East Lancashire Hospitals NHS Trust
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Clinical Radiology Referral Guidelines

Paediatric Referrals

Safe | Personal | Effective

June 2024 v2

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

Paediatrics

Clinical/diagnostic problem	Investigation	Dose	Recommendation [Grade]	Comment
Congenital disorders: Head	MRI	None	Indicated	MRI is the definitive investigation for all malformations, avoiding X-irradiation. CT may be needed to define bone and skull base anomalies. Sedation or general anaesthesia may be required for infants and young children, and in some case, therefore CT may be preferred.
Congenital disorders: Spine	MRI	None	Indicate	MRI is the definitive investigation for all malformations, avoiding X-irradiation. CT may be needed to delineate bone detail. Sedation or GA may be required for infants and young children.
Abnormal head appearance: Hydrocephalus	US	None	Indicated	US is identified where anterior fontanelle is open. Where sutures are closed/closing, MRI is indicated (in older children). CT may be appropriate if MRI is not available.
	SXR	☢	Specialised investigation	SXR and low-dose Ct with 3-D reconstructions are indicated in craniostenosis.
Epilepsy	MRI	None	Specialised investigation	Specialist clinical assessment and EEG investigation should usually be undertaken before MRI, unless there are signs of raised intracranial pressure or an acute neurological deficit. There is no routine indication for CT.
	SXR	☢	Not indicated	SXR has a poor yield.
Deafness / hearing loss	CT MRI	☢ ☢ None	Specialised investigation	Both CT and MRI may be necessary in children with congenital or post infective deafness.
Hydrocephalus: Suspected shunt malfunction	US MRI	None None	Indicated	US is used if practicable; MRI in older children (or CT if MRI unavailable). Neurosurgeons may still want cross-sectional imaging even if US is used. New programmable valves cause problems in MRI. US of the abdomen is indicated if cerebrospinal fluid collection is likely.

	XR	☢	Indicated	If there is evidence of hydrocephalus on US or MRI, XR can show the whole vale system.
Developmental delay: Suspected cerebral palsy	MRI	None	Specialised investigation	MRI in developmental delay remains a controversial area with regard to whom to screen and why. Further studies are needed to improve the accuracy of predicting patient outcome, particularly using newer MRI techniques of diffusion, spectroscopy, and functional imaging.
Headache	MRI CT	None ☢ ☢	Specialised investigation	In children MRI is preferable if available because of the absence of irradiation.
	SXR	☢	Not indicated	If headache is persistent or associated with clinical signs, refer patient for specialised investigations.
Neck and Spine				
Torticollis without trauma	US	None	Indicated	In congenital torticollis, US of neck muscles is a useful diagnostic tool for confirmation of sternocleidomastoid tumour in infants. If US is negative, XR and cross-sectional imaging are indicated.
	XR	☢	Indicated only in specific circumstances	Muscular causes are most common, but when history and examination are atypical, XRs are advised.
	CT	☢ ☢	Indicated only in specific circumstances	Persistent torticollis for 1 week justifies further imaging after consultation.
Back pain	MRI CT	None ☢ ☢	Indicated	Persistent back pain in children may have an underlying cause and justifies investigation. Choice of imaging is made after consultation. Back pain with scoliosis or neurological signs merit MRI/CT.
Spina bifida occulta	US MRI	None None	Indicated	A common variation and not in itself significant. Investigation is only indicated if neurological signs are present.
Sacral dimple or other cutaneous stigmata (e.g., hairy patch)	US MRI	None None	Indicated only in specific circumstances	In the new-born child, isolated sacral dimples and small pits which are <5mm from the midline and <25mm from the anus can be safely ignored. A combination of two or more congenital midline skin lesions is a marker of occult spinal dysraphism.

