East Lancashire Hospitals NHS Trust
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Clinical Radiology Referral Guidelines

Musculoskeletal Referrals

Safe | Personal | Effective

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EAST LANCASHIRE HOSPITALS NHS TRUST

CLINICAL RADIOLOGY REFERRAL GUIDELINES

These guidelines are intended to be used by all "referrers" requesting imaging at East Lancashire Hospitals NHS Trust. They are appropriate for both primary and secondary care clinicians and Non-Medical Referrers (NMR) to promote the best use of imaging and resources for the benefit of our patients.

The Ionising Radiation (Medical Exposure) Regulations (IR(ME)R) provide for the health protection of individuals undergoing medical exposures involving ionising radiation. All diagnostic tests should therefore be carefully considered prior to referral and should only be requested appropriately. Diagnostic tests which do not utilise Ionising Radiation (such as ultrasound and magnetic resonance imaging) carry their own potential risks and as such are as strictly governed in terms of justification. This not only serves to protect patients, but also to manage demand appropriately and keep waiting times to a minimum.

The aim for all examinations should be to obtain the maximum information with the minimum of radiation. This means that on occasions the imaging undertaken may not be what the referring clinician/NMR expects. Radiology has set examination protocols utilised for the legal authorisation and justification of requests.

Optimising radiation dose

The use of radiological investigations is an accepted part of medical practice justified in terms of clear clinical benefits to the patient, which should far outweigh the small radiation risks. However, even small radiation doses are not entirely without risk. A small fraction of the generic mutations and malignant diseases that occur in the population can be attributed to natural background radiation. Diagnostic medical exposures account for one-sixth of the total population dose.

The Ionising Radiation (Medical Exposure) Regulations (IR(ME)2017 require that the unnecessary exposure of patients to radiation is kept to a minimum and ELHT must comply with these regulations. This is achieved by avoiding undertaking investigations unnecessarily (especially repeat examinations) and the use of dose optimisation utilising locally set diagnostic reference levels (DRLs).

The effective dose for a radiological investigation is the weighted sum of the doses to a number of body tissues, where the weighting factor for each tissue depends on its relative sensitivity to radiation-induced cancer of severe hereditary effects. This provides a single dose estimate related to the total radiation risk, no matter how the radiation dose is distributed around the body (Table 1).

Typical effective doses for some common diagnostic radiology procedures range over a factor of about 1,000 from the equivalent 1-2 days of natural background radiation.

Table 1

Typical effective doses from diagnostic medical exposure			
Diagnostic Procedure	**Typical effective dose (mSv)**	**Equivalent number of chest x-rays**	**Approximate equivalent period of natural background radiation**
Radiographic examinations			
Limbs & joints (except hip)	<0.01	<0.5	<1.5 days
Chest (single PA film)	0.02	1	3 days
Skull	0.06	3	9 days
Thoracic spine	0.7	35	4 months
Lumbar spine	1.0	50	5 months
Hip	0.4	20	2 months
Pelvis	0.7	35	4 months
Abdomen	0.7	35	4 months
IVU	2.4	120	14 months
Barium swallow	1.5	75	8 months
Barium meal	2.6	130	15 months
Barium follow-through	3	150	16 months
Barium enema	7.2	360	3.2 years
CT Head	2	100	10 months
CT Chest	8	400	3.6 years
CT abdomen or pelvis	10	500	4.5 years
Radionuclide Studies			
Lung ventilation (Xe-133)	0.3	15	7 weeks
Lung perfusion (Tc-99m)	1	50	6 months
Kidney (Tc-99m)	1	5	6 months
Thyroid (Tc-99m)	1	50	6 months
Bone (Tc-99m)	4	200	1.8 years
Dynamic cardiac (Tc-99m)	6	300	2.7 years
PET head (F-18 FDG)	5	250	2.3 years
*UK average background radiation = 2.2 mSv per year: regional averages 1.5-7.5 mSv per year			

Please note that the doses from some CT examinations are particularly high and the demand for CT imaging continues to rise. **It is therefore particularly important that referrals for CT are thoroughly justified and that techniques that minimise dose while retaining essential diagnostic information are adopted.**

In these referral guidelines, the doses are grouped to support the referrer in understanding the order of magnitude of radiation doses of the various investigations (Table 2).

