THE CANADIAN
ASSOCIATION OF
RADIOLOGISTS

Diagnostic Imaging Referral Guidelines

A guide for physicians

First Edition 2005

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CANADIAN ASSOCIATION OF RADIOLOGISTS

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This document is also available in French.

Foreword

The CAR diagnostic imaging referral Guidelines were prepared by an expert advisory committee of the CAR in collaboration with the Canadian Association of Nuclear Medicine (CANM). This document is based on the Royal College of Radiologists' document "Making the Best Use of a Department of Clinical Radiology: Guideline for Doctors, fifth edition.

The Royal College of Radiologists (RCR) was not involved in the guidelines' adaptation, translation or other amendment. As such, the RCR can therefore accept no responsibility for their acuracy or application in clinical situations in Canada.

In drafting these Guidelines, the CAR expert panel was particularly interested in the appropriate use of CT and MRI in clinical conditions where the use of these technologies is felt to be controversial. Consensus of opinion identified 13 clinical conditions that needed further investigation to determine the effectiveness of the technologies specifically for diagnosis and guidance of therapy. For these conditions collaborative work was undertaken by the Canadian Coordinating Office for Health Technology Assessment (CCOHTA) to evaluate clinical, systematic reviews of CT and MRI for selected disorders of the chest, cardiovascular and neurological systems. Recently published literature was retrieved from major medical databases using a predetermined search strategy. Studies were selected based on criteria such as: study design, population group and interventions. The grey literature was then organized and reviewed independently. The results were presented to the expert panel who subsequently used this information in making and refining the recommendations included in the present Guidelines.

This publication would not have been possible without the hard work and dedication of the CAR and CANM Guidelines Committee members:

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We would also like to acknowledge ProMed & Associates, CCOHTA, as well as all the other bodies that were involved in the preparation of this document.

The CAR would also like to acknowledge the many individuals that were consulted by members of the expert advisory committee that contributed to this first edition of the CAR Diagnostic Imaging Referral Guidelines.

These Guidelines are intended for physicians and are aimed at assisting them in making decisions in regard to appropriate imaging studies for specific cases.

In producing Guidelines such as these there are always areas of contention, with difficult decisions having to be made in order to incorporate views that may be at variance with one another. Levels of scientific evidence for the recommendations are included within the document to enable the physician to assess the form and robustness of the advice offered.

These Guidelines are not intended as a means of restricting the physician's role in the process of decision making in regard to the imaging studies to be requested. The Guidelines are based on expert opinion or case studies. They should not be used to diminish in any way the freedom of attending physicians to determine and order imaging studies for their patients for whom they have the ultimate responsibility. Such use of these Guidelines would be an abuse of the process and could jeopardize the quality of care for an individual patient. The Guidelines are intended as a guide for referring physicians; however, discussions between the radiologist and the physician, particularly during multidisciplinary team meetings, must always take precedence. To use these Guidelines in any other way is unacceptable.

The introduction of Guidelines in practice requires the co-operation of all concerned with the care of a patient and their ultimate effectiveness relies on appropriate education and locally agreed implementation procedures.

The Canadian Radiological Foundation

The pubication of the CAR Guidelines was made possible by the financial support of the Canadian Radiological Foundation. The CRF supports ways of exploring the future of medical imaging and radiology's impact on the future of the Canadian health care system.

To keep the CAR Guidelines up-to-date, the financial support of the Foundation is necessary. To make a donation: http://www.car.ca/foundation/ or contact Marie-Noëlle Bouillon, 514-738-3111 ext. 205.

Preface

This document has been prepared to help referring physicians make the best use of a Department of Diagnostic Imaging. The Guidelines have been designed to assimilate, evaluate, and implement the ever-increasing amount of evidence and opinion on current best practice.

The role of the physician in justifying the examination remains paramount and is dependent on each clinical case. These Guidelines must not be used as a means of restricting the freedom of physicians to investigate individual cases in the most appropriate way.

Continued use of recommendations of this kind can lead to a reduction in the number of inappropriate referrals for investigation and therefore to a reduction in medical radiation exposure [1, 2, 3, 4]. However, the primary objective of this document is to improve clinical practice. Such Guidelines work best if they are used as part of clinicoradiological dialogue between physicians charged with the particular care of a patient. They are intended for use by all referring practitioners.

Classification of evidence levels has been translated into grades of recommendation based on the system developed by the US Department of Health and Human Services, Agency for Health Care Policy and Research [5, 6]. The levels are:

[A]

- 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
- Diagnostic clinical practice guidelines / clinical decision rules validated in a test set

[B] Any of the following:

- Studies with a blind and independent comparison of the new test and reference standard in a set of nonconsecutive patients or confined to a narrow spectrum of subjects
- Studies in which the reference standard was not performed on all subjects
- Systematic reviews of such studies
- Diagnostic clinical practice guidelines / clinical decision rules not validated in a test set

[C] Any of the following:

- Studies in which the reference standard was not objective
- Studies in which the comparison between the new test and the reference standard was not blind or independent
- Studies in which positive and negative test results were verified using different reference standards
- Studies performed in an inappropriate set of patients
- Expert opinion

While consultation of experts was undertaken in the development of this document, and best-evidence methodology applied, undoubtedly there will be some decisions that will not accord with local practice. Evidence has at times been conflicting and this has required compromise and interpretation. We would welcome comments to allow us to update these Guidelines in further editions.

Introduction

Why are guidelines needed?

A useful investigation is one in which the result - positive or negative – will alter clinical management and/or add confidence to the physician's diagnosis. A significant number of radiological investigations do not fulfill these aims and may add unnecessarily to patient irradiation [7, 16]. The chief causes of the wasteful use of radiology are:

1. **Repeating investigations which have already been done:** e.g. at another hospital, in an outpatient facility, or in other departments. **HAS IT BEEN DONE ALREADY?** Every attempt should be made to get previous films and reports. Transfer of digital data through electronic links such as PACS/RIS systems will assist in this respect.
2. **Investigation when results are unlikely to affect patient management:** because the anticipated 'positive' finding is usually irrelevant, e.g. degenerative spinal disease (as 'normal' as grey hairs from early middle age) or because a positive finding is so unlikely. **DO I NEED IT?**
3. **Investigating too early:** i.e. before the disease could have progressed or resolved or before the results could influence treatment. **DO I NEED IT NOW?**
4. **Doing the wrong investigation.** Imaging techniques are developing rapidly. It is often helpful to discuss an investigation with a specialist in clinical radiology or nuclear medicine before it is requested. **IS THIS THE BEST INVESTIGATION?**
5. **Failing to provide appropriate clinical information and questions that the imaging investigation should answer.** Deficiencies here may lead to the wrong technique being used (e.g. the omission of an essential view). **HAVE I EXPLAINED THE PROBLEM?**
6. **Over-investigating.** Some physicians tend to rely on investigations more than others. Some patients take comfort in being investigated. **ARE TOO MANY INVESTIGATIONS BEING PERFORMED?**

What advice is available?

In some clinical situations firm guidelines have been established. Guidelines are:

> *systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances... [8].*

Just as the term implies, a guideline is not a rigid constraint on clinical practice, but a concept of good practice against which the needs of the individual patient can be considered. So while there have to be good reasons for ignoring them they are not absolute rules. No set of recommendations will command universal support, and you should discuss any problems with your radiologists.

The preparation of guidelines has become something of a science, with numerous papers emerging within the evolving guidelines discipline. In particular, experts have provided a detailed methodology as to how guidelines should be developed, produced and appraised [9-15, 17]. Using such a methodology, the development of a single, scientifically robust guideline represents a major piece of academic endeavor. For the clinical problems in this document, such expenditure of time and resources is somewhat impractical. Nevertheless, increasing effort has been made to ensure that the methodology for the preparation of guidelines has been followed during the preparation of these recommendations.

What images are taken?

