporosis, and fracture if they are female, not male (Hippisley-Cox and Coupland 2012)</p> <p>People with known osteoporosis have an increased risk of fracture, and those with a previous osteoporotic fracture have a 5.4 x increased risk of vertebral fracture and a 2.8 times risk of hip fracture (SIGN 2015)</p> <p>Medication for osteoporosis can reduce the risk of fracture in the following year by 50-80% (NOS 2017)</p>	<p>Do you have osteoporosis yourself?</p> <p>Do you have a family history of osteoporosis?</p> <p>Have you had previous osteoporotic fractures?</p> <p>Are you taking any medication for your osteoporosis? If so what are you taking?</p> <p>If not, have you been prescribed it or is there a reason you are not taking it?</p>	<p>No family history</p> <p>No other osteoporotic risk factors</p> <p>No previous fractures</p>	<p>Previous osteoporotic fractures</p> <p>Concurrent osteoporotic risk factors</p>
Corticosteroid use <i>Level of evidence: high</i>	<p>Steroid use of 7.5mg of steroids for >3 months increases the risk of osteoporosis (NICE CKS 2016; NOGG 2019) The effects of the use of inhaled steroids is inconclusive in terms of bone mineral density though the clinician should ask about high dose inhaled steroid use (SIGN 2015)</p>	<p>Have you used steroid tablets or inhaled steroids?</p> <p>How long have you used them for and what dose did you use?</p>	<p>No steroid use</p> <p>Steroid use <5mg over a 3-month period in a year</p>	<p>Steroid use of >5mg over a 3-month period</p>

3.1 Risk Factors	Context	Further questions	Low clinical suspicion	High clinical suspicion
Previous history of cancer <i>Level of evidence: low</i>	Metastatic bone disease may decrease bone density especially in the thoracic region (70% of cases)	Do you have a history of cancer? Where was the cancer? What treatment did you have for your cancer? What stage was the cancer?	No past medical history of cancer	History of cancer of the: <ul style="list-style-type: none"> • breast • prostate • lung • kidney • thyroid
Severe trauma <i>Level of evidence: high</i>	The more significant the amount of trauma, the higher the likelihood of bony injury. (ACR Guidelines suggest a fall of 5 stairs or 3 feet) The position of the person at the time of injury also important e.g. flexed as this might precipitate a fracture with seemingly innocuous activity like coughing	Have you had a significant injury/fall from a height? Did your pain start suddenly after a particular activity like coughing or sneezing?	No immediate bony pain post injury	Immediate spinal pain post injury Focal bony tenderness in the midline of the spine may indicate underlying bony injury
Female <i>Level of evidence: high</i>	19.8/1000 Females have osteoporotic fracture 8.4/1000 males have osteoporotic fractures (SIGN 2015) Females with late onset menarche (>16) (Roy et al 2003) or early menopause (<45) are at higher risk of osteoporosis (van der Voort et al 2003) and therefore spinal fracture	How old were you when you started your periods? How old were you when you went through the menopause?	Female with normal menarche and normal menopause with no other risk factors	Female- post menopausal, especially those with early menopause, or those with late menarche

3.1 Risk Factors	Context	Further questions	Low clinical suspicion	High clinical suspicion
Older age <i>Level of evidence: high</i>	Bone density decreases with age in both males and females 12% of women aged 50-70 have had a spinal fracture and 20% of women over 70 have had a spinal fracture 70% of these will not know about it (NOS 2017)	Have you had any investigations for your bones, such as x-rays or DEXA scans?	People under 50	Women over 65 and men over 75 have a higher risk of vertebral fracture (SIGN 2015) Patient's over 80 have a very high likelihood of having had an osteoporotic fracture
Previous spinal fracture <i>Level of evidence: high</i>	If previous fracture due to osteoporosis, then the person has a 5.4 times increased risk of vertebral fracture and a 2.8 times risk of hip fracture within the year (NICE 2012; SIGN 2015)	Have you had a previous spinal fracture?	No previous history of spinal fracture	Previous history of low impact spinal fracture
History of falls <i>Level of evidence: low</i>	Whilst the trauma of a fall may precipitate a fracture, multiple conditions can cause falls and immobility especially in the older patient Conditions such as Parkinsons, MS, dementia, alcoholism, malnutrition can all increase the risk of falls (Nuti et al 2018)	All people with osteoporosis should be assessed for risk of falls (NICE CKS 2016) All people should have a detailed past medical history taken	People with no comorbidities	People with comorbidities- the more they have, the higher risk they are of falling

Table 3.2 Symptoms of Spinal Fracture

3.2 Symptoms (subjective)	Context	Further questions	Low clinical suspicion	High clinical suspicion
Thoracic pain <i>Level of evidence: high</i>	Most (70%) non-traumatic spinal fractures occur in the thoracic spine. 70% of metastases occur in the thoracic spine too and should be considered in the differential diagnosis. Myeloma most commonly affects the thoracic spine too, so should also be considered in the differential diagnosis Band-like pain should be considered a concern and may indicate MSCC (Turnpenny et al 2013)	Detailed questioning of the patient is needed to assess for risk factors for each of these diseases	Thoracic pain with no history of cancer, osteoporosis or myeloma and no further risk factors	Any patient with known cancer, myeloma or osteoporosis
Severe pain <i>Level of evidence: low</i>	Some people may have a long history of back pain so it is important to establish whether this is a new or different pain. In some cases this may be their first episode of back pain so this may be an unfamiliar pain. Where they have a history of back pain explore whether this is something they have experienced in the past or not	Is this a familiar pain to you / Does this feel familiar? Have you experienced back pain in the past?	If this is a person's first episode of back pain then conservative management as the first course of action	Describes pain that is unfamiliar and possibly worsening pain
Neurological symptoms <i>Level of evidence: low</i>	People with spinal fracture will not usually develop neurological deficit/signs, but must be carefully questioned and examined to exclude this Are they complaining of pins and needles, numbness or weakness	Do you have any change in sensation in your arms or legs? Do you have any difficulties with walking or coordination? Do you have any difficulties with your balance?	No distally referred symptoms or subjective neurological symptoms	People with bilateral /quadriateral neurological symptoms including gait disturbance and coordination issues/bladder and bowel disturbance