Table 2 **Typical effective doses of ionising radiation from common imaging procedures**		
Symbol	Typical effective dose (mSv)	Examples
None	0	Ultrasound (US), Magnetic Resonance Imaging (MRI)
☢	<1	Chest, limbs & pelvis X-ray, mammography
☢ ☢	1-5	Lumbar spine X-ray, Nuclear Medicine (NM) (e.g., bone), Computed tomography (CT) head and neck
☢ ☢ ☢	5-10	CT chest or abdomen, NM (e.g., cardiac)
☢ ☢ ☢ ☢	>10	Extensive CT studies, some NM studies (e.g., some Position Emission Tomography co-registered with CT (PET-CT)
The average annual background dose in most parts of Europe falls within the 1-5 mSv range ☢ ☢		

Pregnancy and Protection of the foetus

Irradiation of a foetus should be avoided whenever possible. This includes situations in which the woman herself does not suspect pregnancy. The prime responsibility for identifying such patients lies with the referring clinician. Radiology also checks the pregnancy status of patients when they attend for examination.

Persons of childbearing potential presenting for an examination in which the primary beam irradiates the pelvic area (essentially, any ionising irradiation between the diaphragm and the knees), directly or by scatter, or for a procedure involving radioactive isotopes, will be asked whether they are or may be pregnant.

If the patient can exclude the possibility of pregnancy, the examination can proceed. If the patient is definitely pregnant, or if pregnancy cannot be excluded, the justification for the proposed examination should be reviewed by the radiologist and the referring clinician/NMR, with a decision taken on whether to defer the investigation until after delivery. However, a procedure of clinical benefit to the parent may also be of indirect benefit to the unborn child and a delay in an essential procedure may increase the risk to the foetus as well as the parent. This consideration is especially relevant in an emergency situation and all decisions must be documented.

Guidelines Key

The pages of each section are composed five columns:

Clinical/diagnostic problem	Situation for requesting an examination
Investigation	Possible imaging techniques
Dose	Level of exposure to radiation ☢
Recommendation	Recommendation on appropriateness of the investigation
Comment	Explanatory notes

Musculoskeletal System

Clinical/diagnostic problem	Investigation	Dose	Recommendation	Comment
Cervical Spine				
Possible atlanto-axial subluxation	XR	☢	Indicated	A single lateral cervical spine XR with the patient in supervised comfortable flexion should show any significant subluxation in patients with rheumatoid arthritis, Down's syndrome etc.
	MRI	None	Specialised investigation	MRI shows effect on cord when XR is positive or neurological signs are present.
	CT	☢ ☢	Specialised investigation	CT is used to identify congenital or structural abnormalities predisposing to atlanto-axial subluxation, including diagnosis of post-traumatic rotatory subluxation.
Neck pain, brachialgia, degenerative change	MRI	None	Specialised investigation	Consider MRI and specialist referral when pain affects lifestyle or when there are neurological signs. CT myelography may occasionally be required to provide further delineation, or when MRI is unavailable or impossible.
	XR	☢	Indicated only in specific circumstances	Neck pain generally improves or resolves with conservative treatment. Degenerative changes begin in early middle age and are often unrelated symptoms.
Thoracic Spine				
Pain without trauma: degenerative disease	MRI	None	Specialised investigation	MRI may be indicated if local pain persists or is difficult to manage, or if there are long tract signs.
	XR	☢	Indicated only in specific circumstances	Degenerative changes are invariably present from middle age onwards. Imaging is rarely useful in the absence of neurological signs or pointers to metastases or infection. Consider more urgent referral in elderly patients with sudden pain, to show osteoporotic collapse or other forms of bone destruction. Consider NM for possible metastatic lesions.

Lumbar Spine				
Chronic back pain with no clinical or serological indicators of infection of neoplasia (i.e., no red flags)	MRI	None	Indicated	MRI is the preferred investigation for the diagnosis of most spinal diseases.
	XR	☢	Indicated only in specific circumstances	XR is only indicated if presentation suggests osteoporotic collapse in the elderly or suspected spondyloarthropathies in young patients.
	CT	☢ ☢	Specialised investigation	CT is used when MR is contraindicated and when further assessment of spondyloses is required.
	NM	☢ ☢	Specialised investigation	NM is non-specific and has been largely supplanted by MR and CT in the assessment of chronic back pain. It may show occult osteoid osteomas and spondylolysis.
Acute back pain with potentially serious (red flag) features: Neurological • Sphincter and gait disturbance • Saddle anaesthesia • Sever or progressive motor loss. • Widespread neurological deficit Other • Age <20 or >55 years	MRI	None	Indicated	MRI is the imaging investigation of choice and is indicated immediately in patients with acute neurological features and urgently in those with suspected malignancy or infection.
	XR	☢	Indicated only in specific circumstances	Plain radiograph may be required preoperatively. MR is preferable as the first-line investigation in patients with red flag signs, since it has a stronger negative predictive value.
	CT	☢ ☢	Specialised investigation	CT is useful to guide soft tissue and bone biopsy and may identify sequestra in infection.
	NM	☢ ☢	Specialised investigation	NM is non-specific and should be viewed with plain radiographs. It is useful to show the full extent of disease, especially with metastatic deposits.