All imaging departments should have protocols for each common clinical situation. Therefore no definite recommendations are given about this aspect. Suffice it to say that all examinations should be optimized to obtain maximum information with the minimum of radiation. It is important to be aware of this, as the imaging performed may not be what the referring physician expects.

For whom are the guidelines designed?

These Guidelines are intended to be used by all 'referrers', including in particular general practitioners.

The range of investigations available to different health professionals must be determined in consultation with local specialists in radiology and nuclear medicine, bearing in mind the available resources. The recommendations are also of value to those interested in audit of a department's referral pattern and workload [7, 16].

Using the Guidelines

This document tends to highlight areas of difficulty or controversy. The pages are composed of five columns: the first sets the clinical/diagnostic situation for requesting an examination; the next lists some possible imaging techniques; the third gives the recommendation [and the grade of available evidence] on whether or not the investigation is appropriate; the fourth provides explanatory comment; and the fifth shows the band of radiation exposure involved.

The recommendations used are:

1. **Indicated.** This shows an investigation most likely to contribute to clinical diagnosis and management. This may differ from the investigation requested by the physician: e.g. US rather than venography for deep vein thrombosis.
2. **Specialized investigation.** These are frequently complex, time-consuming or resource-intensive investigations which will usually only be performed after discussion with the radiologist or in the context of locally agreed protocols.
3. **Not indicated initially.** This includes situations where experience shows that the clinical problem usually resolves with time; we therefore suggest deferring the study and only performing it if symptoms persist and are important enough to warrant action from the physician. Shoulder pain is a typical example.
4. **Indicated only in specific circumstances.** These are non-routine studies which will only be carried out if a physician provides cogent reasons or if the radiologist feels the examination represents an appropriate way of furthering the diagnosis and management of the patient. An example of such a justification would be plain radiography in a patient with backache in whom there were clinical findings to suggest something more than a degenerative disease (e.g. osteoporotic vertebral fracture).
5. **Not indicated.** Examinations in this group are those where the supposed rationale for the investigation is untenable (e.g. skull radiograph for dementia).

Pregnancy and protection of the fetus

Irradiation of a fetus should be avoided whenever possible [18, 19, 20, 22]. This includes situations where the woman herself does not suspect pregnancy. The prime responsibility for identifying such patients lies with the referring physician.

Women of reproductive age presenting for an examination in which the primary beam irradiates directly, or by scatter, the pelvic area (essentially, any ionizing irradiation between the diaphragm and the knees), or for a procedure involving radioactive isotopes, should be asked whether they are or may be pregnant. If a patient cannot exclude the possibility of pregnancy, non-urgent x-ray examination should be restricted to the first ten days from the beginning of menses. This practice is commonly known as the 10 Day Rule.

If there is no possibility of pregnancy the examination can proceed, but if the patient is definitely or possibly pregnant (i.e. menstrual period is overdue) the justification for the proposed examination should be reviewed by the radiologist and the referring physician, with a decision taken on whether to defer the investigation until after delivery or until the next menstrual period has occurred. However, a procedure of clinical benefit to the mother may also be of indirect benefit to her unborn child, and a delay in an essential procedure may increase the risk to the fetus as well as to the mother.

If pregnancy cannot be excluded, but the menstrual period is not overdue and the procedure gives a relatively low dose to the uterus, the examination may proceed. However, if the examination gives relatively high doses there will be discussion in line with locally agreed recommendations.

In all cases, if the radiologist and referring physician agree that irradiation of the pregnant or possibly pregnant uterus is clinically justified or is not clinically justified, this decision should be recorded. If it is decided that the irradiation is justified, the radiologist must then ensure that exposure is limited to the minimum required to acquire the necessary information.

If a fetus has been or will be exposed to radiation, the small risk to the fetus from the exposure is unlikely to justify, even at the higher doses, the greater risks of invasive fetal diagnostic procedures (e.g. amniocentesis) or those of a termination of the pregnancy. When such exposure has occurred or will occure, a radiation physicist should make an individual risk assessment and the results should be discussed with the patient.

Optimizing 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 genetic mutations and malignant diseases occurring in the population can be attributed to natural background radiation. Diagnostic medical exposures, being the major source of man-made radiation exposure of the population, add about one-sixth to the population dose from background radiation.

The Canadian Nuclear Safety and Control Act and the Radiation Protection Act require all concerned to reduce unnecessary exposure of patients to radiation. Responsible organizations and individuals using ionizing radiation must comply with these regulations. One important way of reducing the radiation dose is to avoid undertaking investigations unnecessarily (especially repeat examinations).

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 upon its relative sensitivity to radiation-induced cancer or severe hereditary effects. It thus provides a single dose estimate related to the total radiation risk, no matter how the radiation dose is distributed around the body [See Table 1].

Continued

Table 1. Typical effective doses from diagnostic medical exposure in the 2000s [21]

Diagnostic procedure	Typical effective dose (mSv)	Equiv. no. of chest x-rays	Approx. equiv. period of natural background radiation[a]
Radiographic examinations:			
Limbs and joints (except hip)	less than 0.01	less than 0.5	less than 1.5 days
Chest (single PA film)	0.02	1	3 days
Skull	0.06	3	9 days
Thoracic spine	0.07	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/IVP	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	2.0	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	50	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

[a] Canadian average background radiation = 2.2 mSv per year; regional averages range from 2.0 to 4.0 mSv per year.

Typical effective doses for some common diagnostic radiology procedures range over a factor of about 1000 from the equivalent of a day or two of natural background radiation (e.g. 0.02 mSv for a chest radiograph) to 4.5 years (e.g. for CT of the abdomen). The doses for conventional x-ray examinations are based on results compiled by the NRPB from patient dose measurements made in a large sample of hospitals throughout the UK from 1990 to 2000 [21]. The doses for CT examinations and radionuclide studies are based on national surveys conducted by the NRPB and the British Nuclear Medicine Society (BNMS) and are unlikely to have changed significantly since then.

Low-dose examinations of the limbs and chest are among the most common radiological investigations, but relatively infrequent high-dose examinations such as body CT and barium studies make the major contribution to the collective population dose. The doses from some CT examinations are particularly high and show no sign of decreasing. The use of CT is still rising. CT now probably contributes almost half of the collective dose from all x-ray examinations. It is thus particularly important that requests for CT are thoroughly justified and that techniques are adopted which minimize dose while retaining essential diagnostic information. Indeed, some authorities estimate the additional lifetime risk of fatal cancer from an abdominal CT examination in an adult is around 1 in 2,000 (compared with the risk from a chest radiograph at 1 in a million) [22]. However, the overall risk of cancer in the general population is nearly 1 in 3, and in comparison to this the excess risk of a CT scan is very small and should be more than offset by the gain from a CT scan.

In these referral Guidelines the doses have been grouped into broad bands to help the referrer understand the order of magnitude of radiation dose of the various investigations.

Table 2. Band classification of the typical effective doses of ionizing radiation from common imaging procedures

Band	Typical effective dose (mSv)	Examples
0	0	US, MRI
I	less than 1	CXR, XR limb, XR pelvis
II[a]	1-5	IVU, XR lumbar spine, NM (e.g. skeletal scintigram), CT head and neck
III	5-10	CT chest or abdomen, NM (e.g. cardiac)
IV	more than 10	Extensive CT studies, some NM studies (e.g. some PET)

Communications with a department of Diagnostic Imaging

Referral for an imaging examination is generally regarded as a request for an opinion from a specialist in radiology or nuclear medicine. The outcome of this request for an opinion should be presented in the form of a report to assist in the management of a clinical problem.

Request forms should be completed accurately and legibly in order to avoid any misinterpretation. 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 radiological investigation.

In some cases the best investigation for resolving the problem may be an alternative imaging investigation.

If there is doubt as to whether an investigation is required or which investigation is best, an appropriate specialist in radiology or nuclear medicine must be consulted. Indeed, imaging departments are always pleased to discuss investigations with referring doctors. Regular clinicoradiological meetings provide a useful format for such discussion and are considered good practice [23].