				If there are other stigmata of spinal dysraphism or associated congenital abnormalities. US of the neonatal lumbar spine is the investigation of choice. MRI is indicated when US is abnormal/equivocal, when there are neurological signs, or when there is a discharging lesion.
Musculoskeletal				
Non-accidental injury / child abuse	Skeletal survey	☢ ☢	Indicated	The investigation of suspected child abuse may be complex and should be multidisciplinary. There is no recognised upper age limit for a skeletal survey, however the diagnostic yield diminishes with age with a greater diagnostic yield in a child under 1. Before undertaking a skeletal survey, there should be discussion between the senior paediatrician involved in the direct care of the child and the radiologist who is supervising the skeletal survey. The skeletal survey should be undertaken by a radiographer trained in paediatric practice and non-accidental injury. It is important that a radiologist supervised the undertaking of the skeletal survey and advises about additional views, as necessary.
	SXR CT	☢ ☢ ☢	Indicated	For non-accidental head injury, SXR is mandatory regardless of whether or not a CT head is done, SXR has a greater yield in detecting skull fractures. The use of CT should follow national guidelines. In all cases, discussion about the merits of CT examination should be undertaken between paediatrician and radiologist.
	NM	☢ ☢	Specialised investigation	Bone scintigraphy can be valuable in the investigation of non-accidental injury. The diagnostic yield from a skeletal survey and NM is greater than either investigation alone. The routine use of bone scan without a skeletal survey is not standard practice within the UK. If there are any areas of increased activity on the bone scan, then corresponding radiographs should be obtained. Abnormal findings should be correlated with clinical history, physical examination and XR.
Limb injury: opposite side for comparison	Comparison XRs of the joint on the	☢	Not indicated	Seek radiological advice.

	contralateral side			
Short stature, growth failure	XR for bone age	☢	Indicated	Child aged 1 year and over: left (or non-dominant) hand/wrist only. XR may need supplementing with further specialised investigations. Skeletal scintigraphy if dysplasia is suspected. MRI of hypothalamus-pituitary fossa if central hormone failure is a possibility.
Irritable hip	US	None	Indicated	US will confirm presence of an effusion but will not discriminate sepsis from transient synovitis.
	XR	☢	Not indicated initially	XR which may include a frog lateral view, is required if slipped under femoral epiphysis or Perthes' disease is suspected or if symptoms persist. If symptoms persist, then follow-up should be as for the limping child.
Limping	US	None	Indicated	US will confirm the presence of an effusion but will not discriminate sepsis from transient synovitis.
	XR	☢	Not indicated initially	Children with a limp need proper clinical assessment. If pain persists, or localising signs are present, XR is indicated.
	MRI	None	Specialised investigation	MRI should be used after discussion with a radiologist.
Focal bone pain	XR	☢	Indicated	XR should be the first-line investigation, though MRI and NM are more sensitive than XR in detecting occult infection or fracture.
	NM	☢ ☢	Specialised investigation	XR should be obtained initially. Skeletal scintigraphy is useful if pain is not well localised. A negative multiphasic study does not exclude active arthritis.
	MRI	None	Specialised investigation	MRI is especially useful if the child can localist the site of the pain.
	US	None	Specialised investigation	US can detect occult infection.
Clicking hip: Suspected dysplasia	US	None	Indicated	US is indicated where there is clinical doubt development dysplasia of the hip but not routine screening. XR may be necessary in the older child.

