East Lancashire Hospitals NHS Trust
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Clinical Radiology Referral Guidelines

Trauma 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
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

Trauma

Clinical/diagnostic problem	Investigation	Dose	Recommendation	Comment
Face and Orbits				
Head injury The following clinical features indicate a risk of significant brain injury: ▪ GCS score ≤12 or less at any time since injury ▪ GCS score of 13 or 14, 2 hours or more after the event ▪ Suspected open or depressed skull fracture ▪ Signs of a skull base fracture ▪ More than one episode of vomiting ▪ Post-traumatic seizure ▪ New or evolving focal neurology ▪ Age over 65 or coagulopathy in the presence of a	CT	☢ ☢	Indicated	CT should be available in all hospitals, responsible for assessment of patients with head injuries. CT should take place as soon as possible (in accordance with local guidelines) in all patients meeting the clinical criteria. CT may be delayed in patients who present with amnesia only or a significant mechanism of injury, bit not of the other clinical features of significant brain injury. Deterioration in GCS score by just one pint warrants early CT, despite a normal initial CT, a persistent reduced GCS score (less than 15) at 24h after the event may warrant repeat CT or even MRI. A head-injury patient should be discussed with a neurosurgeon when a new lesion is seen on CT, when CT is not available, or irrespective of the result of the CT when the patient has clinical features that suggest that neurosurgical assessment, monitoring, or management are appropriate (see local guidelines).
	MRI	None	Indicated only in specific circumstances	See above.
	SXR	☢	Not indicated	When CT is not available SXR could be justified for triage. An important exception is in the case of suspected NAI in children, when SXR is routinely indicated as part of a skeletal survey. In children 0-2 years old, CT of the head is mandatory.

history of amnesia or reduced level of consciousness				
Blunt orbital trauma	XR facial bones	☢	Indicated	XR of the facial bones is used especially where a blowout injury is suspected. MRI or direct coronal CT may be required by specialised where there is persistent diplopia or XRs and clinical signs are equivocal.
Orbital trauma: Penetrating injury	XR orbits	☢	Indicated	XR of the orbits is indicated for suspected radio-opaque (metallic) intra orbital foreign body.
	CT	☢ ☢	Specialised investigation	CT is indicated for suspected poorly opaque (small or non-metallic) intra orbital foreign body.
	MRI	None	Specialised investigation	MRI is hazardous with meal intra orbital foreign bodies. Specialised investigation is needed in cases when there is a strong clinical suspicion but failure of localisation or identification of the foreign body on other imaging.
Middle-third facial injury	XR facial bones	☢	Indicated	Discuss with maxillofacial surgeon, who may request low-dose CT at an early stage in management of complex injuries.
	CT	☢ ☢	Specialised investigation	Patient cooperation is essential to obtain views of diagnostic quality. Consider delay if patient is uncooperative.
Mandibular trauma	XR mandible / OPG	☢	Indicated	Panoramic XR is not appropriate in uncooperative or multiply injured patients.
Cervical spine				
Conscious patient with head and /or facial injury only	XR cervical spine	☢	Indicated only in specific circumstances	Patients with any one of the following risk factors should have cervical spine imaging: ▪ Inability to rotate neck left and right to 45o ▪ GCS score <15 ▪ Paraesthesia in extremities ▪ Focal neurological deficit

				▪ Not possible to test for range of neck movement (safe assessment if: simple rear-end collision, sitting position in A&E, ambulatory at any time since injury, delayed onset of neck pain, absence of midline cervical spine tenderness) ▪ Age ≥65 ▪ Dangerous mechanism of injury (fall >1m) For patients with risk factors, three-view cervical spine radiographs are the investigation of choice but when technically inadequate CT may be considered.
Unconscious patient with head injury	CT XR cervical spine	☢ ☢ ☢	Indicated	CT of the whole cervical spine to include the upper thoracic vertebrae is the preferred examination in patient with high risk of significant cervical injury. Although cervical spine XRs are acceptable for less severe injuries, adequate XRs of the cervical spine are difficult to achieve in the unconscious patient.
Neck injury with pain	XR cervical spine	☢	Indicated	Patients with any of the following risk factors should have cervical spine imaging: ▪ Inability to rotate neck left and right to 45o ▪ GCS<15 ▪ Paraesthesia in extremities ▪ Focal neurological deficit ▪ Not possible to test for range of neck movement (safe assessment if: simple rear-end collision, sitting position in A&E, ambulatory at any time since injury, delayed onset of neck pain, absence of midline cervical spine tenderness) ▪ Age >65 ▪ Dangerous mechanism, of injury (fall >1m)
	CT MRI	☢ ☢ None	Specialised investigation	CT is indicated with high-risk patients, equivocal XR findings, and complex injuries. MRI may be helpful for complex cases.
Neck injury with neurological deficit	XR cervical spine	☢	Indicated	XR of the cervical spine is used for orthopaedic assessment to act as baseline information, and for surgical planning.