• Previous malignancy • Systemic illness • HIV • Weight loss • IV drug use • Steroid use • Structural deformity • Non-mechanical pain (no relief with bed rest) • Fever • Thoracic pain				
Acute back pain without possible serious features (Red flags)	MRI	None	Specialised investigation	MRI is the preferred investigation (wider field of view visualising the conus, postoperative changes, etc.) Demonstration of disc herniation should be considered after failed conservative management. Clinico-radiological correlation is important because many disc herniations are symptomatic.
	XR	☢ ☢	Indicated only in specific circumstances	Acute back pain is usually the result of conditions that cannot be diagnosed on XR (osteoporotic collapse is an exception). Normal XR may be falsely reassuring.
Osteomyelitis	XR	☢	Indicated	XR is the initial investigation.
	MRI	None	Indicated	MRI accurately shows osteomyelitis and associated soft tissue abnormality. It is the best imaging technique in suspected osteomyelitis.
	US	None	Specialised investigation	US can show subperiosteal abscess in acute osteomyelitis but it is or lower sensitivity than MRI.

	CT	☢ ☢	Specialised investigation	CT is valuable for showing sequestra and for guiding biopsy.
	NM	☢ ☢	Specialised investigation	Two and three-phase skeletal scintigraphy, Tc-99-HMPAO and In-111-labelled white-cell scans are an alternative to MRI. If osteomyelitis is suspected but there are no localising signs or symptoms a skeletal scintigraphy is useful; however, findings are not specific. NM may be used to identify periprosthetic infection. PET may be useful in chronic infection.
Primary bone tumour	XR	☢	Indicated	XR should be used in cases of unresolving bone pain.
	MRI	None	Indicated	If the XR appearances are suggestive of primary bone tumour, referral to a specialist centre should not be delayed. MRI is the investigation of choice for local staging.
	NM	☢ ☢	Indicated	If the XR appearances are suggestive of primary bone tumour, the acquisition of skeletal scintigraphy to exclude multiple lesions should not delay referral to a specialised centre. The role of FDG-PET remains to be clarified.
	US	None	Specialised investigation	US-guided biopsy of certain superficial primary bone tumours should be used in specialised bone tumour centres where histological expertise and knowledge of surgical approach is available.
	CT	☢ ☢	Specialised investigation	CT may improve diagnostic information in some tumours, such as osteoid osteoma, and show intratumoral calcification and ossification. CT-guided biopsy of primary bone tumours should take place in specialised bone tumour centres where histological expertise and knowledge of surgical approach is available.
Skeletal metastases from known primary tumour.	MRI	None	Indicated	More sensitive and specific, than NM, MRI is the primary investigation of choice, especially in the axial skeleton. However, it may underestimate some peripheral lesions.
	NM	☢ ☢	Indicated	NM is a sensitive test, but correlative imaging is required to increase specificity. NM is useful for assessment of presence and extent of skeletal metastases in patients with known primary cancers. The

				skeletal scintigram is insensitive in assessment of extent of myeloma. It may also be used to assess response to treatment, although the flare phenomenon may suggest disease progression if used too soon after systemic therapy. It is usually only appropriate to repeat a skeletal scintigram within 6 months if there are new symptoms.
	XR skeletal survey	☢ ☢	Not indicated	XRs are indicated only for specific focal symptomatic areas of for correlation with an NM examination.
Soft tissue mass	MRI	None	Indicated	MRI provides best local staging and can provide a tissue diagnosis in a proportion of patients.
	US	None	Indicated	US can distinguish cystic from solid masses, monitor benign masses (e.g., haematomas) and assess for local recurrence of soft tissue sarcomas.
	XR	☢	Indicated	XR may show bony abnormality associated with masses and can show tumour mineralisation. CT may occasionally help on these areas.
	Image-guided biopsy	Up to ☢ ☢	Specialised investigation	Image-guided biopsy, most frequently with US, is useful for deep-seated tumours.
Bone pain	XR	☢	Indicated	XR gives a dedicated view of the symptomatic area.
	MRI	None	Indicated	MRI is appropriate if pain persists with normal XR or apparently normal NM. If pain is diffuse, MRI is not always practicable (depends on the technical capabilities of the MRI unit) MRI may also provide further information when XR and/or NM findings are abnormal.
	NM	☢ ☢	Indicated	NM is used if pain persists with normal XR or equivocal and abnormal XR in specific circumstances (e.g., suspected osteoid osteoma, osteomyelitis, or metastases)
	CT	☢ ☢	Specialised investigation	CT is used to define bony anatomy in areas of abnormality on XR/MRI/NM, especially if bone biopsy is indicated.
Myeloma	XR skeletal	☢ ☢	Indicated	Skeletal survey limited to spine, pelvis and proximal femora is sensitive. It is especially useful in non-secretory myeloma or in the presence of

