

## Supplementary Data

The following tables outline the search terms that were used to perform searches of the identified key databases (MEDLINE, CINAHL complete, PsycINFO and SPORTDiscus) from 2009 to the 17<sup>th</sup> April 2019 as part of the scoping review of clinical practice guides.

**Table S1. Search terms – LBP (Medline)**

<b>1. (in title/abstract)</b> MH “Practice Guidelines”
<b>2. (in title/abstract) OR</b> Guideline* OR consensus OR recommendations
<b>3. (title/abstract) AND</b> Lumb* or LBP or NSLBP or CNLSBP or non-specific or low* or back or spin* or radic* or stenosis or facet* or inf* or fracture or scoliosis or cancer* or malign* or cord or cauda or CES or spond* or OA or osteo*
<b>4. (title/abstract) AND</b> Imaging or diagnostic imaging or x-ray or radiograp* or ultraso* or USS or MRI or magnetic resonance imaging or computed tomography or radiolog* or CT
<b>Limits:</b> 2009 – to date of search, English Language, Guidelines, Consensus Development Conference, Practice Guideline

**Table S2. Search terms – LBP (CINAHL)**

<b>1. (in title/abstract)</b> MH “Practice Guidelines”
<b>2. (in title/abstract) OR</b> Guideline* OR consensus OR recommendations
<b>3. (title/abstract) AND</b> Lumb* or LBP or NSLBP or CNLSBP or non-specific or low* or back or spin* or radic* or stenosis or facet* or inf* or fracture or scoliosis or cancer* or malign* or cord or cauda or CES or spond* or OA or osteo*
<b>4. (title/abstract) AND</b> Imaging or diagnostic imaging or x-ray or radiograp* or ultraso* or USS or MRI or magnetic resonance imaging or computed tomography or radiolog* or CT
<b>Limits:</b> 2009 – to date of search, English Language, Practice Guidelines

**Table S3. Search – LBP (PsycINFO)**

<b>1. (in title/abstract) AND</b> Guideline* OR consensus OR recommendations
<b>2. (title/abstract) AND</b> Lumb* or LBP or NSLBP or CNLSBP or non-specific or low* or back or spin* or radic* or stenosis or facet* or inf* or fracture or scoliosis or cancer* or malign* or cord or cauda or CES or spond* or OA or osteo*
<b>3. (title/abstract) AND</b> Imaging or diagnostic imaging or x-ray or radiograp* or ultraso* or USS or MRI or magnetic resonance imaging or computed tomography or radiolog* or CT
<b>Limits:</b> 2009 – to date of search, English Language

**Table S4. Search terms – LBP (SPORTDiscus)**

<b>1. (in title/abstract) AND</b> Guideline* OR consensus OR recommendations
<b>2. (title/abstract) AND</b> Lumb* or LBP or NSLBP or CNLSBP or non-specific or low* or back or spin* or radic* or stenosis or facet* or inf* or fracture or scoliosis or cancer* or malign* or cord or cauda or CES or spond* or OA or osteo*
<b>3. (title/abstract) AND</b> Imaging or diagnostic imaging or x-ray or radiograp* or ultraso* or USS or MRI or magnetic resonance imaging or computed tomography or radiolog* or CT
<b>Limits:</b> 2009 – to date of search, English Language

**Table S5. Search terms – Knee (Medline)**

<b>1. (in title/abstract)</b> MH “Practice Guidelines”)
<b>2. (in title/abstract) OR</b> Guideline* OR consensus OR recommendations
<b>3. (title/abstract) AND</b> Knee or osteoarthr* or menisc* or ligament* or tend* or musc* or inf* or fracture or cancer* or malign* or osteo* or sarcoma or patell* or PFP
<b>4. (title/abstract) AND</b> Imaging or diagnostic imaging or x-ray or radiograp* or ultraso* or USS or MRI or magnetic resonance imaging or computed tomography or radiolog* or CT
<b>Limits:</b> 2009 – to date of search, English Language, Guidelines, Consensus Development Conference, Practice Guideline

**Table S6. Search terms – Knee (CINAHL)**

<b>1. (in title/abstract)</b> MH “Practice Guidelines”)
<b>2. (in title/abstract) OR</b> Guideline* OR consensus OR recommendations
<b>3. (title/abstract) AND</b> Knee or osteoarthr* or menisc* or ligament* or tend* or musc* or inf* or fracture or cancer* or malign* or osteo* or sarcoma or patell* or PFP
<b>4. (title/abstract) AND</b> Imaging or diagnostic imaging or x-ray or radiograp* or ultraso* or USS or MRI or magnetic resonance imaging or computed tomography or radiolog* or CT
<b>Limits:</b> 2009 – to date of search, English Language, Practice Guidelines

**Table S7. Search terms – Knee (PsycINFO)**

<b>1. (in title/abstract) AND</b> Guideline* OR consensus OR recommendations
<b>2. (title/abstract) AND</b> Knee or osteoarthr* or menisc* or ligament* or tend* or musc* or inf* or fracture or cancer* or malign* or osteo* or sarcoma or patell* or PFP
<b>3. (title/abstract) AND</b>

Imaging or diagnostic imaging or x-ray or radiograp\* or ultraso\* or USS or MRI or magnetic resonance imaging or computed tomography or radiolog\* or CT  
**Limits:** 2009 – to date of search, English Language