	MRI	None	Indicated	MRI is the best and safest method of showing intrinsic cord damage, cord compression, ligamentous injuries, and vertebral fractures at multiple levels. Some constraints dependent on life support being provided.
	CT	☢ ☢	Specialised investigation	CT can be used to rapidly assess the cervical spine when it is impossible to obtain good quality radiographs. CT myelography may be considered if MRI is not practicable but this may only be available in specialist centres.
Neck injury with pain but initial XR normal; suspected ligamentous injury	XR cervical spine	☢	Specialised investigation	Flexion/extension views should be achieved by the patient with no assistance and under medical supervision. These views are of value 10 days or more after injury but not in the acute setting when MRI may be preferable.
	MRI	None	Specialised investigation [C]	MRI shows ligamentous, spinal cord and soft tissue injuries.
Thoracic and lumbar spine				
Trauma without pain or neurological deficit	XR	☢	Not indicated	Physical examination is reliable in this region. When the patient is alert and asymptomatic without neurological signs, the probability of a radiological finding that would after management is low.
Trauma with pain but no neurological deficit, or patient not able to be evaluated	XR	☢	Indicated	Threshold to XR is low when there is pain/tenderness, after a significant fall, a high impact road traffic accident, and presence of other spinal fracture or when it is not possible to clinically assess the patient. If XR suggests instability or posterior element fractures, CT or MRI is essential.
Trauma with neurological deficit with or without pain	XR	☢	Indicated	XR is used as initial investigation, but CT/MRI is essential.
	CT	☢ ☢	Indicated	Detailed analysis of bone injury is achieved with CT with or without reconstructions.
	MRI	None	Indicated	Whole spine MRI is indicated when there are multilevel or ligamentous injuries and cauda equina injuries.
Pelvis and sacrum				

Fall with inability to weight-bear	XR pelvis + lateral XR hip	☢ ☢	Indicated	Physical examination may be reliable. Check for femoral neck fractures, which may not show on initial XR, even with good lateral views. In selected cases, NM or MRI or CT can be useful when XR us normal or equivocal.
Urethral bleeding and pelvic injury	Retrograde urethrogram	☢ ☢	Indicated	Retrograde urethrogram is used to show urethral integrity, lea, or rupture. Cystography or delayed post-contrast CT should be considered if urethra is normal and haematuria is present to assess for other urinary tract injuries. There is increasing use to MRI as the initial investigation in the non-acute situation.
Trauma to coccyx or coccydynia	XR	☢	Indicated only in specific circumstances	Normal appearance is often misleading, and findings do not affect management. Radiation does significant.
Upper Limb				
Shoulder injury	XR	☢	Indicated	Some dislocations present subtle findings. As a minimum, orthogonal views are required, US, MRI and CT may have a role in a complex cases or soft-tissue injury. Consider assessment of rotator cuff in over 50s who mobilise poorly after a first dislocation.
Elbow trauma	XR	☢	Indicated	XR is used to show effusion. Routine follow-up XRs are not indicated in cases of effusion with no obvious fracture. MRI is a specialised investigation.
Wrist injury: Suspected scaphoid fracture	XR	☢	Indicated	Four-view series is needed where scaphoid fracture suspected. Increasing use of MR as the initial investigation for scaphoid.
	MRI NM CT	None ☢ ☢ ☢ ☢	Indicated	If clinical doubt persists, MRI/NM/CT studies are reliable. MRI is preferable as it is more specific. Increasingly, MRI is being used as the only examination.
Knee trauma: Fall / blunt trauma	XR	☢	Indicated only in specific circumstances	When blunt trauma or a fall is the mechanism if injury. XR is warranted when age <12 or >50 years, or if the patient cannot walk four weight-bearing steps. CT/MRI/Us may be needed where further information is required. CT is helpful for intra-articular fractures. MRI for suspected injuries of the ligaments/menisci and US for injuries of the extensor mechanism.