Table 3.3 Signs of Spinal Fracture

3.3 Signs (objective)	Context	Objective Tests	Low clinical suspicion	High clinical suspicion
Spine tenderness <i>Level of evidence: low</i>	Patients with midline bony tenderness should be considered to be at risk of potential spinal fracture (McCarthy and Davis 2016)	The clinician should palpate the spinous processes and may use percussion/vibration with a 128 Hz tuning fork to examine spinal tenderness or reproduction of symptoms further. Bony percussion/use of a tuning fork may indicate the presence of bony injury though this should be interpreted with caution	No spinal tenderness	Tenderness or reproduction of symptoms on palpation, percussion and/or vibration
Neurological signs <i>Level of evidence: low</i>	People with a subjective complaint of neurological symptoms must have a full neurological examination	Upper and lower limb neurology and upper and lower motor neuron testing should be performed on these people. Neurological examination which may need to include upper and/or lower limbs, including upper and lower motor neurone clinical tests	Localised spinal pain with no distal referral or limb symptoms	People with spinal fracture and symptoms in the limbs, or with coordination/gait disturbance, or changes to bladder/bowel activity
Spinal deformity <i>Level of evidence: low</i>	Onset of deformity post trauma Sudden change in posture associated with a sudden increase in pain in the person with known osteoporosis	Bony percussion may indicate bony injury, as may use of a tuning fork, though these tests should be treated with some caution. Imaging may be appropriate	No change in spinal posture	Sudden change in spinal shape related to trauma or in a known osteoporotic patient
Contusion or abrasion <i>Level of evidence: low</i>	May indicate the site of trauma and should be considered if associated with painful site		Abrasion with no bony tenderness	Abrasion following trauma associated with central spinal bony tenderness

Table 3.4 Initial Investigations for Spinal Fracture

Modality	Context
X-Ray	X-rays, the first line choice to determine if there is a fracture present, with lateral views likely to yield most information (McCarthy and Davis 2016). X-rays are readily available and relatively low cost. It may be difficult to determine the age of the fracture using x-ray alone
MRI	MRI is the investigation of choice for differentiating osteoporotic fractures from metastatic disease and myeloma. It should be used if there are multiple fractures identified on x-ray (McCarthy and Davis 2016). MRI will also help to determine the age of the fracture as it can identify bone marrow oedema from recent/healing fractures (Nutti et al 2018)
CT Scan	A CT scan is commonly performed for other conditions and clinicians should assess the sagittal view to assess for undiagnosed vertebral fractures (NOS 2017). CT scans may be helpful in evaluating complex fractures or those with retro-pulsed fragments, as it gives excellent bony definition (Nutti et al 2018). CT scans may also be used where MRI is contraindicated

3.2 Spinal fracture clinical reasoning cases/scenarios

1) A 35 year old man presents with sudden onset of thoracic pain following lifting a heavy bag of concrete. No previous history of fracture and generally in good health. Smokes 5 cigarettes a day and has done for 10 years. He has limited thoracic spine movement into rotation to both sides. He is locally tender to palpate at T8 and T9 unilaterally on both sides.

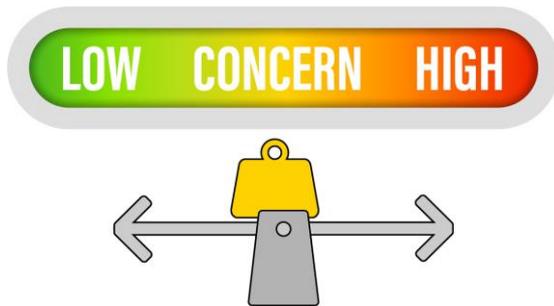


Male under 65	no family history
no steroid use	no previous fractures
no excessive alcohol use	low cigarette use

Clinical action = Treat and monitor symptoms.

His age and sex put him at low risk of osteoporotic fracture and his smoking habit is below 20/day which is again low risk. No further investigation required at this stage

2) A 60 year old lady presents with moderately severe thoraco-lumbar pain after lifting a heavy pot in the garden whilst flexed. It has been present for 3 weeks but is slightly improved. She is otherwise well and not on any medication other than paracetamol for her pain. She has no history of fracture. She had an early menopause aged 35. She smokes 20/day. She has pain in extension and rotation and some local spinal tenderness and zygapophyseal (facet) joint tenderness bilaterally.



Age and sex are risk factors for this lady, though under 65

PMH early menopause

Smokes 20 cigarettes a day

Clinical Action = Treat and monitor symptoms.

Whilst there are some risk factors for this lady, her symptoms are recent and improving, she is on low dose medication for pain. She does not require imaging and it would be safe to treat her and monitor progress without further investigation at this stage

3) A 78 year old lady presents with upper lumbar pain. No precipitating injury, but the pain has worsened over the last 3 months. It is worse lying supine. She has a past history of radius fractures x2 on the left. She had her menopause aged 38, having started her periods aged 15. She is otherwise well and has no family history of osteoporosis.



Age and sex risk factors

Worsening pain

Early menopause and a late menarche

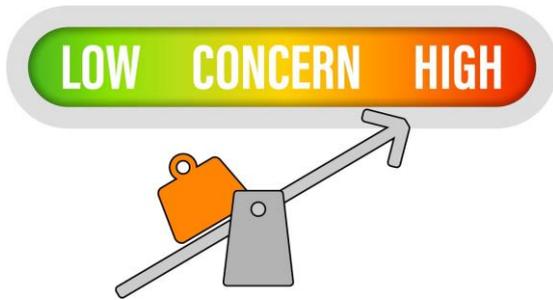
Worse lying supine

past history of fractures

Clinical action =Thoracic spine x-ray.

This lady has several osteoporotic risk factors. These include her age and her sex, her early menopause and late menarche, as well as a past history of radius fractures. X-ray of her thoraco-lumbar region in the first instance would be appropriate.

4) A 74 year old man with mid thoracic and lumbar pain presents with increasing pain locally in the spine but no trauma/injury. Pain is worse in lying and standing, eased slightly in sitting. He is taking increasing doses and strength of analgesia, which helps a little. He has some shortness of breath on exertion and pain on deep inspiration. He is a non-smoker, but drinks 3 pints of beer a day. He had a transurethral resection of the prostate (TURP) for prostate cancer 10 years ago and has been discharged from follow-up by the urologist.