**Table S8. Search terms – Knee (SPORTDiscus)**

**1. (in title/abstract) AND**  
Guideline\* OR consensus OR recommendations

**2. (title/abstract) AND**  
Knee or osteoarthr\* or menisc\* or ligament\* or tend\* or musc\* or inf\* or fracture or cancer\* or malign\* or osteo\* or sarcoma or patell\* or PFP

**3. (title/abstract) AND**  
Imaging or diagnostic imaging or x-ray or radiograp\* or ultraso\* or USS or MRI or magnetic resonance imaging or computed tomography or radiolog\* or CT

**Limits:** 2009 – to date of search, English Language

**Table S9. Search terms – Shoulder (Medline)**

**1. (in title/abstract)**  
MH “Practice Guidelines”)

**2. (in title/abstract) OR**  
Guideline\* OR consensus OR recommendations

**3. (title/abstract) AND**  
Shoulder or glenohumeral or GHJ or acromioclavicular or ACJ or labr\* or SLAP or rotator or cuff or subacromial or impingement or burs\* or osteoarthr\* or instability or dislocation or unstable or inf\* or fracture or cancer\* or malign\* or osteo\* or sarcoma

**4. (title/abstract) AND**  
Imaging or diagnostic imaging or x-ray or radiograp\* or ultraso\* or USS or MRI or magnetic resonance imaging or computed tomography or radiolog\* or CT

**Limits:** 2009 – to date of search, English Language, Guidelines, Consensus Development Conference, Practice Guideline

**Table S10. Search terms – Shoulder (CINAHL)**

**1. (in title/abstract)**  
MH “Practice Guidelines”)

**2. (in title/abstract) OR**  
Guideline\* OR consensus OR recommendations

**3. (title/abstract) AND**  
Shoulder or glenohumeral or GHJ or acromioclavicular or ACJ or labr\* or SLAP or rotator or cuff or subacromial or impingement or burs\* or osteoarthr\* or instability or dislocation or unstable or inf\* or fracture or cancer\* or malign\* or osteo\* or sarcoma

**4. (title/abstract) AND**  
Imaging or diagnostic imaging or x-ray or radiograp\* or ultraso\* or USS or MRI or magnetic resonance imaging or computed tomography or radiolog\* or CT

**Limits:** 2009 – to date of search, English Language, Practice Guidelines

**Table S11. Search terms - Shoulder (PsycINFO)**

**1. (in title/abstract) AND**  
Guideline\* OR consensus OR recommendations

**2. (title/abstract) AND**

Shoulder or glenohumeral or GHJ or acromioclavicular or ACJ or labr\* or SLAP or rotator or cuff or subacromial or impingement or burs\* or osteoarthr\* or instability or dislocation or unstable or inf\* or fracture or cancer\* or malign\* or osteo\* or sarcoma

**3. (title/abstract) AND**

Imaging or diagnostic imaging or x-ray or radiograp\* or ultraso\* or USS or MRI or magnetic resonance imaging or computed tomography or radiolog\* or CT

**Limits:** 2009 – to date of search, English Language

**Table S12. Search terms - Shoulder (SPORTDiscus)**

**1. (in title/abstract) AND**

Guideline\* OR consensus OR recommendations

**2. (title/abstract) AND**

Shoulder or glenohumeral or GHJ or acromioclavicular or ACJ or labr\* or SLAP or rotator or cuff or subacromial or impingement or burs\* or osteoarthr\* or instability or dislocation or unstable or inf\* or fracture or cancer\* or malign\* or osteo\* or sarcoma

**3. (title/abstract) AND**

Imaging or diagnostic imaging or x-ray or radiograp\* or ultraso\* or USS or MRI or magnetic resonance imaging or computed tomography or radiolog\* or CT

**Limits:** 2009 – to date of search, English Language

The following tables outline the search terms that were used to perform searches of guideline repositories as part of the scoping review of clinical practice guides. The repositories searched include: National Institute for Health and Care Excellence (NICE); Guidelines International Network (GIN) and Guidelines (a UK-based repository of clinical guidelines for primary care).

**Table S13: Search terms – NICE (LBP)**

**1. Back Pain**

**2. Limits:** Clinical guidelines, Diagnostics guidelines, NICE guidelines, Published

**Table S14: Search terms - NICE (Knee)**

**1. Knee Pain**

**2. Limits:** Clinical guidelines, Diagnostics guidelines, NICE guidelines, Published

**Table S15: Search terms – NICE (Shoulder)**

**1. Shoulder Pain**

**2. Limits:** Clinical guidelines, Diagnostics guidelines, NICE guidelines, Published

**Table S16: Search terms – GIN (LBP)**

**1. Low back pain**

**2. Limits:** English, Guideline, Published

**Table S17: Search terms – GIN (Knee)**

1. Knee pain
2. **Limits:** English, Guideline, Published

**Table S18: Search terms – GIN (Shoulder)**

1. Shoulder pain
2. **Limits:** English, Guideline, Published

**Table S19: Search terms – Guidelines (LBP)**

1. Low back pain
2. **Filters:** Musculoskeletal and joints, 2009 – to date of search

**Table S20: Search terms – Guidelines (Knee)**

1. Knee pain
2. **Filters:** Musculoskeletal and joints, 2009 – to date of search

**Table S21: Search terms – Guidelines (Shoulder)**

1. Shoulder pain
2. **Filters:** Musculoskeletal and joints, 2009 – to date of search

**Table S22: This table outlines the search terms used within the ‘snowball’ search. Each term was entered separately into Google with the top 50 results assessed.**

