Introduction

1. What are the guidelines?

As a key diagnostic and treatment service, radiology is central to the provision of healthcare services. Referral guidelines can help referrers to request the best, safest and most valuable imaging investigations, facilitating rapid authorisation and justification.

iRefer guidelines

The Royal College of Radiologists (RCR) has published iRefer Guidelines: Making the best use of clinical radiology (iRefer) since 1989. iRefer is now widely accepted as a major tool to promote evidence-based imaging.

Why are guidelines needed?

A useful investigation is one in which the result – positive or negative – will inform clinical management and/or add confidence to the clinician’s diagnosis. To avoid the wasteful use of radiology, the important questions to be asked are as follows.

1. HAS IT BEEN DONE ALREADY? Repeating investigations that have already been done.

2. IS IT NEEDED? Undertaking investigations when results are unlikely to affect patient management or over-investigating.

3. IS IT NEEDED NOW? Investigating too early.

4. IS THIS THE BEST INVESTIGATION? Doing the wrong investigation.

5. HAS THE PROBLEM BEEN PROPERLY EXPLAINED? Failing to provide appropriate clinical information and questions that the imaging investigation should answer.

The aim for all examinations should be to obtain maximum information with the minimum of radiation.

Who are the guidelines for?

The guidelines are aimed at clinicians, radiologists, radiographers and other healthcare professionals to help to determine the most appropriate imaging procedures for a wide range of clinical problems and to help clinicians to meet their obligations under the Ionising Radiation (Medical Exposure) Regulations (IRMER) see below.

The guidelines may also be of use to healthcare organisations to facilitate planning and to some patients who may need reassurance that the investigation requested by their doctor is appropriate. They are useful in both primary and secondary care, and will assist in ensuring that imaging strategies are broadly similar nationally. They aim to promote the best use of imaging for the benefit of patients, minimise radiation dose and to assist in the equitable use of expensive equipment, staff and other resources.

What evidence informs the guidelines?

The iRefer guidelines are evidence-based. The methodology used to develop them has been accredited by NICE Evidence, managed by the National Institute for Health and Care Excellence (NICE).

Recommendations within the guidelines have been graded according to evidence levels as set out below. Grading is adapted from the Oxford Centre of Evidence-based Medicine. 2
[A] Any of the following
- High-quality diagnostic studies in which a new test is independently and blindly compared with a reference standard in an appropriate spectrum of patients.
- Systematic review and meta-analyses of such high-quality studies.

[B] Any of the following
- Studies with a blind and independent comparison of the new test with the reference standard in a set of non-consecutive patients or confined to a narrow spectrum of patients.
- Studies in which the reference standard was not applied to all patients.
- Systematic reviews of such studies.

[C] Any of the following
- Studies in which the reference standard was not objective.
- Studies in which the comparison of the new test with the reference standard was not blind or independent.
- Studies in which positive and negative test results were verified using different reference standards.
- Expert opinion.

In some clinical situations there are conflicting data within a large body of excellent scientific reports. Thus, no firm recommendations are given and the evidence is graded C.

2. Using the guidelines

The iRefer guidelines are designed to assist the referrer in selecting the most appropriate investigation or procedure for a given diagnostic or imaging problem.

The guidelines are divided into sections, each of which sets out the clinical scenario, including where appropriate red flags (these provide additional information to assist referrals), and lists relevant procedures with an indication of the associated radiation dose. For each procedure, there is a recommendation on its appropriateness (together with the grade). Finally, an explanatory comment is included when required to clarify the circumstances in which the procedure should be used.

The recommendations used are as follows.

1. Indicated.

Investigations most likely to contribute to the clinical diagnosis and management.

2. Specialised investigation.

Specialised investigations are frequently complex, time-consuming and/or resource-intensive, and will usually only be undertaken after discussion with the radiologist or according to locally agreed protocols.

3. Indicated only in specific circumstances.

Non-routine investigations, usually only undertaken if a clinician provides cogent reasons or if the radiologist believes the examination represents an appropriate means of furthering the diagnosis and management of the patient. With certain clinical problems which may resolve with time, it may be correct to defer investigation.

4. Not indicated.

Investigations for which the proposed rationale is no longer appropriate.

The full iRefer guidelines detail and provide links to key references and relevant clinical guidelines where appropriate.

3. Justifying and optimising radiation dose

While some imaging techniques, for example ultrasound and MRI, do not involve ionising radiation many do. The use of radiological investigations that involve ionising radiation 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.

The IRMER\(^3\) regulations and subsequent amending regulations (2006\(^3\) and 2011\(^4\)) impose a responsibility on imaging departments to ensure that all exposures to ionising radiation are justified, and that doses are optimised.