Acute ankle injury	XR	☢	Indicated only in specific circumstances	Features (Ottawa criteria) that justify XR include: ▪ Inability to weight-bear immediately and in the emergency room ▪ Tenderness over the posterior edge or trip of either malleolus Soft tissue injuries and occult fractures may be shown by US, MRI, or CT if XR is normal. Discuss with the radiologist.
Foot injury	XR	☢	Indicated only in specific circumstances	XR is indicated only if there is true bony tenderness or ongoing inability to weight-bear. Demonstration of a forefoot injury rarely affects management. XRs of foot and ankle are rarely indicated together; both will not be done without good reasons. If XRs are not taken, advise return within 1 week if symptoms are not improved. For complex mid-foot injuries. CT is required.
Stress fracture	XR	☢	Indicated	XR is indicated, although is often unrewarding.
	NM MRI CT	☢ ☢ None ☢ ☢	Indicated	Provides a means of early detection as well as a visual account of the biomechanical properties of the bone. Some centres use US.
Imaging of a foreign body				
Soft tissue injury: Foreign body – e.g., metal, glass, painted wood	XR	☢	Indicated	All glass is radio opaque wood is rarely radio opaque.
	US	None	Indicated	US may be indicated for radiolucent foreign body or where XR is difficult.
Soft tissue injury: foreign body e.g., plastic wood	XR	☢	Indicated only in specific circumstances	Plastic is not radiopaque wood is rarely radiopaque.
	US	None	Indicated only in specific circumstances	Soft tissue US may show non opaque foreign body.
Ingested foreign body suspected in pharyngeal or	XR	☢	Indicated only in specific circumstances	XR is used after direct examination of oropharynx (where most foreign bodies lodge), and if foreign body is likely to be opaque. Differentiation

upper oesophageal region				from calcified cartilage can be difficult. Most fish bones are invisible on XR.
	AXR	☢	Indicated only in specific circumstances	Maintain a low threshold for laryngoscopy or endoscopy, especially if pain persists after 24h.
Ingested foreign body: smooth and small e.g., coin	CXR	☢	Indicated	Few ingested foreign bodies will be radio opaque. In children a single slightly overexposed, frontal CXR to include neck should suffice. In adults a lateral CXR may be needed in addition if frontal CXR is negative.
	AXR	☢	Indicated only in specific circumstances	Most foreign bodies that impact do so at the cricopharayngeus muscle. If the foreign body has not passed within 6 days. AXR may be useful for localisation.
Ingested foreign body: sharp or potentially poisonous e.g., battery	AXR	☢	Indicated	Most swallowed foreign bodies that pass the oesophagus eventually pass through the remainder of the GI tract without complication. However, the location of a battery is important, as leakage can be dangerous.
	CXR	☢	Indicated only in specific circumstances	Indicated only is AXR is negative.
Chest				
Chest trauma; minor	CXR	☢	Indicated only in specific circumstances	Demonstration of a simple rib fracture does not alter management but if a complication such as pneumothorax is suspected CXR would be appropriate.
Chest trauma: moderate severity stable patient	CXR	☢	Indicated	Erect posteroanterior CXR needed to exclude pneumothorax, CXR useful to show pleural fluid or lung contusion.
	CT	☢ ☢	Specialised investigation	CT is useful for suspected aortic trauma and to exclude suspected pneumothorax not shown on supine CXR.
Stab injury	CXR	☢	Indicated	Posteroanterior and/or other views are used to show pneumothorax, lung damage, or fluid. Ct/US is useful for pleural and pericardial fluid.

Sternal injury	Lateral XR sternum	☢	Indicated	In addition to CXR, lateral XR of the sternum is required. Consider thoracic spinal and aortic injuries too.
Abdomen (including kidney)				
Blunt or stab injury	AXR supine+ CXR erect US	☢ ☢ None	Indicated	Supine AXR and erect CXR are indicated. US valuable for detecting haematoma and possible injuries to some organs – e.g., spleen and liver.
	Ct	☢ ☢ ☢	Specialised investigation	CT may be needed.
Renal trauma	CT	☢ ☢ ☢	Indicated	CT is the best imaging technique in patients with major injury +/- hypotension, +/- macroscopic haematuria. Delayed (excretory phase) CT must be included to assess the collecting system.
	US	None	Indicated only in specific circumstances	US can be useful in the initial assessment of patients with suspected renal injury, but a negative US does not exclude renal injury.
Major trauma: general screen in the unconscious or confused patient	XR cervical spine CXR XR pelvis	☢ ☢ ☢	Indicated	Stabilisation of the patient's condition must be a priority. Only the minimum XRs necessary for initial assessment will be performed. XR cervical spine can wait as long as spine and cord are suitably protected. Pelvic fractures are often associated with major blood loss.
	CT	☢ ☢ ☢	Specialised investigation	CT of the head or other site of injury as appropriate. CT cervical spine is used instead of XR cervical spine when CT of the head or body is anticipated.
Major trauma: chest, abdomen, and pelvis	CXR XR	☢ ☢	Indicated	Pneumothorax must be excluded. Pelvic fractures with instability of the pelvic ring are often associated with major blood loss
	US	None	Indicated	Widely used in the emergency room to show free fluid and sloid organ injury. US has largely replaced lavage but has a low sensitivity for splenic, GI tract and urological injury
	CT	☢ ☢ ☢	Indicated	CT is sensitive and specific and the investigation of choice. Plain radiographs and US may not be required if MDCT with reformatting is

				carried out. It is especially useful to exclude mediastinal haemorrhage and aortic injury.