Age and site of pain	Worsening pain
Increasing analgesia	Alcohol intake
Past history of prostate cancer	Breathlessness

Clinical action = Urgent MRI whole spine

This man has several risk factors for spinal fracture. These include a past history of prostate cancer, which is one of the cancers most likely to metastasise to the spine. His pain is worse in lying which is more unusual and may indicate underlying serious pathology (tumour). His age puts him at risk of osteoporosis, even though he is male, as we know his bone density is likely to have decreased. His shortness of breath may be a concern in the absence of a chronic obstructive pulmonary disease (COPD) or smoking history, given his prostate cancer. This man would benefit from further investigation of his spine with whole spine MRI to exclude metastases and fracture. In addition, a chest x-ray would be appropriate to exclude lung metastases/disease, and blood tests would be relevant to exclude myeloma and look for signs of inflammation/infection/increased bone turnover. If one is not in a position to request these medical tests, then urgent referral would be appropriate.

3.3 Consider the pathway for emergency/ urgent referral

Refer to clinical decision tool for suggested pathways for emergency/ urgent referral (Step 3 of section 1.2).

4 Spinal Malignancy

Metastases are cancer lesions that have spread from the primary cancer site, to a new and different site in the body. Spinal malignancy refers to metastases which have spread specifically into the spine. Bone is a common site for metastases, known as metastatic bone disease (MBD), in a number of cancers (breast, prostate lung, kidney and thyroid). (Sutcliffe et al 2013).

4.1 Literature and International Consensus

The Henschke et al. (2013) Cochrane review was the key source paper used to formulate the international consensus questionnaire for the Spinal Malignancy section (Appendix 1). The questionnaire was sent to 28 international experts and contained 29 items (Table 4.0).

Table 4.0 Number of spinal malignancy red flags gaining consensus

	Number of Red flags
Questionnaire sent to 28 international experts	29 items reviewed <ul style="list-style-type: none"> • 14 items reached consensus as appropriate • 6 items reached consensus as inappropriate • 9 items with no consensus
Steering committee review of results	14 Items included in framework (Tables 4.1-4.4) 15 items excluded (Appendix 2)

Estimates for the point prevalence of spinal malignancy as a cause of LBP range between 0.0% - 0.7% in the primary care setting (Henschke et al 2009; Donner-Banzhoff et al 2006; Khoo et al 2003; Frazier et al 1989; Deyo and Diehl 1986; Deyo and Deihl 1998), 0.1% in the emergency care setting (Reinus et al 1998) and 1.6% in the tertiary care setting (Premkumar et al 2018). Malignancy as a cause for musculoskeletal pain is estimated at 7.0% in the secondary care setting (Jacobson 1997).

The second most common serious pathology to affect the spine, after fracture, is MBD as a consequence of a primary cancer (Downie et al 2013). More effective medical treatment of primary cancers means people are living longer putting them at greater risk of later developing MBD (Biermann et al 2009). It should be noted that cancer can affect all ages but the risk of developing malignancy increases with age (Harel et al 2010). The consequences of untreated or late diagnosis are widespread metastases and visceral involvement. MBD can lead to significant morbidity and reduction in quality of life due to Metastatic Spinal Cord Compression (MSCC) and in the worst-case scenario, can lead to paralysis and compromise of the bladder, bowel and sexual dysfunction (Sutcliffe et al 2013).

The spine is one of the earliest sites affected by MBD, especially in those cancers that have a propensity to metastasise (Sciubba et al 2010). The five most common cancers to

metastasise are breast, prostate, lung, kidney and thyroid (Coleman and Holen 2014). Approximately 30% of all people with one of these primary diagnoses of cancer will go onto metastasise, so it is important not to subject all people with a past history of cancer to unnecessary and worrying investigations if not warranted. In breast cancer MBD can occur at any time with 50% occurring within the first 5 years after a primary diagnosis of cancer, with the other 50% developing 10 years and beyond (Lee et al 2011).

Other primary cancers may metastasise but are at a lower incidence (Oliver et al 2011). Clinicians should not be reassured by the absence of a past history of cancer, as MSCC can be the first sign of metastases in approximately 25% of people who do not have a primary diagnosis of cancer and are subsequently diagnosed with MSCC (NICE 2008). MSCC can occur as a consequence of MBD when there is pathological vertebral body collapse or where direct tumour growth causes compression of the spinal cord, leading to irreversible neurological damage (Levack et al 2002). A high index of suspicion, early diagnosis, with referral for urgent investigation and prompt treatment can result in better outcomes in terms of function and prognosis (Turnpenny et al 2013). Careful questioning using good communication skills is essential in early identification. The use of credit card size patient information handouts can aid in communication between clinicians and patients.

https://www.christie.nhs.uk/media/1125/legacymedia-1201-mscc-service_education_mscc-resources_red-flag-card.pdf.

Metastases can affect any region of the spine, most commonly the thoracic spine (70%) but also cervical (10%) and lumbar spine (20%) (Scuibba et al 2010). Primary tumours that are of a high risk of metastasising are those where at diagnosis the tumour was large, diagnosed at a late stage of the disease (stage 3 or 4), lymph node involvement with radical treatment including surgery, chemotherapy and /or radiotherapy (Oliver et al 2011)

Table 4.1 Risk Factors for Spinal Malignancy

4.1 Risk Factors	Context	Further questions	Low clinical suspicion	High clinical suspicion
<p>Past history of cancer <i>Level of evidence: high</i></p>	<p>Not all those cancers with a predilection to bone metastases will develop them. However, some will metastasise in the first 5 years of diagnosis with 50% 10-20 years later (Lee et al 2011)</p> <p>NB: Approximately 25% of people with MSCC have no known primary at diagnosis (NICE 2008)</p>	<p>Do you have any concerns?</p> <p>How long ago was the primary diagnosis made?</p> <p>How big was the primary tumour and what stage?</p> <p>Was there any lymph node involvement?</p> <p>What treatment did you have?</p>	<p>Cancers with a predilection to bone but early stage (1 or 2) with no lymph node involvement (Oliver et al 2011)</p> <p>Cancers that do not have a predilection to bone e.g. ovarian cancer, melanoma (Oliver et al 2011)</p>	<p>Cancers which have a predilection to bone e.g. breast, prostate, lung, kidney and thyroid (Coleman and Holen 2014)</p> <p>In breast cancer grade 3 or 4 (late stage), large tumours with lymph involvement (Oliver et al 2011)</p> <p>In prostate cancer a Gleason score greater than 8, despite PSA level or PSA greater than 50 at diagnosis (American Cancer Society 2017)</p>