				diffuse osteopenia. It can also be used for tumour mass assessment and follow-up.
	CT	☢ ☢	Specialised investigation	Low dose skeletal survey from vertex to below knees.
	MRI	None	Specialised investigation	MRI is used for staging and the identification of lesions that may benefit from radiotherapy; Survey can be limited to specific areas for follow-up.
	NM	☢ ☢	Not indicated	Skeletal scintigraphy is often negative and underestimates disease extent; consider bone marrow studies.
Metabolic bone disease	XR	☢ ☢	Indicated	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. MR may distinguish acute from chronic osteoporotic collapse, and also distinguishes between osteoporotic and malignant vertebral collapse.
	DEXA	☢ ☢	Indicated	DEXA is used for measurement of bone density. Quantitative Ct provides objective measurements of bone mineral content in patients where DEXA is difficult to interpret, whether because of deformity of spine or hypertrophic degenerative change.
	NM	☢ ☢	Indicated	NM is useful in hypercalcaemia after exclusion of myeloma in the identification of metastases.
Suspected osteomalacia with pain	XR	☢	Indicated	Localised XR is used to establish the cause of local pain, or an equivocal lesion identified on NM.
	NM	☢ ☢	Specialised investigation	NM can show increased activity and some local complications, such as pseudo-fractures.
	MRI	None	Specialised investigation	MRI is used to establish the cause of local bone pain not shown on XR and to assess equivocal XR findings.

Suspected osteoporotic collapse.	Lateral XR	☢ ☢	Indicated	Lateral XR of the thoracic and lumbar spine is the first investigation in suspected osteoporotic collapse. Collapsed vertebrae are often seen as incidental findings at CT.
	MRI	None	Specialised investigation	MRI distinguishes acute from chronic osteoporotic collapse, and also distinguishes between osteoporotic and malignant vertebral collapse.
	DEXA	☢	Specialised investigation	DEXA is unnecessary if fractures present in elderly patients since plain radiography is adequate to establish a diagnosis. Other lesions are excluded by XR and/or MRI. It is reserved for patients with risk factors for osteoporosis.
Arthropathy: Presentation	XR affected joint	☢	Indicated	XR of the affected joint may be helpful to establish cause, although erosions are relatively late feature.
	XR hands/feet	☢	Indicated	In patient with suspected rheumatoid arthritis, XR of the feet may show erosions even when symptomatic hand (s) appear normal.
	XR multiple joints	☢ ☢	Indicated only in specific circumstances	Symptomatic joints only.
	US NM MRI	None ☢ ☢ None	Specialised investigation	All can show acute synovitis. NM can show distribution. US and MRI can show early erosions. MRI can also show articular cartilage.
Arthropathy: Follow-up	XR	☢	Indicated only in specific circumstances	XR may be required by specialist to assist management decisions.
	US MRI	None None	Indicated only in specific circumstances	XR, US and MR may be required by specialists to assess disease progression and assist in management decisions, although the choice of these investigations is controversial.
Painful shoulder (including impingement syndrome and	US	None	Specialised investigation	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 first-line treatment and clinically guided injection. It is indicated preoperatively if the surgeon requires assessment of rotator cuff integrity.