**Knee Pain Guidelines**  
**Shoulder Pain Guidelines**  
**Low Back Pain Guidelines**

**Box S1: Professional Bodies**

Advanced Practice Physiotherapy Network (APPN); Royal College of General Practitioners (RCGP); Royal College of Radiologists (RCR); Chartered Society of Physiotherapy (CSP); Primary Care Rheumatology Society (PCR) and the British Association of Sport and Exercise Medicine (BASEM).

**Box S2: Twitter**

The following message was distributed on Twitter and promoted for 14 days (39) from the 17<sup>th</sup> April 2019 to the 1<sup>st</sup> May 2019 with responses to the message reviewed for relevance.

*“Please help with my PhD research by sharing any clinical practice guidelines that indicate when to order #diagnostic #imaging for #knee, #shoulder or #LBP. Retweets appreciated. Thank you”.*

**Table S23:** A data charting table of recommendations from Clinical Practice Guidelines that inform MSK/Orthopaedic clinical practice in the UK on the use of diagnostic imaging in those with Low Back Pain (LBP).

Authors	Year	Development Group e.g. NICE, RCR	Origin	Agree II Score (%)	Clinical Condition e.g. GHJ OA	Key Findings that relate to the review questions (Inc. recommendations for/against diagnostic imaging and under what circumstances)
Ward et al.	2016	National Institute for Health and Care Excellence (NICE)	UK	91%	LBP and Sciatica	<p>Do not routinely offer imaging in a non-specialist setting for people with low back pain with or without sciatica.</p> <p>Explain to people with low back pain with or without sciatica that if they are being referred for specialist opinion, they may not need imaging.</p> <p>Consider imaging in specialist settings of care (for example, a musculoskeletal interface clinic or hospital) for people with low back pain with or without sciatica only if the result is likely to change management.</p>
NICE Clinical Knowledge Summary (CKS)	2018	NICE	UK	50%	LBP	<p>Do not routinely X-ray the spine to diagnose non-specific low back pain, as it will generally not inform management.</p> <ul style="list-style-type: none"> <li>• However, spinal X-ray may be indicated if there is suspicion of a specific pathology, such as a compression fracture due to osteoporosis.</li> </ul> <p>If there are <b>Red flag symptoms and signs</b> that may suggest a serious underlying cause, admit or refer urgently for specialist assessment, or imaging, using clinical judgement.</p>
NICE CKS	2018	NICE	UK	50%	Sciatica	<b>Do not routinely X-ray the spine to confirm the diagnosis.</b>
NICE CKS	2013	NICE	UK	51.7%	Ankylosing Spondylitis (AS)	<p>Follow local referral protocols on imaging the sacroiliac joints and spine or seek specialist advice on imaging before referral.</p> <p>AS is suggested by X-ray changes of the sacroiliac joints and spine, including sacroiliitis, sclerosis (thickening of bone), erosions, and partial or total ankylosis (fusion of joints).</p> <p>Magnetic resonance imaging (MRI). In some people with symptoms of AS inflammation of the sacroiliac joints can be detected on MRI despite an absence of changes on X-ray. The use of MRI has enabled an increase in detection of sacroiliitis and inflammatory back pain and the diagnosis of non-radiographic axial spondyloarthritis.</p>
White et al.	2014	NICE	UK	78.6%	Metastatic Spinal Cord Compression (MSCC)	<p>Do not perform plain radiographs of the spine either to make or to exclude the diagnosis of spinal metastases or MSCC.</p> <p>MRI of the spine in patients with suspected MSCC should be supervised and reported by a radiologist and should include sagittal T1 and/or short T1 inversion recovery (STIR) sequences of the whole spine, to prove or exclude the presence of</p>

					<p>spinal metastases. Sagittal T2 weighted sequences should also be performed to show the level and degree of compression of the cord or cauda equina by a soft tissue mass and to detect lesions within the cord itself. Supplementary axial imaging should be performed through any significant abnormality noted on the sagittal scan.</p> <p>Contact the MSCC coordinator to determine the most appropriate method of imaging for patients with suspected MSCC in whom MRI is contraindicated and where this should be carried out.</p> <p>In patients with a previous diagnosis of malignancy, routine imaging of the spine is not recommended if they are asymptomatic.</p> <p>Serial imaging of the spine in asymptomatic patients with cancer who are at high risk of developing spinal metastases should only be performed as part of a randomised controlled trial.</p> <p>Perform MRI of the whole spine in patients with suspected MSCC, unless there is a specific contraindication. This should be done in time to allow definitive treatment to be planned within 1 week of the suspected diagnosis in the case of spinal pain suggestive of spinal metastases, and within 24 hours in the case of spinal pain suggestive of spinal metastases and neurological symptoms or signs suggestive of MSCC, and occasionally sooner if there is a pressing clinical need for emergency surgery.</p>
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**Table S24:** A data charting table of recommendations from Clinical Practice Guidelines that inform MSK/Orthopaedic clinical practice in the UK on the use of diagnostic imaging in those with Knee Pain.