Table 4.2 Symptoms of Spinal Malignancy

4.2 Symptoms (subjective)	Context	Further questions	Low clinical suspicion	High clinical suspicion
Severe pain that may become progressive and constant <i>Level of evidence: low</i>	MBD does not have a linear progression and is more likely to wax and wane but in the later stages becomes more constant and progressive. People may report escalating pain which can increase when lying flat. (Turnpenny et al 2013)	Are your symptoms getting better same or worse? Does the person describe band like pain?	Person presents with initial severe pain but reports improvement with treatment, important to continue to evaluate as may be in a good phase	Subjectively reports progressively worsening symptoms, with possible features of band like pain and unable to lie flat
Night pain <i>Level of evidence: low</i>	Most people with back pain will suffer with night pain. People who report being woken on movement and subsequently are unable to get comfortable and go back to sleep are of less concern than those who describe an inability to get back to sleep due to the intensity of symptoms and report having to get up to relieve the pain (Finucane et al 2017)	Does your pain wake you at night? What do you have to do to get back to sleep? Does your night pain occur in a particular position?	Person reports they are able get back to sleep following a change of position or taking medication	People who report having to walk the floors or sit in a chair or lie on the floor with minimal relief

4.2 Symptoms (subjective)	Context	Further questions	Low clinical suspicion	High clinical suspicion
Systemically unwell <i>Level of evidence: low</i>	These are often symptoms described in the late stages of the disease and may include fatigue, nausea, anorexia and constipation which are symptoms suggestive of hypercalcaemia (Farrell 2013) Although constipation is not necessarily a systemic complaint These could appear on their own or as a cluster of symptoms	Does the person feel well in themselves? If not then explore the features of hypercalcaemia Establish whether these symptoms could be associated with other causes	Able to associate with another cause	May describe the features of hypercalcaemia such as fatigue, nausea, stomach pain including fever. These also tend to be progressive in nature
Thoracic pain <i>Level of evidence: low</i>	The thoracic spine is the most common site of MBD N.B. MBD may not correspond to the sensory level of pain	Is the area sensitive to touch? Mechanical in presentation?	Appears mechanical but caution needs to be applied here as often MBD gives the impression of being mechanical in nature, often appearing to initially respond to treatment	May be painful on percussion over the area of pain. May not be a mechanical pain pattern
Neurological symptoms <i>Level of evidence: low</i>	MBD can cause neurological symptoms and in some cases cord compression including UMN signs & CES	Do you have any P&N or numbness? Have you noticed any weakness in your legs? Ask CES questions see section 2 for more detail	No distally referred symptoms or subjective neurological symptoms	People with bilateral /quadrilateral neurological symptoms including gait disturbance and coordination issues/bladder and bowel disturbance

4.2 Symptoms (subjective)	Context	Further questions	Low clinical suspicion	High clinical suspicion
Unexplained weight loss <i>Level of evidence: high</i>	Consider other causes of weight loss, such as change in diet, increase in exercise, medication increasing levels of pain or other morbidities such as hyperthyroidism, diabetes (Nicholson et al 2019) Consider more than 5% of weight loss over a 6 month period as significant and requires further questioning to establish a cause (Nicholson et al 2019)	Is your weight steady? If person answers 'Yes' they have lost weight, ask if they know why they have lost weight Do you know why you might have lost weight? Have you changed your diet? How much weight loss over the last 3-6 months?	Weight loss related to medication or change in diet or weight loss has stabilised Can be attributed to other causes	The individual has lost 5-10% body weight loss over 3-6 month period (Nicholson et al 2019)
Unfamiliar back pain <i>Level of evidence: low</i>	Some people may have a long history of back pain so it is important to establish whether this is a new or different pain. In some cases this may be their first episode of back pain so this may be an unfamiliar pain. Where they have a history of back pain explore whether this is something they have experienced in the past or not	Is this a familiar pain to you? Have you experienced back pain in the past? Does this feel familiar to you?	If this is a person's first episode of back pain then conservative management as the first course of action	Describes pain that is unfamiliar and possibly worsening pain

Table 4.3 Signs of Spinal Malignancy

Signs (objective)	Context	Objective Tests	Low clinical suspicion	High clinical suspicion
Altered sensation from trunk down, <i>Level of evidence: low</i>	People might report subjectively altered sensation that is non-dermatomal and describe funny feelings in legs, often unable to describe this sensation which is vague and non-specific , may report decreased mobility (Turnpenny et al 2013)	Neurological examination testing Sensation throughout the area described by the patient	Normal neurology and no objective change in sensation	Objective signs and reduced sensation
Neurological signs <i>Level of evidence: low</i>	People who present with a subjective complaint of neurological symptoms must have a full neurological examination	Neurological examination which may need to include upper and/or lower limbs, including upper and lower motor neurone clinical tests	Localised spinal pain with no distal referral or limb symptoms	People with symptoms in the limbs, and/or with coordination/gait disturbance, or changes to bladder/bowel activity
Spine tenderness <i>Level of evidence: low</i>	In some cases where metastases have infiltrated the vertebrae the spine can be tender on percussion. However, lack of tenderness does not rule out the possibility of metastases It is important to percuss the whole spine as the area of pain reported may not be the area of metastases	The clinician should palpate the spinous processes and may use percussion/vibration with a 128 Hz tuning fork to examine spinal tenderness or reproduction of symptoms further	No tenderness on palpation or percussion/vibration	Tenderness or reproduction of symptoms on palpation or percussion/vibration

Table 4.4 Initial Investigations for Spinal Malignancy

Modality	Context
MRI	MRI is considered the gold standard in diagnosing MBD (Sutcliffe et al 2013). Since the sensory level does not always correspond to the level of metastases if MBD is suspected an MRI of the whole spine is required (Levack et al 2002).
CT Scan	If there are contraindications for MRI
Blood Tests	There is no combination of inflammatory markers that can be used as a reliable rule-in or rule-out test strategy. The decision to test must be made in the context of other clinical findings (Watson et al 2019).