suspected rotator cuff tear)	MRI	None	Specialised investigation	MRI is an alternative to US and is useful after major trauma to assess complex injury and bony abnormality. MRI excludes rare conditions. obscured by acromial arch and bone abnormalities when other investigations and treatment do not establish a diagnosis.
	XR	☢	Indicated only in specific circumstances	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.
Shoulder instability	XR	☢	Indicated	Plain XRs may show characteristic bone lesions in the humeral head and glenoid.
	MR MR arthrography	None ☢	Specialised investigation	MR may show the larum without intra-articular contrast, but MR arthrography is the investigation of choice for labral and ligamentous lesions.
	CT CT arthrography	☢ ☢ ☢ ☢	Specialised investigation	CT will show the bony glenoid and CT arthrography will show cartilaginous labral tears.
Sacroiliac pain	XR	☢	Indicated	XR of the sacroiliac joints is the first-line investigation for seronegative arthropathy.
	MRI CT NM	None ☢ ☢ ☢ ☢	Specialised investigation	MR is the investigation of choice for early stage sacroiliitis, CT and NM are alternatives.
Non-traumatic hip pain	XR pelvis	☢	Indicated	XR of the pelvis is indicated for persistent pain. It may demonstrate focal bony pathology, erosive joint changes, and dysplasia.
	MRI	None	Specialised investigation	MRI is widely accepted as the best investigation for further evaluation of XR negative persistent hip pain.
	NM	☢ ☢	Indicated only in specific circumstances	NM is rarely indicated if MR available since it is less specific.

Hip pain: suspected avascular necrosis.	XR pelvis	☢	Indicated	XR of the pelvis is abnormal in established disease but frequently normal within the first 6-9 months.
	MRI	None	Indicated	MRI is the most sensitive investigation in the detection of early avascular necrosis and will show the extent of necrosis.
	NM CT	☢ ☢ ☢ ☢	Specialised investigation	NM/CT are less sensitive and specific than MRI and are not indicated if MR is available.
Knee pain without trauma, locking or restriction of movement.	MRI	None	Specialised investigation	MRI is useful in patient with persistent undiagnosed pain, including suspected avascular necrosis and sepsis.
	US	☢	Indicated only in specific circumstances	US is useful for anterior knee pain with suspected tendinopathy or associated bursitis.
	XR	☢	Indicated only in specific circumstances	Symptoms frequently arise from soft tissues, which will not show on XR. Osteoarthritis changes are common. XR is needed when considering surgery. Sudden onset or exacerbation of pain is a good indication for imaging, as in pain persisting for more than 6 weeks in children and young adults.
Knee pain with locking (For traumatic knee pain see T21	MRI	None	Indicated	MRI is the investigation of choice to identify meniscal tears and loose bodies.
	XR	☢	Indicated	XR will identify radio-opaque loose bodies, a less frequent cause of locking.
Painful prosthesis	XR	☢	Indicated	XR is useful to detect established loosening.
	NM	☢ ☢ ☢ ☢ ☢	Indicated	A normal skeletal scintigram excludes most late complications. Increased uptake is seen around a loose prosthesis, but a three-phase study is of limited value in distinguishing between sterile and infected loosening. The role of PET is being assessed.

	US	☢ ☢	Specialised investigation	US is accurate for the detection of periprosthetic abscess or superficial infection. Useful to guide aspiration.
	Arthrography (aspiration / biopsy)	☢ ☢	Specialised investigation	Aspiration in conjunction with arthrography is useful when findings are equivocal, when there is a high clinical suspicion of infection, or when a cause of pain is not established.
	MRI	None	Indicated only in specific circumstances	Sequences that minimise metallic artefact may be helpful in the assessment of periprosthetic soft tissues, especially postoperative muscle defects and bursitis.
Hallux valgus	XR	☢	Indicated only in specific circumstances	XR is useful to guide surgery.
Heel pain: suspected plantar fasciitis	NM US MRI	☢ ☢ None None	Indicated only in specific circumstances	Calcaneal spurs are common incidental findings. The cause of pain is rarely detectable on XR. Other imaging (NM, US, and MRI) is more sensitive in showing inflammatory change and should be used selectively. Most patients should be managed on the basis of clinical findings without imaging.
	XR	☢	Not indicated	
General				
Congenital disorders	MRI	None	Indicated	MRI defines all spinal malformations and excludes associated thecal abnormality. CT may be needed to delineate bone detail. Sedation or GA may be required for infants and young children.
	XR	☢	Specialised investigation	XR may be useful in some situations; for example, full-length standing XR for scoliosis.
Myelopathy: tumours, inflammation, infection, infarction etc.	MRI	None	Indicated	MRI is the initial investigation of choice for all spinal cord lesions, to assess cord compression and to give an indication of postoperative prognosis.
	CT CTM	☢ ☢ ☢ ☢	Specialised investigation	CT may be needed if better bony detail is required. CTM is used only if MRI is unavailable or impossible.

	NM		Specialised investigation	NM is still widely used to screen for metastases and to identify focal skeletal lesions (such as osteoid osteoma).