While it should be noted that these recommendations have been widely endorsed, it is recognized that a few departments will adapt them according to local circumstances and policies.

Imaging techniques

Computed tomography (CT)

CT is now a widely available modality. Furthermore, there have been recent important advances due to the development of spiral and multi-slice CT, which allow the acquisition of large amounts of data from a single breath hold. Such advances have opened up new diagnostic opportunities, such as the use of multi-slice CT in the diagnosis of coronary artery disease. Nevertheless, different hospitals will have their own policies about accepting CT requests. It is worth remembering that CT imparts a relatively high x-irradiation dose. Thus it is always worth considering alternatives, especially in view of the increasing role of MRI.

Like all radiological requests, any CT referral which falls outside established guidelines should be discussed with a radiologist. Because of the need to minimize the extent of the examination (and thereby the cost and radiation dose), it is helpful if the clinical notes and previous imaging investigations are available for review by the imaging department at the time of the proposed CT.

A few further points:

- CT remains the optimal investigation for many clinical problems within the chest and abdomen, despite the radiation risks.
- CT is still widely used for intracranial problems, especially cerebrovascular accident and trauma.
- CT remains a simple method of staging many malignant diseases (e.g. lymphoma) and of monitoring the response to therapy.

- CT provides valuable pre-operative information about complex masses and is widely used to investigate postoperative complications.
- CT allows accurate guidance for drainage procedures, biopsies, and anesthetic nerve blocks.
- CT has an important role in the management of trauma.
- CT images may be degraded by prostheses, fixation devices, etc.
- CT provides better anatomical detail than US in obese patients. In thinner patients and children, US should be used whenever possible.
- CT of the abdomen imparts a radiation dose equivalent to about 500 chest x-rays.

Magnetic resonance imaging (MRI)

With the recent technical advances and increasing experience, the role of MRI continues to expand, and the limiting factor for further expansion is now often financial.

Since MRI does not use ionizing radiation, MRI should be preferred in cases where it would provide information of similar value to that provided by CT (and when both are available). However, MRI is in danger of being subjected to inappropriate demands, which may lead to long waiting times. Thus, all requests for MRI should be agreed upon by a radiologist.

A few further points:

- MRI usually provides more information than CT about intracranial, head and neck, spinal, and musculoskeletal disorders because of its high contrast sensitivity and multiplanar imaging capability. This helps physicians to establish the diagnosis and institute appropriate management with greater confidence. It is increasingly being used in oncology.
- Major recent advances include: breast and cardiac MRI; angiographic and interventional techniques; magnetic resonance cholangiopancreatography (MRCP) and other fluid-sensitive MRI techniques; functional MRI imaging of the brain. However, many of these techniques await full evaluation.
- MRI is not approved during the first trimester of pregnancy. However, it may well prove to be safer than some of the alternative options. All imaging of pregnant women should be discussed with the radiology department.
- There are some definite contraindications to the use of MRI: metallic foreign bodies (FBs) in the orbits, aneurysm clips, pacemakers, cochlear implants, etc. Furthermore, MRI will give reduced image quality close to prostheses. The full list of contraindications is provided in several textbooks and monographs. Any uncertainty about contraindications should be discussed with the imaging department well in advance of the proposed investigation.

Nuclear medicine (NM)

The specialist in NM will be able to advise on which particular NM investigation should be used. Accordingly, referring physicians should indicate the precise clinical problem requiring investigation, because this will determine which radionuclide (or alternative) investigation is used.

Despite some misconceptions, the radiation doses imparted by most NM techniques compare favorably with those of many other imaging investigations regarded as 'safe'. As shown in Table 1 the effective dose associated with most routine NM studies is considerably less than that for abdominal CT.

NM is a very sensitive modality for most serious disorders of bone. It is helpful for the early detection of infection, metastases and active benign and malignant tumors. There is particular value in the functional data that can be provided by NM techniques. At a basic level, NM can determine whether a distended renal pelvis shown by US is merely due to a capacious collecting system or is caused by an obstructing lesion. The same investigation can provide data on the percentage of overall renal function provided by each kidney. More complex studies can indicate the ejection fraction of the left ventricle or the distribution of blood flow to the cerebral cortex.

Positron emission tomography (PET) has recently made large strides, and its availability is gradually increasing. Because of the short-lived nature of the key radionuclides (the glucose analogue F-18-fluorodeoxyglucose, FDG, is widely used), PET can only be offered within a reasonable distance of a cyclotron and radionuclide pharmacy. PET can identify small foci of viable tumors, so it offers exceptional opportunities in the staging of various cancers (e.g. bronchus) and in cancer follow-up (e.g. lymphoma), where other imaging techniques may be unable to distinguish between residual fibrotic masses and active disease. PET can also provide unique data about brain metabolism and myocardial viability, and there are several research units studying these aspects. Over the next few years there will be an increasing uptake of PET into clinical practice, and its potential use is flagged for certain clinical problems in the ensuing recommendations.

Nuclear medicine therapy

Although it is not within the scope of these referral Guidelines, it is worth remembering that NM has an important role in the treatment of both benign and malignant disease. The thyroid gland is still the most important target, but the field is rapidly expanding: other indications include neuroendocrine tumours, painful skeletal metastases, some arthropathies, polycythemia, and malignant effusions. NM treatment options are being investigated in the leukemias/lymphomas and some liver tumours.

Ultrasound (US)

In the last 5 to 10 years, US equipment and expertise have advanced and the scope of referrals (colour Doppler, power Doppler, musculoskeletal, transvaginal gynecological work, etc.) has widened. These trends are to be welcomed because US does not employ ionizing radiation. However, there is scant evidence that the increase in US referrals has been accompanied by much reduction in referrals for other radiological investigations and a consequent reduction in total radiation dose to the public. The one notable

exception is the IVP / IVU, which is required much less often since the advent of US. However, because US is non-invasive, the total number of patients investigated with urological problems has increased. Departments of clinical radiology have developed different local policies for dealing with the increasing US workload.

The actual acquisition of US images has to be undertaken by an experienced operator, although such an operator may not be able to gain perfect images in every patient. For example, US can be difficult and unsatisfactory in obese patients. Furthermore, the distribution of bowel gas may mask some features. Nevertheless, its inherent advantages which include cost effectiveness, lack of ionizing radiation, accessibility, multiplanar capability in real time, Doppler interrogation to assess vascularity and its noninvasive nature make US an excellent initial investigation for a wide range of clinical referrals. Accordingly, US has been recommended as the investigation of choice whenever appropriate.

Since US avoids ionizing radiation and is relatively inexpensive, it is often recommended where more expensive studies (e.g. CT) cannot be justified or resources are limited. Conversely, it is difficult to refuse a request for US on grounds of invasiveness or expense. There is thus a danger of US departments being overloaded with requests that may be on the margins of appropriateness. Referring physicians therefore still have a duty to consider carefully whether each request for US is justified and whether the result (e.g. the presence of gallstones) will affect management (see Introduction: Why are guidelines needed?).

A few further points:

- US is excellent in separating solid from cystic masses.
- US allows assessment of vascularity without requiring contrast media.
- US is a dynamic imaging study and as such may expose pathologies not evident on a static examination.
- MSK US is an effective established technique for the imaging of soft tissue and joints. MRI is the competing modality in musculoskeletal imaging and may be more appropriate for the investigation of deeper soft tissue structures and in the assessment of internal derangement of large joints.