4.2 Spinal Malignancy clinical reasoning cases/scenarios

1) A 58 year old woman with a 42 year history of chronic low back pain and history of breast cancer 5 years ago; presents with exacerbation of low back pain, No other red flags or signs and symptoms suggestive of a mechanical problem on examination.



History of breast cancer 5 years ago

Clinical Action = Treat and monitor symptoms

2) The same woman reports that the pain is not responding to usual medication and she has been prescribed stronger medication, which is helping. She describes her symptoms as different to her usual back pain has had some relief from conservative treatment.



History of breast cancer 5 years ago

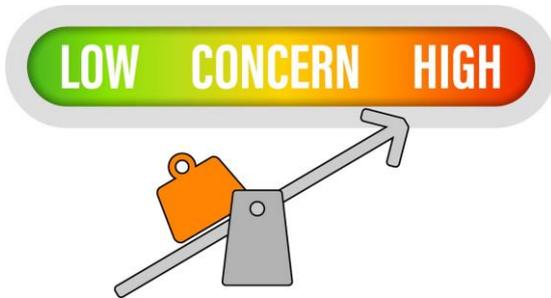
Using stronger painkillers

Some relief with conservative management

Describes unfamiliar pain

Clinical Action = Treat, monitor symptoms, discuss and document a clear strategy to follow if symptoms deteriorate (safety net).

3) In the same woman the pain has become progressively worse and she now complains of symptoms waking her at night-time, she is having difficulty getting back to sleep as the pain is so intense.



History of breast cancer 5 years ago

Using stronger painkillers

Describes unfamiliar pain

Night pain with worsening symptoms

Clinical Action = Refer for urgent MRI, discuss and document a clear strategy to follow if symptoms deteriorate (safety net).

Some concerning features suggestive of malignancy. Where a person presents with spinal pain suggestive of spinal metastases, an MRI of the whole spine should be carried out urgently.

4) A 75 year old man presents with a past history of prostate cancer 2 years ago, he describes band-like pain and his legs feel odd and heavy occasionally tripping and stumbling, he has lost weight but has put it down to a loss of appetite due to the pain.



History of prostate cancer

Balance issues

Odd sensations in legs

Band like pain

Weight loss

Clinical Action = Emergency MRI scan.

Some concerning features which may be suggestive of MSCC. Where people are at high risk of developing MSCC, they should be given information that describes the symptoms of MSCC and what to do if they develop symptoms (Turnpenny et al 2013).

https://www.christie.nhs.uk/media/1125/legacymedia-1201-mscc-service_education_msc-resources_red-flag-card.pdf.

4.3 Consider the pathway for emergency/ urgent onward referral

Refer to clinical decision tool for suggested pathways for emergency/ urgent referral (Step 3 of section 1.2).

5 Spinal Infection

Spinal infection (SI) refers to an infectious disease that affects the spinal structures including the vertebrae, intervertebral discs and adjacent paraspinal tissues (Nickerson et al 2016). In high income and upper middle income countries SI has steadily increased over recent years it is thought that this is related to an ageing population and an increase in intravenous drug abuse (Nagishima et al 2017). In lower middle income and lower income countries, SI has increased due to the dual epidemic of HIV/AIDS and tuberculosis (TB). For further country specific information on TB see

https://www.wvl.nhs.uk/library/general_docs/specialties/a_to_z/t/tb-service-who-estimates-of-tuberculosis-incidence-by-country.pdf (Public Health England 2015) and for

further information on the global burden of the dual epidemic of HIV/AIDS and TB see

<https://www.who.int/tb/areas-of-work/tb-hiv/en/> (WHO 2019). Staphylococcus aureus and Brucella are the other main bacteria that are identified in reports on spinal infection (Yusuf et al 2019).

5.1 Literature and International Consensus

The 2 key source papers used to formulate the international consensus questionnaire for this section on Spinal Infection were the Yusuf et al (2019) scoping review and the Public Health England (2017) TB in England report (Appendix 1). The questionnaire was sent to 21 international experts and contained 56 items (Table 5.0).

Table 5.0 Number of spinal infection red flags gaining consensus

	Number of Red flags
Questionnaire sent to 21 international experts	56 items reviewed <ul style="list-style-type: none"> • 30 items reached consensus as appropriate • 0 items reached consensus as inappropriate • 26 items with no consensus
Steering committee review of results	17 Items included in framework (Tables 5.1-5.4) 26 items excluded (Appendix 2) (16 items were combined)

Spinal infections (SI) such as TB, discitis and spinal abscesses are said to be uncommon with an incidence of 0.2-2.4 cases per 100 000 annually in Western societies (Cheung and Luk 2012, Gouliouris et al 2010). SI represents 2–7% of all musculoskeletal infections (Lenar et al 2018). The point prevalence of spinal infection in developed countries is estimated at 0.0004% (across all settings) (Tyrrell, Cassar-Pullicino and McCall 1999; Duarte and Vaccaro 2013). Point prevalence of infection presenting as non-mechanical LBP is estimated at 0.01% in primary care (Jarvik and Deyo 2002) and 1.2% in a tertiary setting (Premkumar et al 2018) where postprocedural discitis represents up to 30% of all cases (Duarte and Vaccaro 2013).

However, the frequency of spinal infections presenting in a clinical setting depends on the demographics of where you work, for example Lusaka or London and the type of setting, for example a spinal surgical unit in North America or a rural primary care centre in Africa. Due to the rarity of SI in high income countries the diagnosis of SI is often delayed because clinicians fail to recognise the relevant red flags and consider SI as a potential differential diagnosis.

In cases of SI there is often a prolonged period of time between onset and diagnosis and people can remain relatively healthy until symptoms manifest themselves in the later stages of the disease (Wainwright 2001). Unlike malignancy where symptoms wax and wane, SI has a more linear progression with back pain being the most common presenting symptom which can progress to neurological symptoms. If not treated in a timely manner, the condition can progress with serious complications such as paralysis, instability of the spine and can ultimately be fatal.