Authors	Year	Development Group e.g. NICE, RCR	Origin	Agree II Score (%)	Clinical Condition e.g. GHJ OA	Key Findings that relate to the review questions (Inc. recommendations for/against diagnostic imaging and under what circumstances)
Zhang et al.	2010	EULAR	Europe	57.1%	Knee OA	<p>Knee OA is characterised clinically by usage-related pain and/or functional limitation. It is a common complex joint disorder showing focal cartilage loss, new bone formation and involvement of all joint tissues. Structural tissue changes are mirrored in classical radiographic features.</p> <p>In adults aged &gt;40 years with usage-related knee pain, only short-lived morning stiffness, functional limitation and one or more typical examination findings (crepitus, restricted movement, bony enlargement), a confident diagnosis of knee OA can be made without a radiographic examination. This applies even if radiographs appear normal.</p> <p>Plain radiography (both knees, weightbearing, semiflexed PA (MTP) view, plus a lateral and skyline view) is the current 'gold standard' for morphological assessment of knee OA. Classical features are focal joint space narrowing, osteophyte, subchondral bone sclerosis and subchondral cysts. Further imaging modalities (MRI, sonography, scintigraphy) are seldom indicated for diagnosis of OA.</p>
Price et al.	2017	British Orthopaedic Association (BOA)	UK	26.7%	Knee OA	<p>A clinical diagnosis of Osteoarthritis can be made by focusing on the following six clinical symptoms and signs: persistent knee pain, limited knee stiffness (&lt;30 minutes), reduced function, crepitus, restricted movement and bony enlargement.</p> <p>Plain radiographs may be taken for initial diagnosis but are not essential in patients over 45.</p>
Sakellariou et al.	2017	EULAR	Europe	64.2	Peripheral Joint OA – knee	<p>Imaging is not required to make the diagnosis in patients with typical (usage-related pain, short duration morning stiffness, age &gt;40, symptoms affecting one or a few joints) presentation of OA.</p> <p>In atypical presentations, imaging is recommended to help confirm the diagnosis of OA and/or make alternative or additional diagnoses.</p> <p>Routine imaging in OA follow-up is not recommended. However, imaging is recommended if there is unexpected rapid progression of symptoms or change in clinical characteristics to determine if this relates to OA severity or an additional diagnosis.</p> <p>If imaging is needed, conventional (plain) radiography should be used before other modalities. To make additional diagnoses, soft tissues are best imaged by US or MRI and bone by CT or MRI.</p> <p>Consideration of radiographic views is important for optimising detection of OA features; in particular for the knee, weightbearing and patellofemoral views are recommended.</p> <p>According to current evidence, imaging features do not predict non-surgical treatment response and imaging cannot be recommended for this purpose.</p>
Fernandes et al.	2017	EULAR	Europe	57.1%	OA	<p>Whilst a comprehensive initial assessment is considered to be a prerequisite for an individualised management strategy, no recommendations for the use of imaging within the diagnosis or core non-pharmacological management of knee OA.</p>
Crossley et al.	2016	Patellofemoral Pain Research Retreat	International	53.5%	PFP	<p>No recommendations for the use of imaging within the diagnosis or management of PFP.</p>



Barton et al.	2015	N/A	International	57.1%	PFP	No recommendations for the use of imaging within the diagnosis or management of PFP.
McAlindon et al.	2014	Osteoarthritis Research Society International (OARSI)	International	60.7%	Knee OA	No recommendations for the use of imaging within the non-surgical management of knee OA.
NICE CKS	2017	NICE	UK	48.2%	Knee	No recommendations for the use of imaging within the diagnosis or management of non-traumatic knee pain.

**Table S25:** A data charting table of recommendations from Clinical Practice Guidelines that inform MSK/Orthopaedic clinical practice in the UK on the use of diagnostic imaging in those with Shoulder pain.

Authors	Year	Development Group e.g. NICE, RCR	Origin	Agree II Score (%)	Clinical Condition e.g. GHJ OA	Key Findings that relate to the review questions (Inc. recommendations for/against diagnostic imaging and under what circumstances)
Hanchard et al.	2011	Chartered Society of Physiotherapy (CSP)	Frozen Shoulder	71.4%	Frozen Shoulder	<p>A normal X-ray is prerequisite to a definitive diagnosis of contracted (frozen) shoulder.</p> <p>Restricted passive external rotation and the capsular pattern are not unique to contracted (frozen) shoulder: locked dislocations restrict passive external rotation, and arthritis and joint fractures cause a capsular pattern. All are visible on X-ray, though orthogonal views (views taken at right angles) are recommended in order that abnormalities are not overlooked.</p> <p>It is perhaps unrealistic to expect that all patients presenting with the clinical features of contracted (frozen) shoulder will routinely be referred for X-ray, but it should be remembered that in the absence of this procedure the diagnosis is tentative. Care should therefore be taken during the history to rule out substantial trauma, systemic (body-wide) disease and general ill-health; specific examination should be made for crepitus (gross creaking or grating) on passive movement; and a</p>