Abbreviations

Abbreviation	Definition
ACTH	Adrenocorticotrophic hormone
AP	Anteroposterior view
Ba	Barium
CEARMS	Cloacal exstrophy anorectal malformation spectrum
Cr	Chromium
CSF	Cerebrospinal fluid
CT	Computed tomography
CTA	Computed tomographic angiography
CTM	Computed tomographic myelography
CXR	Chest radiograph
DEXA	Dual energy x-ray absorptiometry
DMSA	Dimercaptosuccinic acid
DSA	Digital subtraction angiography
EDTA	Ethylenediaminetetraacetic acid
ERCP	Endoscopic retrograde cholangiopancreatography
ERNVG	Equilibrium radionuclide ventriculography
FB	Foreign body
FDG	F-18-fluorodeoxyglucose
FDG-PET	Positron emission tomography using F-18-fluorodeoxyglucose
FNAC	Fine-needle aspiration cytology
GA	General anesthesia
Ga	Gallium
GCS	Glasgow Coma Score
GFR	Glomerular filtration rate
GI	Gastrointestinal
HMPAO	Hexamethylpropyleneamine oxime
HIDA	Hydroxyiminodiacetic acid
HRCT	High resolution computed tomography
HRT	Hormone replacement therapy
ICU	Intensive care unit
IDA	Iminodiacetic acid
In	Indium
IUCD	Intrauterine contraceptive device
IV	Intravenous
IVC	Inferior vena cava
IVP	Intravenous pyelography
IVU	Intravenous urography

LFT	Liver function tests
LP	Lumbar puncture
LV	Left ventricle
MAG3	Mercaptylacetyltriglycerine
MCUG	Micturating cystourethrography
MIBG	Metaiodobenzylguanidine
MRA	Magnetic resonance angiography
MRCP	Magnetic resonance cholangiopancreatography
MRI	Magnetic resonance imaging
MUGA	Multiple-gated acquisition (radionuclide angiography)
NAI	Non-accidental injury
NM	Nuclear medicine
NRPB	National Radiological Protection Board
OIH	Ortho-iodohippurate
OPG	Orthopantomograph
PA	Posteroanterior view
PET	Positron emission tomography
PSA	Prostate-specific antigen
PTA	Percutaneous transluminal angioplasty
PUJ	Pelvi-ureteric junction
rCBF	Regional cerebral blood flow
RV	Right ventricle
SPECT	Single photon emission computed tomography
SVC	Superior vena cava
SXR	Skull radiograph
Te	Technetium
TEE	Transesophageal echocardiography
Tl	Thallium
TIPS	Transjugular intrahepatic portosystemic shunt
TNM staging	A system of clinicopathological evaluation of tumours based on the anatomical extent of tumour involvement at the primary site (T), lymph node involvement (N) and evidence of metastases (M)
TRUS	Transrectal ultrasonography
TVUS	Transvaginal ultrasonography
US	Ultrasonography/Ultrasound
V:Q	Ventilation-perfusion scintigraphy
WBC	White blood cells
XR	Radiograph

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A. Head (including ENT problems)

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
A01. Congenital disorders ***(For children see section L)***	MRI	Indicated [B]	Definitive exam for all malformations. CT may be needed to define bone and skull base anomalies. Sedation or GA may be required for infants and young children. ***(For congenital disorders in children see L01 and L02)***	0
A02. Acute stroke	CT	Indicated [diagnosis B, treatment A]	A policy of CT for most strokes as soon as reasonably possible is to be encouraged, but at least within 48 hours, as this will ensure accurate diagnosis of the cause, site, and appropriate primary treatment and secondary prevention.	II
	MRI	Specialized investigation [B]	MRI should be considered in young patients with stroke, in patients presenting late where it is essential to know whether they have previously had a hemorrhage, and in suspected posterior fossa stroke in patients in whom it is important to demonstrate the site of the stroke lesion.	0
	US carotids	Indicated only in specific circumstances [B]	Should only be performed in: (1) those in whom carotid endartectomy is contemplated for secondary prevention; (2) suspected dissection; or (3) young patients, whether disabling or non-disabling ischemic stroke.	0
A03. Transient ischemic attack (TIA) ***(See also B05)***	CT	Indicated [B]	May be normal. Can detect established infarction and hemorrhage and exclude disease processes that can mimic stroke syndromes, such as glioma, extracerebral hemorrhage, and cerebritis.	II
	US carotids	Indicated [B]	To assess suitability for carotid endarterectomy or angioplasty. Angiography, MRA, and CTA are alternatives to show the vessels. MRI and NM can be used to show function.	0
A04. Demyelinating and other white matter disease	MRI	Indicated [A]	MRI is viewed as the most sensitive and specific investigation for establishing a diagnosis of multiple sclerosis. The diagnosis is made by demonstrating dissemination of clinical events and lesions in space and time.	0
A05. Space occupying lesion (SOL)	CT	Indicated [B]	CT is often sufficient in supratentorial lesions.	II
	MRI	Indicated [B]	MRI is more sensitive for early tumours, in resolving exact position (useful for surgery), and for posterior fossa lesions. MRI may miss calcification.	0

A. Head (including ENT problems)

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
A06. Headache: acute, severe, subarachnoid hemorrhage (SAH)	CT	Indicated [B]	The clinical history is critical. A clinician should be able to diagnose patients who have classical migraine or cluster headaches without CT. SAH headache comes on typically in seconds, rarely in minutes, and almost never over more than 5 minutes. CT will provide evidence of hemorrhage in up to 98% of patients with SAH if performed on a modern scanner within the first 48 hours of ictus. An LP should still be performed on all patients (delayed 12 hours after ictus for xantho-chromia) with suspected SAH but with negative CT. CT is indicated in patients with acute-onset headache with focal neurological signs, nausea or vomiting, or GCS (Glasgow Coma Score) below 14. An LP is the diagnostic test of choice for meningitis unless there are focal signs or a significantly depressed level of consciousness.	II
	MRI / NM	Specialized investigation [C]	MRI is better than CT for inflammatory causes. SPECT may be the most sensitive investigation for encephalitis and can provide evidence of circulatory derangement in migraine.	0 / II
A07. Headache: chronic ***(See also A13)***	CT / MRI	Indicated only in specific circumstances [C]	In the absence of focal features imaging is not usually useful. The following features significantly increase the odds of finding a major abnormality on CT or MRI: • Recent onset and rapidly increasing frequency and severity of headache • Headache causing to wake from sleep • Associated dizziness, lack of coordination, tingling or numbness ***(For headache in children see L08)***	II / 0
(For children see section L)	SXR, XR sinus, XR cervical spine	Indicated only in specific circumstances [B]	XR is of little use in the absence of focal signs / symptoms.	I / I / I
A08. Pituitary and juxtasellar problems	MRI	Specialized investigation [B]	Urgent referral when vision is deteriorating.	0
	SXR	Not indicated [C]	Patients who require investigation need MRI or CT.	I
A09. Posterior fossa signs	MRI	Indicated [A]	MRI is the investigation of choice. Multislice CT is an acceptable alternative.	0

A. Head (including ENT problems)

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
A10. Hydrocephalus, shunt function	CT	Indicated [B]	CT is adequate for most cases; MRI is sometimes necessary and may be more appropriate in children. US is first choice for infants. ***(For hydrocephalus in children see L06)***	II
	XR	Indicated [C]	If there is evidence of hydrocephalus on CT, XR can demonstrate the whole shunt system.	I
(For children see section L)	NM	Indicated [C]	A radionuclide shunt study can evaluate shunt function.	II
A11. Middle or inner ear symptoms (including vertigo)	CT	Specialized investigation [B]	Evaluation of these symptoms requires ENT, neurological, or neurosurgical expertise.	II
A12. Sensorineural hearing loss ***(For children see section L)***	MRI	Specialized investigation [B]	MRI is much better than CT, especially for acoustic neuromas. ***(For hearing loss in children see L05)***	0
A13. Sinus disease	XR sinus	Indicated only in specific circumstances [B]	Acute sinusitis can be diagnosed and treated clinically. If it persists past 10 days on appropriate treatment, XR sinus may be required. Signs on XR sinus are often non-specific and encountered in asymptomatic individuals. ***(For sinus disease in children see L09)***	I
(For children see section L)	CT sinus	Specialized investigation [B]	CT is useful to demonstrate the presence and distribution of disease and sinonasal anatomy. Low-dose technique is desirable. CT is indicated for failure of maximal medical treatment, development of complications (such as orbital cellulitis), or if malignancy is suspected.	II
A14. Dementia and memory disorders, first-onset psychosis	CT	Indicated only in specific circumstances [A]	Yield is low, even in younger patients; neurological signs and rapid progression increase it. Over the age of 65, CT can be reserved for patients with an onset within the last year or an atypical presentation, rapid unexplained deterioration, unexplained focal neurological signs or symptoms, a recent head injury (preceding the onset of dementia), or urinary incontinence and/or gait ataxia early in illness.	II
	NM	Specialized investigation [B]	Brain perfusion SPECT may be useful in the diagnosis of Alzheimer's Disease.	II
	MRI	Not indicated [B]	More sophisticated examinations have no proven clinical value, although they may be used in research.	0
	SXR	Not indicated [A]	SXR should only ever be used to show clinically relevant abnormalities of the skull bones.	I