The subjective history should consider determinants which can be divided into comorbidities, environmental and social factors. Comorbidities that suppress a patient's immune system such as diabetes, HIV, long-term steroid use and smoking puts the person at risk of infection. Social factors and environmental factors should be considered and include intravenous drug use, obesity born in a TB endemic country, family history of TB, living conditions (overcrowded living, homelessness, imprisonment or rural environment). Spinal surgery is a key risk factor for SI, in particular multiple revision surgery of the lumbar spine, with an added increased risk for obese people (Yusuf 2019).

Discitis mostly affects the lumbar spine (58%) followed by the thoracic (30%) and cervical spine (11%) (Gouliouris et al 2010), whereas TB lesions mainly affect the thoracic spine and often at more than two levels (Chen et al 2016).

The literature describes a classic triad of clinical features which are back pain, fever and neurological dysfunction (Davis et al 2004). However, the reliance on people presenting with these features is likely to result in missed cases or late diagnosis as not all people will present with all three features. For example, only 50% of people report fever as a symptom (Lenar et al 2018) so a lack of fever cannot rule out SI and clinicians should not necessarily be reassured by its absence.

Using both determinants and clinical features will aid the clinician in considering whether there is a need to request further investigations including blood tests and imaging (MRI) if SI is suspected.

Table 5.1 Risk Factors for Spinal Infection

5.1 Risk Factors	Context	Further questions	Low clinical suspicion	High clinical suspicion
Immunosuppression <i>Level of evidence: low</i>	Comorbidities that cause immunosuppression can increase the risk of SI and include diabetes, HIV/AIDS, rheumatoid arthritis, pre-existing infections, alcohol abuse and long-term use of steroids.	Establish the overall health status of the patient. Duration of disease, Is their diabetes well controlled? If on steroids, how long for? Have they suffered from any infections recently? Do you drink alcohol? How many units a week do you drink?	Well controlled comorbidities with no history of infections attributed to their condition.	Uncontrolled morbidities with previous evidence of infections
Surgery/Invasive <i>Level of evidence: low</i>	Long duration of surgery, in particular, the type of instrumentation (more commonly lumbar and posterior approaches), with multiple revisions are significant risk factors of SI (Lenar et al 2018)	Any previous spinal or abdominal surgery?	No previous surgical intervention	The person has undergone surgery particularly of the spine with repeat revisions
Intravenous drug use <i>Level of evidence: low</i>	An increase in intravenous drug abuse (IVDA) is thought to be associated with the increase in SI (Ziu et al 2014). This group of people are challenging as often they present late and do not see the relevance of drug use to their condition. Awareness of the incidence of drug abuse within your locality is important as this may be more prevalent in some areas than others	Questions need to be in the context of the suspicion of SI. I want to make sure you do not have an infection so I am going to ask you some questions that will help me. Do you or have you ever taken recreational drugs? If yes, how were these drugs administered? (orally or intravenously)	No evidence of IV drug abuse	Known recreational drug user

5.1 Risk Factors	Context	Further questions	Low clinical suspicion	High clinical suspicion
Social and environmental factors (e.g. migrant, occupational exposure, homelessness, prisoners, contact with infected animals) <i>Level of evidence: low</i>	There is a strong association with social deprivation and TB. Consideration of a patient's social history and whether their situation includes the following; alcohol abuse, migrant, homelessness and imprisonment (Lipman et al 2019). Observation of a person will provide some insight into whether a person is socially deprived and further questioning exploring their social history will help to build a picture of both their working and living conditions. Whether an individual has been exposed to TB as a consequence of their occupation (e.g. contact with infected cattle) (Yusuf et al 2019)	What are the conditions like; where you live, in the workplace or places you frequently visit?	Appears well kempt and does not report social conditions that raise concern	Appears unkempt and raises concerns of poor living and social conditions
History of TB (Born in TB endemic country) <i>Level of evidence: low</i>	The majority of TB cases are a result of reactivation of latent infection acquired some years before (Lipman et al 2015). However, transmission of TB needs to be considered where individuals are born in TB endemic countries or where an individual has been exposed to TB sufferers (Lipman et al 2015)	Have you ever been diagnosed with TB? Where was the TB? Have you been abroad recently? (if yes consider if this country has a high burden of TB) If country with high burden, have they had an inoculation for TB? Have you been in contact with someone who has a history of TB?	No evidence of TB or contact with TB	No inoculation and has been exposed to TB via an endemic country or persons known to have TB
Recent pre-existing infection <i>Level of evidence: low</i>	New local back pain following a recent episode of sepsis or infection (Nagashima et al 2017)	Have you recently had an infection? Consider other causes such as Urinary Tract Infections and ask questions related to condition.	If the person's infection has responded to treatment (e.g. antibiotics) and back pain symptoms have improved	Progressively worsening symptoms

Table 5.2 Symptoms of Spinal Infection

5.2 Symptoms (subjective)	Context	Further questions	Low clinical suspicion	High clinical suspicion
Spinal pain <i>Level of evidence: low</i>	Back pain is the most common presenting symptom, which can progress to neurological symptoms, unlike malignancy where symptoms wax and wane, SI has a more linear progression. It is usually presents with nonspecific symptoms and an insidious onset. Range of motion of the spine is often limited due to localised spinal pain and muscle spasm (Nagashima 2017)	How did your back pain start? Are your symptoms getting better, worse or remaining the same? Can you point to where your symptoms are?	No evidence of progressive symptoms and person is not able to pinpoint symptoms	Localised progressive pain limiting movement significantly
Neurological symptoms <i>Level of evidence: low</i>	Neurological symptoms make up the part of the classic triad for SI which gets progressively worse	Do you have any pins or needles or numbness? Have you noticed any weakness in your legs?	No distally referred symptoms or subjective neurological symptoms. If the person does not describe any neurological symptoms continue to evaluate for possible change	People with bilateral /quadriateral neurological symptoms including gait disturbance and coordination issues/bladder and bowel disturbance
Fatigue <i>Level of evidence: low</i>	People might describe 'underperforming' activities that they would normally be able to carry out (Howell et al 2018)	Do you feel fit and well in yourself? Have you noticed any changes in your ability to carry out activities that normally you manage easily?	No evidence of fatigue	Describes a level of fatigue that is abnormal for them when carrying out their usual tasks