						poor response to treatment should promptly trigger further investigation.
Dejaco et al.	2015	EULAR	Europe	75%	Polymyalgia Rheumatica (PMR)	No recommendations for the use of imaging within the diagnosis or management of PMR.
NICE CKS	2017	NICE	UK	46.4%	Shoulder	<p>Perform investigations, if appropriate. Investigations should be guided by the suspected cause. (Blood tests and radiography are not usually indicated as part of a primary care assessment of shoulder pain).</p> <ul style="list-style-type: none"> <li>• Consider anteroposterior and lateral shoulders X-rays if: <ul style="list-style-type: none"> <li>○ There is a history of trauma.</li> <li>○ The person is not improving with conservative treatment or symptoms are lasting more than four weeks.</li> <li>○ Movement is significantly restricted.</li> <li>○ There is severe pain.</li> <li>○ Any red flags are present.</li> <li>○ Arthritis is suspected.</li> </ul> </li> <li>• Ultrasound or MRI should not usually be requested by primary care.</li> </ul>

**Table S26:** A data charting table of recommendations from Clinical Practice Guidelines that inform MSK/Orthopaedic clinical practice in the UK on the use of diagnostic imaging in those with regional conditions that may present as Low Back Pain, Knee or Shoulder Pain.

Authors	Year	Development Group e.g. NICE, RCR	Origin	Agree II Score (%)	Clinical Condition e.g. GHJ OA	Key Findings that relate to the review questions (Inc. recommendations for/against diagnostic imaging and under what circumstances)
<b>Osteoporosis</b>						

Compston et al.	2017	National Osteoporosis Guideline Group	UK	62.5%	Osteoporosis (Major osteoporotic fractures – clinical vertebral or proximal humerus fracture).	<p>Vertebral fracture assessment should be considered in postmenopausal women and older men if there is a history of <math>\geq 4</math>cm height loss, kyphosis, recent or current long-term oral glucocorticoid therapy, or a BMD T-score <math>\leq -2.5</math>. It should also be considered in individuals with a history of non-vertebral fracture after the age of 50 years.</p> <p>Vertebral fracture assessment should therefore be considered in high risk individuals, using either lateral lumbar and thoracic spine radiographs or lateral spine DXA imaging. The latter delivers a significantly lower radiation dose but performs comparably to traditional radiographs.</p> <p>No recommendations provided for the use of imaging within the diagnosis or management of proximal humerus fracture.</p>
Ralston et al.	2015	Scottish International Guidelines Network (SIGN)	UK	66%	Osteoporosis (Major osteoporotic fractures – clinical spine or proximal humerus fracture).	No recommendations provided for the use of imaging within the diagnosis or management of those with clinical vertebral or proximal humerus fracture.
Lems et al.	2016	EULAR	Europe	50%	Fragility fracture – clinical spine or proximal humerus fracture.	No recommendations provided for the use of imaging within the diagnosis or management of those with clinical vertebral or proximal humerus fracture.
<b>Spondyloarthritis</b>						
McVeigh et al.	2017	NICE	UK	80%	SpA	No recommendations for the use of imaging within the diagnosis or management of SpA in non-specialist settings (primary care).

					<p>Diagnosing spondyloarthritis in specialist care settings (which may include intermediate care): Imaging for suspected axial spondyloarthritis</p> <p>Initial investigation using X-ray</p> <p>Offer plain film X-ray of the sacroiliac joints for people with suspected axial spondyloarthritis, unless the person is likely to have an immature skeleton.</p> <p>Diagnose radiographic axial spondyloarthritis (ankylosing spondylitis) if the plain film X-ray shows sacroiliitis meeting the modified New York criteria (bilateral grade 2–4 or unilateral grade 3–4 sacroiliitis).</p> <p>If the plain film X-ray does not show sacroiliitis meeting modified New York criteria (bilateral grade 2–4 or unilateral grade 3–4 sacroiliitis), or an X-ray is not appropriate because the person's skeleton is not fully mature, request unenhanced MRI using an inflammatory back pain protocol.</p> <p>Subsequent investigation using MRI</p> <p>Radiologists receiving a request for an inflammatory back pain MRI should perform short T1 inversion recovery (STIR) and T1 weighted sequences of the whole spine (sagittal view), and sacroiliac joints (coronal oblique view).</p> <p>Use the ASAS/Outcome Measures in Rheumatology (OMERACT) MRI criteria to interpret the MRI as follows:</p> <ul style="list-style-type: none"> <li>• If the MRI meets the ASAS/OMERACT MRI criteria: <ul style="list-style-type: none"> <li>○ diagnose non-radiographic axial spondyloarthritis.</li> </ul> </li> </ul>
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					<ul style="list-style-type: none"> <li>• If the MRI does not meet the ASAS/OMERACT MRI criteria: <ul style="list-style-type: none"> <li>○ do not exclude the possibility of axial spondyloarthritis</li> <li>○ consider specialist musculoskeletal radiology review if there is disparity between the clinical suspicion and imaging findings, particularly in people with an immature skeleton</li> <li>○ offer an HLA-B27 test if it has not already been done. If positive, base the diagnosis of non-radiographic axial spondyloarthritis on clinical features, for example, using the clinical 'arm' of the ASAS axial classification criteria.</li> </ul> </li> </ul> <p>If a diagnosis of axial spondyloarthritis cannot be confirmed and clinical suspicion remains high, consider a follow-up MRI.</p> <p>Other types of imaging for diagnosing axial spondyloarthritis</p> <p>Do not offer scintigraphy for people with suspected axial spondyloarthritis.</p> <p>Imaging for suspected psoriatic arthritis and other peripheral spondyloarthritis</p> <p>Offer plain film X-ray of symptomatic hands and feet for people with suspected peripheral spondyloarthritis in these areas.</p>
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						<p>If a diagnosis cannot be made from the plain film X-ray, consider ultrasound of:</p> <ul style="list-style-type: none"> <li>• the hands and feet to assess for joint involvement</li> <li>• suspected enthesitis sites.</li> </ul> <p>Consider plain film X-rays, ultrasound and/or MRI of other peripheral and axial symptomatic sites.</p> <p>If a diagnosis of peripheral spondyloarthritis is confirmed, offer plain film X-ray of the sacroiliac joints to assess for axial involvement, even if the person does not have any symptoms.</p>
Mandl et al.	2015	EULAR	Europe	41%	SpA	<p>Axial SpA: diagnosis</p> <p>A. In general, conventional radiography of the SI joints is recommended as the first imaging method to diagnose sacroiliitis as part of axial SpA. In certain cases, such as young patients and those with short symptom duration, MRI of the SI joints is an alternative first imaging method.</p> <p>B. If the diagnosis of axial SpA cannot be established based on clinical features and conventional radiography, and axial SpA is still suspected, MRI of the SI joints is recommended. On MRI, both active inflammatory lesions (primarily bone marrow oedema) and structural lesions (such as bone erosion, new bone formation, sclerosis and fat infiltration) should be considered. MRI of the spine is not generally recommended to diagnose axial SpA.</p> <p>C. Imaging modalities, other than conventional radiography and MRI are generally not recommended in the diagnosis of axial SpA.</p>