A. Head (including ENT problems)

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
A15. Orbital lesions	CT	Specialized investigation [A]	CT remains the investigation of choice. MRI may be of value if CT is unhelpful or gives insufficient detail. Consider US for intraocular lesions.	II
	XR	Not indicated [A]	Suspected orbital lesions require specialist referral.	I
A16. Orbital lesions: trauma	CT	Specialized investigation [A]	CT is indicated when orbital trauma may be combined with major facial fracture. If a less severe blowout fracture is suspected, CT is carried out only if the patient is a candidate for surgery.	II
A17. Orbital lesions: suspected foreign body	CT	Specialized investigation [A]	Indicated when XR fails to show a strongly suspected foreign body which may not be metallic, when multiple foreign bodies are present, or when it is not certain whether a foreign body already demonstrated is intraocular.	II
	XR orbits	Indicated [A]	A single 'soft tissue' lateral XR is the only projection required to exclude a metallic foreign body; eye-moving images are only for confirmation of the intraocular position of a foreign body once demonstrated. Prior to an MRI study a posteroanterior XR is adequate to exclude a significant metallic foreign body. If a foreign body is confirmed CT may be required by some specialists.	I
	US	Indicated [B]	US may be indicated for radiolucent foreign bodies or where XR is difficult.	0
A18. Acute visual loss: visual disturbances	SXR	Not indicated [A]	Specialists can diagnose many cases without resorting to imaging.	I
	MRI / CT	Specialized investigation [A]	MRI is preferable for suspected lesions of the optic chiasm. CT is preferable for orbital lesions.	0 / II
	Cerebral angiography	Specialized investigation [A]	Specialist referral is indicated.	III
A19. Epilepsy (adult)	MRI	Specialized investigation [B]	Structural imaging is the technique of choice. Higher soft-tissue resolution and multiplanar capability give greater sensitivity and specificity for the identification of small cortical lesions. Particularly valuable in the evaluation of partial epilepsy, e.g. temporal lobe epilepsy. ***(For epilepsy in children see L04)***	0
	CT	Specialized investigation [B]	Following trauma. CT may complement MRI in the characterization of lesions, e.g. calcification.	II
(For children see section L)	NM	Specialized investigation [B]	Ictal SPECT or interictal PET is useful in the planning of epilepsy surgery when MRI is negative or its results conflict with EEG or neurophysiological evidence. Regional cerebral blood flow (rCBF) agents are also of value.	II

B. Neck – Soft tissues (for spine see sections C & J)

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
B01. Thyroid nodules	US	Indicated only in specific circumstances [B]	US is excellent for differentiating between thyroid and extrathyroid masses, for guiding aspiration or biopsy (particularly in difficult-to-palpate or small thyroid nodules), and for the detection of associated lymphadenopathy in thyroid malignancy. In generalized thyroid enlargement or multinodular goitre US readily shows retrosternal extension; real-time studies show effect of neck extension, etc. CT / MRI is needed to demonstrate full retrosternal extent and tracheal compromise. NM has no role in the initial evaluation of thyroid nodules.	0
	US-guided FNAC / FNAC	Indicated [B]	Thyroid nodules are extremely common; the majority are benign. Conventional fine-needle aspiration (FNAC) (without imaging) is the most cost-effective initial investigation.	0 / 0
	NM	Indicated only in specific circumstances [B]	Thyroid scanning may be used to assess nodules following biopsy which has demonstrated a follicular neoplasm with no definite features of malignancy, or in the case of a benign nodule when the serum TSH is suppressed.	II
B02. Thyrotoxicosis	NM	Indicated [B]	NM can differentiate between Graves' disease, toxic nodular goitre, and subacute thyroiditis. Provides functional information about nodules. Also useful in thyroiditis.	II
B03. Ectopic thyroid tissue (e.g. lingual thyroid)	NM	Indicated [C]	NM excellent for small ectopic rests of thyroid tissue.	II
B04. Hyperparathyroidism	US / NM / CT / MRI	Specialized investigation [C]	Seek advice. Diagnosis made on clinical / biochemical grounds. Imaging can assist in pre-operative localization but may not be needed by experienced surgeons. Much depends on local policy and available technology and expertise. US, NM, CT, and MRI are all accurate in the un-operated neck. MRI is probably evolving as the best investigation for ectopic and residual tumours. Super-selective venography for sampling after previous imaging may be useful.	0 / II / II / 0
B05. Asymptomatic carotid bruit	US carotids	Indicated only in specific circumstances [B]	US not usually valuable as evidence suggests that surgery is not recommended for asymptomatic carotid stenosis.	0

B. Neck – Soft tissues (for spine see sections C & J)

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
B06. Swallowed or inhaled foreign body ***(See also J27-J29)*** ***(For children see section L)***	Lateral XR soft tissues of neck	Indicated only in specific circumstances [B]	The majority of foreign bodies are not seen on XR. The clinical history and findings are more accurate indicators of the presence of a foreign body. Direct examination of the oropharynx, laryngoscopy, and endoscopy are the investigations of choice. ***(For swallowed or inhaled foreign body in children see L26 and L31)***	I
B07. Neck mass of unknown origin	US	Indicated [C]	First-line investigation for characterization of neck mass. May be combined with FNAC.	0
	CT / MRI	Indicated only in specific circumstances [C]	CT / MRI may be indicated if the full extent of the lesion is not determined by US, for identifying other lesions, and for staging.	II / 0
B08. Salivary obstruction	US / Sialogram	Indicated [C]	For intermittent, food-related swelling. MR sialography may be preferred in some centres.	0 / II
	XR	Indicated only in specific circumstances [C]	Where there is calculus in the floor of the mouth, XR may be all that is required.	I
B09. Salivary mass	US	Indicated [B]	US is the initial investigation of choice for a suspected salivary mass; it can be combined with FNAC, if necessary. It is extremely sensitive and has high specificity.	0
	MRI / CT	Specialized investigation [B]	Whenever deep lobe involvement or extension into deep spaces is suspected, MRI or CT should be carried out.	0 / II
B10. Dry mouth: connective tissue disease	US / Sialogram / NM	Specialized investigation [C]	Not commonly required. Sialogram may be diagnostic, but NM provides better functional assessment. MR sialography is also used here.	0 / II / II
B11. Temporomandibular joint dysfunction	MRI	Specialized investigation [B]	XRs do not often add information as the majority of temporomandibular joint problems are due to soft tissue dysfunction (usually subluxation of the intra-articular disk) rather than bony changes, which appear late and are often absent in the acute phase.	0