5.2 Symptoms (subjective)	Context	Further questions	Low clinical suspicion	High clinical suspicion
Fever (Consider sepsis/septic shock) <i>Level of evidence: low</i>	Fever makes up one of the classic triad. In the worst case scenario people may go on to develop sepsis and it is important to recognise as it can develop rapidly. For further information see RCP (2017) https://www.rcplondon.ac.uk/projects/outputs/national-early-warning-score-news-2 Fever can be absent in approximately 50% of people with SI so clinicians should not be reassured by its absence (Yusuf et al 2019)	Have you experienced a fever or chill since the onset of your back pain?	The absence of fever should not be reassuring, it should be monitored	Person reports fever within the timeframe since onset of back pain. Concern that person might be developing sepsis
Unexplained weight loss <i>Level of evidence: low</i>	Consider other causes of weight loss, such as change in diet, increase in exercise, medication increasing levels of pain or other morbidities such as hyperthyroidism, diabetes (Nicholson et al 2019) Consider more than 5% of weight loss over a 6 month period as significant, this requires further questioning to establish a cause (Nicholson et al 2019)	Is your weight steady? If person answers 'Yes' they have lost weight ask - Do you know why you might have lost weight? Have you changed your diet? How much weight loss over the last 3-6 months?	Weight loss related to medication or change in diet Weight loss has stabilised Can be attributed to other causes	Person has lost more than 5% body weight over 3-6 month period (Nicholson et al 2019)

Table 5.3 Signs of Spinal Infection

Signs (objective)	Context	Objective Tests	Low clinical suspicion	High clinical suspicion
Neurological signs <i>Level of evidence: low</i>	People with a subjective complaint of neurological symptoms must have a full neurological examination	Neurological examination which may need to include upper and/or lower limbs, including upper and lower motor neurone clinical tests	Localised spinal pain with no distal referral or limb symptoms	People with symptoms in the limbs, or with coordination/gait disturbance, or changes to bladder/bowel activity
Radiculopathy <i>Level of evidence: low</i>	SI can cause radiculopathy which commonly presents with leg pain which usually radiates to the part of the body that is supplied by that specific nerve. The person may present with weakness, pins and needles /numbness	A full neurological examination including dermatomes, myotomes and reflexes	Normal neurological examination	Abnormal and progressing neurological deficit Management depends on the degree of neurological deficit- if gross motor weakness (< 3/5), or deteriorating neurology
Spine tenderness on palpation <i>Level of evidence: low</i>	In some cases, the spine can be tender and reproduce symptoms on percussion. However, lack of tenderness or reproduction of symptoms does not rule out the possibility of infection. It is important to percuss the whole spine, as the area of pain reported may not be the area of infection.	The clinician should palpate the spinous processes and may use percussion/vibration with a 128 Hz tuning fork to examine spinal tenderness or reproduction of symptoms further. Bony percussion/use of a tuning fork may indicate the presence of bony injury though this should be interpreted with caution	No significant tenderness on palpation	Tenderness or reproduction of symptoms on palpation, percussion and/or vibration

Table 5.4 Initial Investigations for Spinal Infection

Modality	Context
MRI	MRI is the imaging of choice when investigating suspected SI. Findings on MRI can be observed just 3-5 days after the onset of infection, with a sensitivity of 96% and a specificity of 92% and its 94% accurate (An and Seldomridge 2006, Cheung et al 2012, Lury et al 2006, Sendi et al 2008)
Blood tests	There is no one blood test that will diagnose SI but inflammatory markers, ESR and CRP, are routinely used to assess for infection. The white blood cell (WBC) count, however, is less useful than ESR and CRP, as the presence of a normal WBC count does not exclude the diagnosis of spinal infection (Lener 2018)
X-ray	Chest x-ray if suspicious of TB

5.2 Spinal Infection clinical reasoning cases/scenarios

1) A 47 year old ex-heroin addict presents with recurrent episodes of LBP. Previous history of back pain. He describes symptoms that are intermittent. Very inactive and usually self-treats problem with rest.



Male

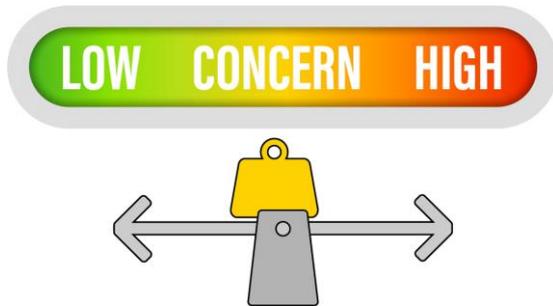
Ex drug addict

No other concerning features

Clinical action = Treat and monitor symptoms, discuss and document a clear strategy to follow if symptoms deteriorate (safety net).

A period of watchful waiting, with advice about being more physically active.

2) A 43 year old man presents with 3-month history of LBP. Intermittent and mechanical in nature. Born in Somalia and smokes 20 per day. Neurologically intact and with normal function.

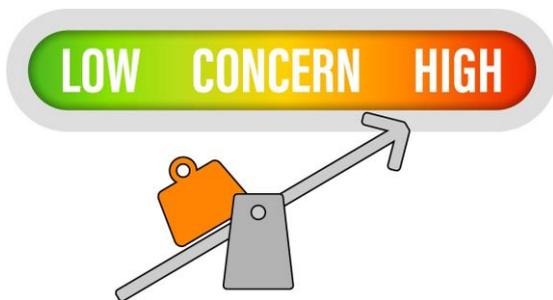


Born in TB endemic country

Smoker

Clinical action = Treat and monitor symptoms, discuss and document a clear strategy to follow if symptoms deteriorate (safety net). Consider MRI if increased suspicion of pathology.

3) This same man now feels unwell and has had a fever and chills in the last few days with an increase in pain at night and is unable to settle, the pain has now become constant and more intense. Neurological assessment normal.



Born in TB endemic country

Smoker

Feels unwell

Night pain, worsening symptoms

Clinical action = Urgent MRI and request blood tests, discuss and document a clear strategy to follow if symptoms deteriorate (safety net).

4) This man has progressed and he has now developed neurological signs and symptoms with back and left leg pain to dorsum of foot scoring 3/5 (Oxford strength scale) for left dorsiflexion and has been up all night with leg pain.



Born in TB endemic country

Smoker

Systemically unwell

Night pain, worsening symptoms

Neurological signs and symptoms

Clinical Action = Emergency medical assessment required. As per local pathway, consider/discuss whether hospital admission is required.