						<p>CT may provide additional information on structural damage if conventional radiography is negative and MRI cannot be performed. Scintigraphy and US are not recommended for diagnosis of sacroiliitis as part of axial SpA.</p> <p>Peripheral SpA: diagnosis</p> <p>When peripheral SpA is suspected, US or MRI may be used to detect peripheral enthesitis, which may support the diagnosis of SpA. Furthermore, US or MRI might be used to detect peripheral arthritis, tenosynovitis and bursitis.</p> <p>Spinal fracture</p> <p>When spinal fracture in (someone with known) axial SpA is suspected, conventional radiography is the recommended initial imaging method. If conventional radiography is negative, CT should be performed. MRI is an additional imaging method to CT, which can also provide information on soft tissue lesions.</p> <p>Recommendations related to monitoring activity, monitoring structural changes, predicting outcome/severity/treatment effect have not been extracted as these are unlikely to take place within primary/intermediate care.</p>
<b>Osteoarthritis (OA)</b>						
NICE CKS	2018	NICE	UK	51.7%	OA - any synovial joint, with knee being a focus alongside hip/hand.	<p>Routine X-ray of the affected joint(s) is not usually needed to confirm the diagnosis. Consider arranging an X-ray, depending on clinical judgement:</p> <ul style="list-style-type: none"> <li>• If there is diagnostic uncertainty.</li> <li>• To exclude alternative conditions.</li> <li>• If there is a sudden clinical deterioration in symptoms.</li> </ul>

						<ul style="list-style-type: none"> <li>○ Typical radiological features of osteoarthritis include subchondral bone thickening and/or cysts; osteophyte formation (new bone formation at joint margins); loss or narrowing of the joint space (provides an estimate of the severity of cartilage damage).</li> <li>● Note: structural changes on X-ray may not correlate with reported symptoms and functional impairment.</li> </ul>
Conaghan et al.	2014	NICE	UK	83.9%	OA	<p>Diagnose osteoarthritis clinically without investigations if a person:</p> <ul style="list-style-type: none"> <li>- is 45 or over and</li> <li>- has activity-related joint pain and</li> <li>- has either no morning joint-related stiffness or morning stiffness that lasts no longer than 30minutes.</li> </ul>
<b>Rheumatoid Arthritis (RA)</b>						
Ward et al.	2018	NICE	UK	89.2%	RA	<p>No recommendations for the use of imaging within the diagnosis or management of RA with reference to those presenting with LBP, knee or shoulder pain.</p> <p>X-ray the hands and feet in adults with suspected RA and persistent synovitis (in these joints).</p> <p>Do not use ultrasound for routine monitoring of disease activity in adults with RA.</p>
Colebatch et al.	2013	EULAR	Europe	57.1%	RA	<p><b>When there is diagnostic doubt, x-ray, ultrasound or MRI can be used to improve the certainty of a diagnosis of RA above clinical criteria alone. <i>Knee and Shoulder</i></b></p> <p>The presence of inflammation seen with ultrasound or MRI can be used to predict the progression to clinical RA from undifferentiated inflammatory arthritis. <i>Knee</i></p>