C. Spine (for trauma see section J)

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
General				
C01. Congenital disorders	MRI	Indicated [B]	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. ***(For congenital disorders in children see L01, L02)***	0
(For children see section L)	XR	Specialized investigation [C]	E.g. full-length standing XR for scoliosis. ***(For congenital disorders in children see L01, L02)***	I
C02. Myelopathy: tumours, inflammation, infection, infarction, etc.	MRI	Indicated [B]	MRI is the initial investigation of choice for all spinal cord lesions, to evaluate cord compression and to give an indication of post-operative prognosis.	0
	CT / CTM	Specialized Investigation [B]	CT may be needed if better bony detail is required. CT myelography (CTM) only if MRI is contraindicated.	II / II
	NM	Specialized investigation [B]	NM is still widely used to screen for metastases and to identify focal skeletal lesions (such as osteoid osteoma).	II
Cervical spine				
C03. Possible atlanto-axial subluxation	XR	Indicated [B]	Lateral cervical spine XRs in flexion and extension with the patient in supervised comfortable flexion should reveal any significant subluxation in patients with rheumatoid arthritis, Down's syndrome, etc.	I
	MRI	Specialized investigation [B]	MRI in flexion / extension shows effect on cord when XR is positive or neurological signs are present.	0
C04. Neck pain, brachialgia, degenerative change	XR	Indicated only in specific circumstances [B]	Neck pain generally improves or resolves with conservative treatment. Degenerative changes begin in early middle age and are often unrelated to symptoms.	I
	MRI	Specialized investigation [B]	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.	0

C. Spine (for trauma see section J)

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
Thoracic spine				
C05. Pain without trauma: degenerative disease	XR	Indicated only in specific circumstances [C]	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. NM can be considered to document the extent and activity of arthitic change and to screen for the presence of metastatic disease.	I
	MRI	Specialized investigation [C]	MRI may be indicated if local pain persists or is difficult to manage, or if there are long tract signs.	0
Lumbar spine				
C06. Chronic back pain with no pointers to infection or neoplasm	XR	Indicated only in specific circumstances [C]	Degenerative changes are common and non-specific. Main value of XR is in younger patients (e.g. < 20 years) with spondylolisthesis, ankylosing spondylitis, etc., or in older patients (e.g. > 55 years). In cases where management is difficult, negative findings may be helpful. NM can be considered to document the extent and activity of arthitic change and to screen for the presence of metastatic disease.	II
	MRI	Specialized investigation [C]	If symptoms persist or are severe or where management is difficult or there is no response to conservative methods, MRI is considered the first-choice investigation. Imaging findings need to be interpreted with caution because many imaging 'abnormalities' occur with high frequency in asymptomatic individuals and therefore have an uncertain relationship with back pain. The significance of imaging findings depends upon correlation with clinical signs. Negative findings may be helpful. CT may be considered if MRI is unavailable or contraindicated.	0
	CT	Specialized investigation [C]	If symptoms persist and are unresponsive to conservative methods.	III

C. Spine (for trauma see section J)

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
C07. Back pain with possible serious features such as: • Onset at < 20 or > 55 years • Sphincter or gait disturbance • Saddle anesthesia • Severe or progressive motor loss • Widespread neurological deficit • Previous carcinoma • Systemic unwellness • HIV • Weight loss • Intravenous drug abuse • Steroids • Structural deformity • Non-mechanical pain ***(For children see section L)***	MRI	Indicated [B]	Together with urgent specialist referral, MRI is usually the best investigation. CT or CTM may be considered when MRI is unavailable or contraindicated. Imaging should not delay specialist referral. ***(For back pain in children see L11)***	0
	NM	Indicated [B]	NM is also widely used for possible bone destruction due to metastases, where infection is suspected, or in some cases of chronic pain. *'Normal' plain XR may be falsely reassuring.* If vertebral collapse is seen on plain film and the date of fracture is unclear from history, NM can be helpful in determining if the injury is old or recent.	II
C08. Acute back pain: disk herniation; sciatica with no adverse features and no history of acute trauma ***(For children see section L)***	XR	Indicated only in specific circumstances [C]	Acute back pain is usually due to conditions that cannot be diagnosed on XR (osteoporotic collapse is an exception). 'Normal' plain XR may be falsely reassuring. ***(For acute back pain in children see L11)***	II
	MRI / CT	Specialized investigation [B]	Demonstration of disk herniation requires MRI or CT and should be considered after failed conservative management. MRI is generally preferred (wider field of view visualizing the conus, post-operative changes, etc.). Clinico-radiological correlation is important as a significant number of disk herniations are asymptomatic. ***(For acute back pain in children see L11)***	0 / III

D. Musculoskeletal system

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
D01. Osteomyelitis	XR	Indicated [C]	Initial investigation.	I
	NM	Specialized investigation [C]	The two- or three-phase skeletal scintigram is more sensitive than XR in detecting suspected focal osteomyelitis. If osteomyelitis is suspected but there are no localizing signs or symptoms, a skeletal scintigram is useful. Findings on a skeletal scintigram are not specific and further specialist NM imaging with alternative agents may be required. White cells: the use of Tc-99m-HMPAO or In-111- labelled white cells may be useful in confirming infection in bone or joint. False negative results may be encountered in the spine. Gallium-67 Citrate imaging can be helpful in evaluating suspected spinal infection and chronic infections.	II-III
	MRI	Specialized investigation [C]	MRI accurately demonstrates infection, especially in the spine.	0
	CT	Specialized investigation [C]	CT is valuable for demonstration of sequestra.	II
	US	Specialized investigation [C]	US may be valuable in acute osteomyelitis to demonstrate subperiosteal abscess, but there is a high false negative rate.	0
D02. Primary bone tumour	XR	Indicated [B]	XR should be carried out where there is bone pain that is not resolving.	I
	MRI	Specialized investigation [B]	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.	0
	NM	Indicated [B]	If the XR appearances are suggestive of primary bone tumour, the acquisition of skeletal scintigraphy should not delay referral to a specialist centre. NM is primarily used for evaluating the skeleton for additional sites of involvment; the bone scan may overestimate the local tumour extent. The role of FDG-PET remains to be clarified.	II
	CT	Specialized investigation [B]	CT may improve diagnostic information in some tumours, such as osteoid osteoma, and demonstrate intratumoral calcification and ossification. CT-guided biopsy of primary bone tumours should be carried out in specialized bone tumour centres where histological expertise and knowledge of surgical approach is available.	II
(See also K44, K45)				
Continued				

D. Musculoskeletal system

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
D02. Primary bone tumour ***Continued from page 22***	US	Specialized investigation [B]	US-guided biopsy of certain superficial primary bone tumours should be carried out in specialized bone tumour centres where histological expertise and knowledge of surgical approach is available.	0
D03. Known primary tumour, skeletal metastases	NM	Indicated [B]	A sensitive test, but correlative imaging may be required to increase specificity. NM is useful for assessing the presence and extent of skeletal metastases in patients with known primary cancers both at initial presentation and in follow-up. The skeletal scintigram is insensitive in assessing the extent of myeloma. NM may also be used to assess response to treatment, although the flare phenomena may suggest progression if bone scans are performed too soon after the initiation of systemic therapy (< 3 months). Bone scans are helpful in determining when radionuclide therapy for palliation may be helpful.	II
	MRI	Indicated [B]	More sensitive and specific than NM, MRI is the primary investigation of choice, particularly in the axial skeleton. May underestimate some peripheral lesions.	0
	XR skeletal survey	Not indicated [B]	XRs are indicated only for specific focal symptomatic areas or for correlation with a NM examination.	II
D04. Soft tissue mass tumour	MRI	Indicated [B]	Provides best local staging and can provide a tissue diagnosis in a proportion of patients.	0
	US	Indicated [C]	US can answer specific questions (e.g. cystic / solid) and can monitor progress of benign masses such as hematomas.	0
D05. Bone pain	XR	Indicated [C]	Local view of the symptomatic area.	I
	NM	Indicated [C]	If pain persists with normal XR or equivocal and abnormal XR in specific circumstances (e.g. suspected osteoid osteoma, osteomyelitis, or metastases). Bone scans are commonly positive in patients with persistent bone pain and may be helpful in directing more specific studies.	II
	MRI	Specialized investigation [C]	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.	0
	CT	Specialized investigation [C]	To define bony anatomy in areas of abnormality on XR / MRI / NM, especially if bone biopsy is indicated.	II