The guidelines use the following table to help the referrer to understand the order of magnitude of radiation does of various investigations

**Band classification of the typical doses of ionising radiation from common imaging procedures**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Typical effective dose (mSv)*</th>
<th>Examples</th>
<th>Lifetime additional risk of cancer induction/exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0</td>
<td>US; MRI</td>
<td>0</td>
</tr>
<tr>
<td>☢</td>
<td>&lt;1</td>
<td>CXR; XR limb, pelvis, lumbar spine; mammography</td>
<td>&lt;1:20,000</td>
</tr>
<tr>
<td>☢☢</td>
<td>1–5</td>
<td>IVU; NM (eg, bone); CT head and neck</td>
<td>1:20,000–1:4,000</td>
</tr>
<tr>
<td>☢☢☢</td>
<td>5.1–10</td>
<td>CT KUB; NM (eg, cardiac)</td>
<td>1:4,000–1:2,000</td>
</tr>
<tr>
<td>☢☢☢☢</td>
<td>&gt;10</td>
<td>Extensive CT studies, some NM studies (eg, some PET-CT)</td>
<td>&gt;1:2,000</td>
</tr>
</tbody>
</table>

*The average annual background dose in most parts of Europe falls within the 1–5 mSv range (☢☢). Cancer risks from radiation vary considerably with age and sex, with higher risks in infants and females.\(^5\) Cancer risk indicated in this table is averaged for adults. As risks for children are higher, the examinations indicated may need to be moved to higher risk band; ie, CT head and neck for a child may move to the Band categorised as ☢☢☢☢. This should be taken in the context of the considerably higher 1 in 2 average lifetime risk for cancer induction and must be balanced against the benefit of the investigation.

[Key: US=ultrasound; MRI=magnetic resonance imaging; CXR=chest X-ray; XR=X-ray; IVU=intravenous urography; NM=nuclear medicine; CT=computed tomography; PET-CT=positron emission tomography co-registered with CT.]

Typical effective doses for radiological examinations and associated risks are based on data supplied by CRCR, Public Health England. \(^5,\(^6\)

4. Communication with the radiology service

Referral for an imaging examination or interventional radiology procedure is a request for a clinical opinion usually from a specialist in radiology or radionuclide radiology. Requests should be completed accurately and legibly to avoid misinterpretation. The referrer’s details and contact information must be included. Reasons for the request should be clearly stated, and sufficient clinical details should be supplied to enable the imaging specialist to understand the particular diagnostic or clinical problems to be resolved by the radiological investigation or procedure. \(^7\) Referrers have a duty of care to confirm that results are followed up.

Communication is vital to guarantee a patient-centred high-quality service. An important function of the clinical radiologist is to assist in patient investigation and management pathways to improve patient care.
5. Paediatrics

Children are more sensitive than adults to the harmful effects of ionising radiation. Exposure to ionising radiation and invasive, painful diagnostic or interventional procedures should be avoided whenever possible.

Plain radiography and fluoroscopic contrast examinations have an important role in paediatric diagnosis but should be used only when clinically necessary, and exposure factors should be appropriate to the size of the child. In fluoroscopic examinations, screening times should be kept as low as possible.

Ultrasound is often the first modality of choice for imaging children. Ultrasound examination is painless and non-invasive and, with patience, useful images can be obtained even with a restless child. However, ultrasound cannot penetrate bone and air and some anatomical locations are not accessible to ultrasound examination.

Magnetic resonance imaging (MRI) allows non-invasive imaging with no exposure to ionising radiation, providing a high level of intrinsic contrast and the capability of multiplanar imaging. MRI does not offer the same capability for real-time imaging that ultrasound can provide; imaging times are relatively long, and as the images are easily degraded by movement artefact, younger children may require sedation or general anaesthesia. However, MRI is not constrained by the same limitations as ultrasound to anatomically accessible areas; the presence of bone and air does not interfere with MR images.

CT involves exposure to relatively high doses of ionising radiation and alternative modalities should always be considered, but CT is often the modality of choice in major trauma and other emergency situations where rapid cross-sectional imaging is necessary. It is important to 'right size' the exposure factors, to scan only the essential anatomical areas and to avoid multiple exposures.

Radionuclide imaging can provide unique functional information but is generally indicated in children only in the special circumstances listed in the full guidelines.

6. Abbreviations used in the paediatrics guidelines

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>CT</td>
<td>Computed tomography</td>
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<tr>
<td>CXR</td>
<td>Chest radiograph</td>
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<tr>
<td>GI</td>
<td>Gastrointestinal</td>
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<tr>
<td>HRCT</td>
<td>High-resolution computed tomography</td>
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<tr>
<td>MRI</td>
<td>Magnetic resonance imaging</td>
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<tr>
<td>NM</td>
<td>Nuclear medicine</td>
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<tr>
<td>PET-CT</td>
<td>Positron emission tomography co-registered with CT. Also includes stand-alone PET currently</td>
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<tr>
<td>SPECT</td>
<td>Single photon emission computed tomography</td>
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<tr>
<td>SXR</td>
<td>Skull radiograph</td>
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<tr>
<td>US</td>
<td>Ultrasound</td>
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<tr>
<td>XR</td>
<td>Radiograph</td>
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</tbody>
</table>
7. References