						<b>Ultrasound and MRI are superior to clinical examination in the detection of joint inflammation; these techniques should be considered for a more accurate assessment of inflammation. <i>Knee</i></b>
<b>Gout</b>						
Richette et al.	2016	EULAR	Europe	55.3%	Gout - Management	No recommendations for the use of imaging within the diagnosis or management of Gout.
Richette et al.	2018	EULAR	Europe	50%	Gout - Diagnosis	<p>When a clinical diagnosis of gout is uncertain and crystal identification is not possible, patients should be investigated by imaging to search for MSU crystal deposition and features of any alternative diagnosis.</p> <p>Plain radiographs are indicated to search for imaging evidence of MSU crystal deposition but have limited value for the diagnosis of gout flare. USS can be more helpful in established a diagnosis in patients with suspected gout flare or chronic gouty arthritis by detection of tophi not evident on clinical examination, or a double contour sign at cartilage surfaces, which is highly specific for urate deposits in joints.</p> <p>...continuum from preclinical states (asymptomatic hyperuricaemia and then asymptomatic MSU crystal deposition) to gout (clinical states). The EULAR recommends a three-step approach for the diagnosis of gout. *The first step relies on MSU crystal identification in synovial fluid or tophus aspirates; **If not feasible, the second step relies on a clinical diagnosis (based on the presence of hyperuricaemia and associated clinical features of gout); ***The last step recommends imaging, particularly USS or DECT, to search for imaging evidence of MSU crystal deposition when a clinical diagnosis of gout is uncertain and crystal identification is not possible.</p>
Hui et al.	2017	BSR	UK	53.5%	Gout	No recommendations for the use of imaging within the diagnosis or management of Gout.

Malignancy						
Hajioff et al.	2015	NICE	UK	94.6%	Suspected Cancer	<p>Consider an urgent direct access ultrasound scan (to be performed within 2 weeks) to assess for soft tissue sarcoma in adults with an unexplained lump that is increasing in size.</p> <p>Consider a very urgent direct access ultrasound scan (to be performed within 48hours) to assess for soft tissue sarcoma in children and young people (up to 24 years) with an unexplained lump that is increasing in size.</p> <p>Bone pain or swelling (unexplained) in children and young people (up to 24 years), Consider a very urgent direct access X-ray (to be performed within 48 hours).</p>
Paget's Disease						
Ralston et al.	2019	Paget's Association UK	UK		Paget's Disease	<p>Plain X-rays of the abdomen, tibias, skull, and facial bones are recommended as an initial diagnostic screening test in patients suspected to have Paget's Disease on a biochemical (raised serum total alkaline phosphatase (ALP) with normal liver function test) or clinical grounds.</p> <p>In those presenting with 'bone pain', bone deformity or pathological fracture a targeted X-ray of the site is recommended.</p> <p>MRI is not recommended for the diagnosis of Paget's disease but is recommended to assess disease complications e.g. spinal stenosis.</p>
Miscellaneous						
Remedios	2017	The Royal College of Radiologists (RCR)	UK	64.2%	Imaging for Primary Care for all common MSK conditions.	<p>Painful shoulder (including impingement syndrome and rotator cuff tear)</p> <p>Specialised investigation [B]</p>