D. Musculoskeletal system

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
D06. Myeloma	XR skeletal survey	Indicated [C]	For staging and identifying lesions which may benefit from radiotherapy. Survey can be limited to specific areas for follow-up.	I-II
	MRI	Specialized investigation [B]	Sensitive, limited to spine, pelvis, and proximal femora. Particularly useful in non-secretory myeloma or in the presence of diffuse osteopenia. Can be used for tumour mass assessment and follow-up.	0
	NM	Not indicated [B]	Skeletal scintigraphy is often negative and underestimates disease extent; consider bone marrow studies.	II
D07. Metabolic bone disease	NM	Indicated [C]	Skeletal scintigraphy may be useful in differentiating causes of hypercalcemia, e.g. metastases and hyperparathyroidism, and of raised alkaline phosphatase, e.g. Paget's disease and metastases.	II
	XR	Indicated [C]	May be helpful in differentiating new from old vertebral fractures or identifying a different cause of pain unrelated to osteoporosis. Correlation with NM will be required.	II
	DEXA	Indicated [A]	Measurement of bone density. DEXA is the standard for measurement of bone density. Quantitative CT can also provide an objective measurement of bone mineral content.	I-II
D08. Osteomalacia	XR	Indicated [B]	Localized XR to establish cause of local pain or equivocal lesion identified on NM.	I
	NM	Specialized investigation [C]	Can show increased activity and some local complications, such as pseudo-fractures.	II
(See also D09)				
D09. Pain: osteoporotic collapse	Lateral XR thoracic and lumbar spine	Indicated [B]	Lateral views will demonstrate compression fractures. NM or MRI more useful in distinguishing between recent and old fractures and can help exclude pathological fractures.	I-II
(See also D08)				
D10. Arthropathy: presentation	XR affected joint	Indicated [C]	May be helpful to determine cause, although erosions are a relatively late feature.	I
	XR hands / feet	Indicated [C]	In patients with suspected rheumatoid arthritis, XR feet may show erosions even when symptomatic hand(s) appear normal.	I
	XR multiple joints	Indicated only in specific circumstances [C]	Symptomatic joints only.	II
	US / NM / MRI	Specialized investigation [C]	All can show acute synovitis. NM can show distribution. MRI can show articular cartilage, early erosions and bone marrow edema. US can show erosions in superficial joints.	0 / II / 0

D. Musculoskeletal system

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
D11. Arthropathy: follow-up	XR	Indicated only in specific circumstances [C]	May be needed by specialist to assist management decisions.	I
D12. Painful shoulder	XR	Not indicated initially [C]	Degenerative changes in the acromioclavicular joints and rotator cuff are common. XR used only if unresponsive to conservative treatment.	I
D13. Shoulder impingement syndrome	XR	Indicated only in specific circumstances [B]	Pre-operative investigation.	I
	US	Specialized investigation [B]	Provides a dynamic assessment.	0
	MRI	Specialized investigation [B]	MRI has value in the demonstration both of bursal inflammatory change and the etiology of associated abnormalities. Dynamic MRI or MRI in the abducted position may be of diagnostic value in subacromial impingement syndrome.	0
D14. Shoulder instability	CT / MRI	Specialized investigation [B]	Glenoid labrum and synovial cavity are well delineated by both techniques. Some gradient echo MRI techniques can show labrum well without arthrography but MRI arthrography is the most sensitive.	II / 0
D15. Rotator cuff tear	US / MRI / Arthrography	Specialized investigation [C]	MRI has the advantage of providing a global assessment of structures around the shoulder and when combined with arthrography has the highest accuracy. US is excellent in demonstrating static and dynamic anatomy and pathology.	0 / 0 / I
D16. Sacroiliac joint lesion	XR sacroiliac joints	Indicated [B]	May help in investigation of sero-negative arthropathy. Sacroiliac joints are usually adequately demonstrated on AP XR lumbar spine or pelvis.	I
	MRI / CT / NM	Specialized investigation [C]	MRI or CT or perhaps NM when XR is equivocal; MRI can detect changes, acute and chronic, earlier than XR. MRI is particularly useful in children, adolescents and female patients.	0 / II / II
D17. Hip pain: full or limited movement ***(For children see section L)***	XR pelvis	Indicated only in specific circumstances [C]	XR and MRI only if symptoms and signs persist or there is a complex history.	I
Continued				

D. Musculoskeletal system

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
D17. Hip pain: full or limited movement ***Continued from page 25***	MRI	Indicated only in specific circumstances [C]	MRI is useful to demonstrate inflammation and MR arthrography for evaluation of acetabular labral tears or loose bodies. Intra-articular local anesthetic injections have still to be evaluated properly.	0
    (For children see section L)	NM	Not indicated initially [B]	May be helpful if XR is normal. ***This recommendation does not apply to children.*** ***(For hip pain in children see L18, L21)***	II
D18. Hip pain: avascular necrosis	XR pelvis	Indicated [B]	Abnormal in established disease.	I
	MRI	Indicated [B]	MRI is the most sensitive in the detection of early avascular necrosis and will demonstrate its extent.	0
	NM / CT	Specialized investigation [B]	The use of pinhole collimator or SPECT is important.	II / II
D19. Knee pain without locking or restriction of movement	XR	Indicated only in specific circumstances [C]	Symptoms frequently arise from soft tissues and these will not be demonstrated on XR. Osteoarthritis changes are common. XR is needed when considering surgery.	I
D20. Knee pain with locking	XR	Indicated [C]	To identify radio-opaque loose bodies.	I
D21. Knee pain	MRI	Specialized investigation [B]	MRI is only appropriate where there is a specific clinical management decision, e.g. arthroscopy being considered. MRI may also be required in defining the extent of rheumatological disorders, e.g. rheumatoid arthritis. Even in patients with definite clinical abnormalities warranting intervention, some surgeons find pre-operative MRI helpful in identifying unsuspected lesions.	0
D22. Painful prosthesis	XR	Indicated [B]	XR is useful to detect established loosening.	I
        Continued	NM	Indicated [B]	Two- to three-phase skeletal scintigraphy is useful for diagnosing and differentiating infection and loosening. A normal NM study excludes most late complications. Further specialized NM studies can help distinguish loosening from infection. It may be difficult to differentiate post-surgical changes from pathology in the early stages. If infection is suspected, more specific imaging may be required. Combined leukocyte and marrow imaging is currently the technique of choice for peri-prosthetic infection.	II-III

D. Musculoskeletal system

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
D22. Painful prosthesis ***Continued from page 26***	Arthrography (aspiration / biopsy)	Specialized investigation [B]	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.	II
	US	Specialized investigation [C]	Accurate for detection of peri-prosthetic abscess or superficial infection.	0
D23. Hallux valgus	XR	Indicated only in specific circumstances [C]	Useful for assessment before surgery.	I
D24. Heel pain: plantar fasciitis or calcaneal spur	NM / US / MRI	Indicated only in specific circumstances [B]	Calcaneal spurs are common incidental findings. The cause of pain is rarely detectable on XR. Other imaging, NM, US, and MRI, are more sensitive in showing inflammatory change and should be used selectively. The majority of patients should be managed on the basis of clinical findings without imaging.	II / 0 / 0