Osgood-Schlatter disease	XR	☢	Indicated only in specific circumstances	Although bony radiological changes are visible in Osgood-Schlatter disease, they overlap with normal appearances. Associated soft tissue swelling should be assessed clinically rather than radiologically.
Cardiothoracic				
Acute chest infection	CXR	☢	Indicated only in specific circumstances	CXR is indicated if symptoms persist despite treatment, or in severely ill children. If CXR is used and shows simple pneumonia, routine follow-up CXR is not required.
Recurrent productive cough	CXR	☢	Indicated only in specific circumstances	In general, children with recurrent productive cough have CXRs that are normal or show parabronchial thickening. In these children repeat CXR is not indicated unless atelectasis is seen on the initial CXR. Children with suspected cystic fibrosis or immune deficiency require specialist referral.
Cystic fibrosis	NM	☢ ☢	Not performed at ELHT	Perfusion lung scintigraphy is useful in selected cases, especially if surgery is contemplated.
Inhaled foreign body (suspected)	CXR	☢	Indicated	CXR is indicated, though often normal. If there is clinical suspicion of an inhaled foreign body, bronchoscopy is mandatory. While air trapping is the most common sign seen in patients with inhaled foreign bodies, it is seen infrequently, and the routine use of expiratory XR is not warranted. Fluoroscopy is often a better and easier alternative to expiratory XR.
Wheeze	CXR	☢	Indicated only in specific circumstances	In most children with wheeze, the CXR is either normal or shows features of uncomplicated asthma or bronchiolitis, such as hyperinflation or peri bronchial cuffing. In selected cases, such as those with fever or localised crackles, the CXR may be useful in guiding patient management.
Acute stridor	Lateral XR soft tissue neck	☢	Indicated only in specific circumstances	Epiglottitis and croup are clinical diagnoses. Lateral neck XR may be of value in children with a stable airway in whom an obstructing foreign body or retropharyngeal abscess is possible.

Heart murmur	CXR US	☢ None	Indicated only in specific circumstances	Specialist referral is needed; cardiac US may be indicated.
Gastrointestinal				
Intussusception	US-guided or fluoroscopy-guided hydrostatic / pneumatic reduction	None ☢ ☢	Indicated	US has high sensitivity in the diagnosis of intussusception but is operator dependent. It is useful in assessment of blood flow and identification of lead points and small bowel intussusceptions. Pneumatic reduction has a higher success rate than traditional hydrostatic reduction. However, there is a slightly higher risk of perforation (approximately 1%). Absolute contraindications are perforation, shock, and peritonitis.
Ingested foreign body.	CXR, including neck	☢	Indicated	If there is doubt whether the foreign body has passed, an AXR after 6 days may be indicated.
	AXR	☢	Indicated only in specific circumstances	Only for sharp or potentially poisonous foreign body-e.g., battery.
Blunt abdominal trauma	CT	☢ ☢ ☢	Specialised investigation	CT remains the primary imaging investigation of choice to detect the presence and extent of intra-abdominal injuries following blunt abdominal trauma and will guide the level or intensity of hospital and post-discharge management of the patient. US may be useful in the follow-up of known organ injuries, to reduce the total radiation burden to the patient.
	AXR	☢	Indicated only in specific circumstances	Clinical assessment of the patient should be used to determine which patients require further evaluation by imaging. AXR is of limited use after minor trauma unless there are positive physical signs suggestive of intra-abdominal pathology or injury to the spine of bony pelvis.
	US	None	Indicated only in specific circumstances	US may be used to search for the presence of free fluid following blunt abdominal trauma, but a negative examination does not exclude the presence of intra-abdominal injury.
Projectile vomiting in infants	US	None	Indicated	US can confirm the presence of hypertrophic pyloric stenosis, especially where clinical findings are equivocal.

Recurrent vomiting	Contrast meal +/- follow through	☢ ☢	Indicated only in specific circumstances	Recurrent vomiting in children can be caused by a range of conditions, many of which cannot be diagnosed radiologically. At upper GI contrast study is not indicated for the diagnosis of simple gastro-oesophageal reflux. Where significant gastro-oesophageal reflux has been shown on pH studies, an upper GI contrast study may be indicated to exclude a significant structural abnormality such as hiatus hernia or malrotation. If there are other associated clinical symptoms/signs – e.g., bile-strained vomit – the case for contrast studies is much stronger.
Persistent neonatal jaundice	US	None	Specialised investigation	Early (<10 weeks) and prompt investigation is essential. The absence of dilatation in the intrahepatic bile duct does not exclude obstructive cholangiopathy.
GI bleeding (per rectum)	AXR	☢	Indicated only in specific circumstances	Imaging strategy depends on the age of the patient and severity of bleeding, diagnostic, possibilities, and clinical presentation. AXR is required if necrotising enterocolitis is suspected.
	US	None	Specialised investigation	US is used for the diagnosis of intussusception and demonstration of duplication cysts. Upper or lower GI endoscopy is often the most often the most useful next investigation of rapid haemorrhage or chronic haemorrhage not found by other means.
	NM	☢ ☢	Specialised investigation	NM is used for detecting active bleeding sites including Meckel's diverticulum. Angiography is used for investigation of rapid haemorrhage or chronic haemorrhage not found by other means.
Acute abdominal pain	US	None	Specialised investigation	There are many causes of acute abdominal pain. Us can be helpful in further assessment but needs to be guided by clinical findings.
	AXR	☢	Indicated only in specific circumstances	AXR is rarely of value and is best performed under specialist guidance. Generally, AXR is not undertaken before US.
Constipation (See also G23)	AXR	☢	Indicated only in specific circumstances	There is a wide variation in the amount of faecal residue shown on the AXR and good correlation with constipation has not been proven. Additionally, there is interobserver variation in interpretation. AXR can help specialists in the management of intractable constipation.