					<p>US is the investigation of choice in the assessment of rotator cuff and surrounding soft tissues. It may be used to guide injection. It is reserved for cases unresponsive to firstline treatment and clinically guided injection. It is indicated preoperatively if the surgeon requires assessment of rotator cuff integrity.</p> <p>Specialised investigation [B]</p> <p>MRI is an alternative to US and is useful after major trauma to assess complex injury and bony abnormality. MRI can show alternative pathology when other modalities are unrevealing.</p> <p>Indicated only in specific circumstances [C]</p> <p>XR is used as a preoperative assessment. Impingement is clinically diagnosed. XR is indicated for persistent shoulder pain that is unresponsive to conservative treatment to exclude calcific tendinitis and diagnoses unrelated to the rotator cuff.</p> <p>Knee pain without trauma, locking or restriction in movement</p> <p>USS - Indicated only in specific circumstances [C]  MRI - Indicated only in specific circumstances [B]  XR – Specialised investigation [C]</p> <p>Clinical features will often be sufficient to guide management without the need for imaging. Red flags to guide referral include:</p> <ul style="list-style-type: none"> <li>• Acute swelling (&lt;24 hours)</li> <li>• Mono-arthritis</li> </ul>
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					<ul style="list-style-type: none"> <li>• Severe pain out of proportion to the usual symptoms</li> <li>• Fever</li> <li>• Risk factors for infection: recent surgery, rheumatoid arthritis, immunocompromised, adjacent skin infection</li> <li>• Rest pain or morning stiffness</li> <li>• Joint swelling, tenderness and warmth.</li> </ul> <p>Symptoms frequently arise from soft tissues, which will not show on XR. Osteoarthritic changes are common in those aged 45-plus. XR may help when there is uncertainty of diagnosis. MRI is useful in patients with persistent undiagnosed pain, including suspected avascular necrosis, cartilage pathology and sepsis. US in expert hands is useful for anterior knee pain with suspected tendinopathy or associated bursitis.</p> <p><b>Knee pain with locking</b></p> <p>USS – not indicated.</p> <p>MRI - MRI is the investigation of choice to identify meniscal tears and loose bodies. Indicated [B]</p> <p>XR - XR will identify radio-opaque loose bodies – a less frequent cause of locking. Indicated [C])</p> <p>Chronic lumbar back pain (&gt;6 weeks) with no clinical or serological indicators of infection or neoplasia (i.e. no red flags)</p> <p>USS – not indicated</p> <p>MRI - MRI is the preferred investigation for the diagnosis of most spinal diseases and is helpful in identifying those patients who may benefit when planning surgical</p>
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					<p>intervention or pain management. Indicated only in specific circumstances [C]</p> <p>XR - XR is only indicated if presentation suggests osteoporotic collapse in the elderly. Indicated only in specific circumstances [C]</p> <p>Acute back pain (<math>\leq 6</math> weeks) without potentially serious features (malignancy, infection, fracture, CES, AS or another inflammatory disorder)</p> <p>USS – not indicated</p> <p>MRI - For patients with non-specific back pain (with no radicular symptoms or red flags), MRI does not help clinical outcome. It should be reserved for patients referred for orthopaedic opinion. MRI is the preferred investigation (wider field of view visualising the conus, postoperative changes, etc). Indicated only in specific circumstances [C]</p> <p>XR – Acute back pain is usually the results of conditions that cannot be diagnosed on XR (osteoporotic collapse is an exception). Normal XR may be falsely reassuring. Indicated only in specific circumstances [C].</p> <p>Acute back pain (<math>\leq 6</math> weeks) with potentially serious features (CES, previous malignancy, immunosuppression, steroid use, fever)</p> <p>USS – not indicated</p> <p>MRI – is the imaging investigation of choice. It is indicated immediately in patients with acute neurological features and</p>
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					<p>urgently in those with suspected malignancy or infection. Indicated [B].</p> <p>XR – Plain radiograph may be required preoperatively. MRI is preferable as the first line investigation in patients with potentially serious features, since it has a stronger negative predictive value. Indicated only in specific circumstances [C].</p> <p>Suspected Osteomyelitis</p> <p>USS – not indicated in adults</p> <p>MRI - MRI accurately shows osteomyelitis and associated soft tissue abnormality. It is the best imaging technique in suspected osteomyelitis. Indicated [B].</p> <p>XR - XR is the initial investigation but may be normal in early osteomyelitis. Indicated [C].</p> <p>Suspected primary bone tumour</p> <p>USS – not indicated in primary/intermediate care. Indicated only in specific circumstances [B]</p> <p>MRI – not indicated in primary/intermediate care. Indicated [B]</p> <p>XR – should be used in cases of unresolving bone pain. Indicated [B]</p> <p>Soft tissue mass (stable, soft, mobile, non-tender lumps &lt;5cm do not routinely warrant imaging)</p>
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					<p>USS – is the first investigation for soft tissue masses, is usually sufficient for superficial lesions and can provide specific diagnosis in some cases. It can differentiate solid and cystic lesions and also assess the internal vascularity. US is also useful to monitor benign masses (e.g. haematomas) and to assess for local recurrence of soft tissue sarcomas. Indicated [B]</p> <p>MRI – indicated for assessment of deep seated and larger lesions. MRI may be helpful for indeterminate soft tissue masses. Indicated [B]</p> <p>XR – only useful if lesions is close to bone or for assessment of internal calcification. Indicated [B]</p> <p>Bone pain</p> <p>USS – may be helpful to assess suspected infection, tumour and some fractures (particularly in children). US may also help guide biopsy. Indicated only in specific circumstances [C]</p> <p>MRI – is appropriate if pain persisted with a normal XR. MRI may also provide further information when XR and/or NM findings are abnormal. Indicated [C]</p> <p>XR – gives a dedicated view of the symptomatic area. Indicated [C]</p> <p>Metabolic bone disease</p> <p>USS – not indicated</p> <p>MRI – may distinguish acute from chronic osteoporotic collapse. It also distinguishes between osteoporotic and</p>
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					<p>malignant vertebral collapse. Indicated only in specific circumstances [B]</p> <p>XR – is helpful in the identification of osteoporotic collapse and differentiation from other unrelated causes. It also identifies characteristic signs of other metabolic bone disease, including osteomalacia and hyperparathyroidism. It is important in correlation with NM abnormalities. Indicated [C]</p> <p>Suspected osteoporotic collapse</p> <p>USS – not indicated</p> <p>MRI – distinguishes acute from chronic osteoporotic collapse and may determine between osteoporotic and malignant vertebral collapse. PET-CT is an alternative to MRI to differentiate malignant from benign fractures. Specialised investigation [C]</p> <p>XR – Lateral XR of the thoracic and lumbar spine is the first investigation in suspected osteoporotic collapse. In the elderly, fracture on XR is adequate to establish a diagnosis and DEXA is unnecessary unless monitoring of treatment is required. Indicated [B]</p> <p>Arthropathy</p> <p>USS – can show acute synovitis and erosions allowing early introduction of disease-modifying drugs. Maybe helpful both for assessment and monitoring of activity. Specialised investigation [B]</p> <p>MRI - can show acute synovitis and erosions allowing early introduction of disease-modifying drugs; bone marrow</p>
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					<p>oedema is a strong predictor of radiographic progression. Specialised investigation [B]</p> <p>XR – of the affected joint (shoulder, knee) may be helpful to establish cause, although erosions are a relatively late feature.</p>
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