5.3 Consider the pathway for emergency/ urgent onward referral

Refer to clinical decision tool for suggested pathways for emergency/ urgent referral (Step 3 of section 1.2).

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Appendix 1. Table A.1 Key papers, evidence statements

Pathology	Reference	Number of Papers Reviewed	Number of Patients	Evidence Statement
CES	Dionne, N., Adefolarin, A., Kunzelman, D., Trehan, N., Finucane, L., Levesque, L., Sadi, J. and Walton, D. (2019) 'What is the diagnostic accuracy of red flags related to Cauda Equina Syndrome (CES) when compared to Magnetic Resonance Imaging (MRI) A systematic review.'	7	569	"red flags commonly used to screen for CES are not robust enough to diagnose CES on their own as their diagnostic accuracy is poor. That being said, red flags still remain important clinical markers in the suspicion of CES as presently they are the best tools that general healthcare practitioners have to screen for this serious condition."
CES	Germon, T., Ahuja, S., Casey, A.T., Todd, N.V. and Rai, A., (2015). British Association of Spine Surgeons standards of care for cauda equina syndrome. <i>The Spine Journal</i> , 15(3), pp.S2-S4.	N/A	N/A	Policy document outlining best standards of care. "In patients with symptoms suggestive of CES, with confirmed CES compression on MRI, the recommended treatment of choice is urgent surgical decompression" "Nothing is to be gained by delaying surgery and potentially much to be lost. Decompressive surgery should be undertaken at the earliest opportunity, taking into consideration the duration of pre-existing symptoms and the potential for increased morbidity whilst operating in the small hours. We do not consider that there is anything in the literature which justifies contravention of this principle. We recommend reasons for any delay in surgery are documented"

Pathology	Reference	Number of Papers Reviewed	Number of Patients	Evidence Statement
CES	Greenhalgh, S., Finucane, L., Mercer, C. and Selfe, J., 2018. Assessment and management of Cauda Equina Syndrome. <i>Musculoskeletal Science and Practice</i> .	N/A	N/A	"A number of authors including Henschke et al. (2006), Downie et al. (2013) and Verhagen et al. (2016) have published high quality review papers demonstrating that Red Flags have a weak evidence base."
Fracture	Williams, C.M., Henschke, N., Maher, C.G., van Tulder, M.W., Koes, B.W., Macaskill, P., Irwig, L. (2013) 'Red flags to screen for vertebral fracture in patients presenting with low-back pain' <i>Cochrane Database of Systematic Reviews</i> , (1).	8	7,378	"The available evidence does not support the use of many red flags to specifically screen for vertebral fracture in patients presenting for LBP. From the limited evidence, the findings give rise to a weak recommendation that a combination of a small subset of red flags may be useful to screen for vertebral fracture."
Fracture	National Osteoporosis Society (2017) 'Clinical Guidance for the Effective Identification of Vertebral Fractures'	N/A	N/A	N/A
Fracture	Parreira, P.C., Maher, C.G., Megale, R.Z., March, L. and Ferreira, M.L., 2017. An overview of clinical guidelines for the management of vertebral compression fracture: a systematic review. <i>The Spine Journal</i> .	4 Guidelines	N/A	"Overall, none of the guidelines was of satisfactory quality. The domains with the lowest scores were rigor of development and applicability."

Pathology	Reference	Number of Papers Reviewed	Number of Patients	Evidence Statement
Fracture	Esses, S. I., McGuire, R., Jenkins, J., Finkelstein, J., Woodard, E., Watters III, W. C., ... & Sluka, P. (2011). The treatment of symptomatic osteoporotic spinal compression fractures. <i>JAAOS-Journal of the American Academy of Orthopaedic Surgeons</i> , 19(3), 176-182.	N/A	N/A	N/A
Fracture	McCarthy, J. and Davis, A., 2016. Diagnosis and Management of Vertebral Compression Fractures. <i>American family physician</i> , 94(1).	N/A	N/A	Evidence rating C = consensus, disease-oriented evidence, usual practice, expert opinion, or case series.
Malignancy	Henschke, N., Maher, C. G., Ostelo, R. W. J. G, de Vet, H. C. W., Macaskill, P and Irwig, L. (2013) . 'Red flags to screen for malignancy in patients with low-back pain (Review)' <i>Cochrane Database of Systematic Reviews</i> , 2(2)	8	7,361	"For most "red flags," there is insufficient evidence to provide recommendations regarding their diagnostic accuracy or usefulness for detecting spinal malignancy."
Infection	Yusuf, M., Finucane, L. and Selfe, J. (2019) 'Red flags for the early detection of Spinal Infection in back pain patients? A Scoping Review.' <i>BMJ Open</i>	41	2,058	"The current evidence surrounding red flags for SI remains of low quality and clinical features alone should not be relied upon to identify SI."
Infection	Public Health England (2017) Tuberculosis in England report	N/A	N/A	N/A

Appendix 2. Table A.2: Red Flags which Gained Consensus as Inappropriate

Pathology	Risk Factors	Signs	Symptoms	Investigations
CES		Absent bulbocavernosus reflex	Saddle anaesthesia	X-Ray Bladder Ultrasound
Fracture	BMI <23 Recent back injury No regular exercise Family history of spinal fracture Smoking Alcohol intake >14 units/week	Muscle spasm	Muscle spasm Leg pain	
Malignancy	Failure to improve after 1 month with conservative therapy Duration of episode >1 month Age > 50	Muscle spasm Fever recorded via thermometer (temp >100°F/37.8°C)	Muscle spasm Insidious onset Patient reports symptoms of fever Patient reports neurological symptoms Patient reports tried bedrest with no relief Patient reports gradual onset before age 40	X-Ray
Infection	Older age Spinal trauma Males Lived in rural area Ingestion of unpasteurised dairy product Blood pressure dysfunction	Abscess Paralysis Active bacterial/fungal infection Sepsis/septic shock Weight loss (at least 4kg) Observed spinal deformity Anorexia (BMI ≤19) Hepatosplenomegaly (liver and spleen enlargement)	Patient reports stiffness Patient reports feeling of tenderness Patient reports radiculopathy Patient reports bladder/bowel dysfunction Patient reports urinary incontinence Weakness/Extreme weakness Arthralgia Myalgia Anorexia	CT Scan