	Contrast enema	☢ ☢	Indicated only in specific circumstances	Non-radiological investigations, such as rectal manometry and biopsy are preferred. Contrast enema may have a role if these are not available and referral difficult. Some centres use NM.
Palpable abdominal / pelvic mass	US	None	Indicated	Indicated in the assessment of all suspected abdominal masses. If the presence of a mass is confirmed, the patient should be referred to a specialised centre.
Genitourinary				
Continuous wetting	US	None	Indicated	In toilet-trained girls with a history of continuous dribbling/wetting, an ectopic infrasphincteric ureter must be excluded. US of the whole renal tract including the bladder and pelvis is recommended in addition to video-urodynamics. Imaging of the urinary tract in children with solely night-time enuresis is of limited value.
	XR lumbosacral spine	☢ ☢	Indicated	XR of the lumbosacral spine is indicated in children with abnormal neurology or skeletal examination, in addition to those with bladder wall thickening/trabeculation shown on US or neuropathic vesicourethral dysfunction on video urodynamics.
	CT MRI	☢ ☢ ☢ None	Specialised investigation	CT/MRI may be of value in the location of the dysplastic kidney or dysplastic occult moiety when US and DMSA imaging have failed.
	NM	☢ ☢	Indicated only in specific circumstances	DMSA imaging is useful in the detection and location of the dysplastic kidney and upper moiety of a duplex system.
Impalpable testis	US	None	Indicated	US is used in the location of the testis within the inguinal canal.
	MRI / Laparoscopy	None	Specialised investigation	MRI may be of value after US to locate intra-abdominal testis, but laparoscopy is generally preferred.
Fetal renal pelvic dilatation	US	None	Indicated	Ideally, US should take place post-partum at 72 hours and again at 4-6 weeks. Other imaging investigations, including micturating

				cystourethrogram and diuretic renography, should be used as per local protocol.
	NM	☢ ☢	Specialised investigation	In cases of persistent postnatal pelvic dilatation, MAG3 diuretic renography is essential in the estimation of renal uptake function (differential function) as well as drainage.
Proven urinary tract infection.	US	None	Specialised investigation	There is wide variation in local policy. Much depends on local technology and expertise. Most patients should remain on prophylactic antibiotics pending the results of investigations. The age of the patient also affects decisions. There is much current emphasis on minimising radiation dose; hence AXR is not indicated routinely (calculi are rare). Expert US is the key investigation in all imaging strategies at this age.
	NM	☢ ☢	Specialised investigation	There is an increasing trend to examine the acutely ill child secondary to urinary tract infection with a DMSA study in the acute setting. In the outpatient setting, to exclude a scar a DMSA study should be done 3-6 months after a proven urinary tract infection. NM will establish function and if MAG3 is used, can exclude obstruction.
	XR cystography	☢ ☢	Specialised investigation	Direct XR cystography is still needed in the young (e.g., <2 years old) male patient where delineation of the anatomy (e.g., urethral valves) is critical.
P43	NM cystography	☢ ☢	Specialised investigation	NM can also be used for direct or indirect cystography.