E. Cardiovascular system

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
E01. Acute central chest pain: myocardial infarction	CXR	Indicated [B]	CXR must not delay admission to a specialized unit. CXR can assess heart size, pulmonary edema, tumour, etc., and can exclude other causes. Portable radiograph preferable.	I
E02. Chronic ischemic heart disease and assessment after myocardial infarction	CXR	Indicated only in specific circumstances [B]	May be helpful only if signs or symptoms have changed, when comparison with the CXR obtained at presentation.	I
	US echo-cardiography	Indicated [A]	Allows assessment of residual LV contraction, valves, and complications such as myocardial rupture. Can easily be used sequentially, particularly if hemodynamic clinical deterioration is noted.	0
	NM (myocardial perfusion imaging)	Indicated [B]	Appropriate method of determining prognosis / diagnosis, ischemic burden, and specific ischemic zone. Either pharmaceutical or exercise stress can be used in conjunction with isotopes. Tl-201 imparts a higher radiation burden but may be a better prognostic / viability agent. Tc-99m has a higher energy and allows concomitant assessment of LV contraction to be made via gated imaging. Particular uses are: • Prognostic assessment • Diagnosis in atypical or asymptomatic individuals • Assessing patients for revascularisation strategies • Risk stratification prior to non-cardiac surgery	II
	NM (radionuclide angiography: MUGA or ERNVG)	Specialized investigation [B]	Can assess both LV and RV function after myocardial infarction. Echocardiography is the preferred technique for assessment of LV contraction, etc.	III
	Angiography	Indicated [B]	Only technique currently available for detailed assessment of coronary artery anatomy. Essential prerequisite for interventional strategies and sometimes to establish diagnosis.	III
	MRI	Specialized investigation [B]	The role of MRI perfusion is still to be evaluated.	0
E03. Chest pain: aortic dissection	CXR	Indicated [B]	Mainly to exclude other causes; rarely diagnostic.	I
	US trans-esophageal echo-cardiography (TEE)	Indicated [B]	TEE is a useful and accurate bedside technique, but not as good as CT for aortic arch.	0
	CT	Indicated [B]	CT with IV contrast is the most reliable and practical technique.	III
Continued				

E. Cardiovascular system

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
E03. Chest pain: aortic dissection ***Continued from page 28***	MRI	Specialized investigation [B]	MRI is accurate and assesses any change in longitudinal extent, but practical difficulties can limit imaging potential. Useful for sequential follow-up.	0
E04. Pulmonary embolism	CXR	Indicated [B]	CXR should be the preliminary investigation to demonstrate consolidation and pleural effusion, but a normal CXR does not exclude a pulmonary embolus.	I
	NM (ventilation / perfusion scintigraphy)	Indicated [B]	Ventilation / perfusion (V:Q) scintigraphy can be diagnostic if used selectively in patients without COPD or consolidation on CXR, or less often if used non-selectively. A normal perfusion scintigram excludes clinically significant pulmonary emboli.	II
(See also E13)	Spiral CT	Indicated [B]	Spiral CT is the investigation of choice, is as accurate as pulmonary angiography in the detection of pulmonary emboli, and reliably excludes clinically important pulmonary embolism. It is the investigation of choice for patients with COPD or an abnormal CXR, and may be used following a non-diagnostic V:Q scintigram.	III
E05. Pericarditis, pericardial effusion	US echo-cardiography	Indicated [B]	Useful for assessment of concomitant pathology (e.g. effusion). Can make assessment of size of pericardial effusion, suitability for drainage, development of tamponade, etc. Best for sequential follow-up.	0
	CXR (including left lateral)	Indicated [B]	May reveal concomitant pathology (e.g. tumour) or calcification in pericardium.	I
E06. Suspected valvular cardiac disease	CXR	Indicated [B]	Used for initial assessment and when there is a change in the clinical picture.	I
	US echo-cardiography	Indicated [B]	Best method of sequential follow-up. TEE may be needed for prosthetic valves.	0
	MRI	Indicated [B]	Can be useful but is generally impracticable. Contraindicated for many prosthetic valves. Useful in the context of congenital heart disease.	0
E07. Clinical deterioration following myocardial infarction	CXR	Indicated [B]		I
	US echo-cardiography	Indicated [B]	US may show remediable complications (ventriculoseptal defect, papillary rupture, aneurysm, etc.).	0
E08. Hypertension	CXR	Indicated [B]	Assesses cardiac size and possible associated pathology such as coarctation or rib erosion from collaterals.	I
(See also H03) ***Continued***	US echo-cardiography	Indicated [B]	Most practical method of assessing LV hypertrophy.	0

E. Cardiovascular system

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
E08. Hypertension ***(See also H03)*** ***Continued from page 29***	MRI	Specialized investigation [B]	Most accurate method of assessing LV hypertrophy.	0
E09. Suspected cardiomyopathy, myocarditis	CXR	Indicated [B]	Globular cardiac silhouette suggestive of dilated cardiomyopathy.	I
	US echo-cardiography	Indicated [A]	Allows clear assessment of dilated, hypertrophic, and constrictive / restrictive cardiomyopathy and associated cardiac abnormalities. Not so useful for arrhythmogenic RV dysplasia. TEE can distinguish constrictive from restrictive cardiomyopathy.	0
	NM (radionuclide angiography)	Specialized investigation [B]	Rest radionuclide angiography is indicated in the determination of initial and serial LV and RV performance in patients with myocarditis or dilated, hypertrophic and restrictive cardiomyopathy and in patients receiving chemotherapy with doxorubicin.	III
	NM (myocardial perfusion)	Specialized investigation [B]	Myocardial perfusion imaging may help to differentiate ischemic and dilated cardiomyopathy and to assess myocardial ischemia in hypertrophic cardiomyopathy.	III
E10. Congenital heart disease	US echo-cardiography / US trans-esophageal echo-cardiography (TEE)	Indicated [B]	Provides diagnostic and functional data. Facilitates follow-up. Specialist area. TEE can provide additional useful information to transthoracic echocardiography.	0 / 0
	MRI	Indicated [B]	Best assessment / follow-up tool. Contraindicated for many prosthetic valves.	0
	NM	Specialized investigation [B]	Radionuclide angiography may be used to provide non-invasive quantitation of right-to-left and left-to-right shunts.	II
E11. Unstable angina	NM	Specialized investigation [B]	Tc-99m or Tl-201 scintigraphy in diagnosis, prognosis, and assessment of therapy in patients with unstable angina is indicated in the: • Identification of ischemia in the distribution of the culprit lesion or in remote areas • Measurement of baseline LV function • Identification of the extent and the severity of disease in patients with ongoing ischemia or myocardial hibernation	III
	Coronary angiography	Specialized investigation [B]	Only tool currently available for assessment of coronary artery anatomy. Essential prerequisite for interventional strategies and sometimes to establish diagnosis.	III

E. Cardiovascular system

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
E12. Abdominal aortic aneurysm	US	Indicated [A]	Useful in diagnosis, determination of maximal diameter, and follow-up. CT preferable for suspected leak but should not delay urgent surgery.	0
	CT / MRI	Indicated [A]	CT (especially spiral) and MRI for relationship to renal and iliac vessels. There is increasing demand for detailed anatomical information because of increasing consideration of percutaneous stenting.	III / 0
E13. Deep vein thrombosis	US	Indicated [A]	More sensitive with colour flow Doppler. Most clinically significant thrombi are detected. There is increasing experience with US for calf vein thrombi. May show other lesions.	0
	Venography	Indicated only in specific circumstances [B]	Extensive variation according to US expertise and local therapeutic strategy. Radionuclide venography may be used to provide additional diagnostic information in some centres.	II
E14. Peripheral Vascular Disease	Angiography	Specialized investigation [A]	Local policy needs to be determined in agreement with vascular surgeons, especially with regard to therapeutic interventions. US used in some centres as first investigation.	III
	CTA / MRA	Specialized investigation [C]	CTA and MRA are increasingly used for diagnosis.	III / 0

F. Thoracic system

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
F01. Non-specific chest pain	CXR	Not indicated initially [C]	Conditions such as Tietze's disease show no abnormality on CXR. Main purpose is reassurance.	I
F02. Minor chest trauma ***(See also J30)***	CXR	Indicated only in specific circumstances [C]	Showing a rib fracture does not alter management. Bone scanning may be useful to document rib fracture in the case of persistent symptoms.	I
F03. Pre-employment or screening medicals	CXR	Indicated only in specific circumstances [B]	Not justified except in a few high-risk categories (e.g. at-risk immigrants with no recent CXR). Some have to be done for occupational (e.g. divers) or emigration purposes.	I
F04. Routine pre-operative CXR	CXR	Not indicated [A]	Routine pre-operative CXR is not indicated in patients aged < 60 years undergoing non-cardiothoracic surgery. The yield of abnormalities increases in patients > 60 years. However, if patients without known cardio-respiratory disease are excluded, the yield is still low.	I
F05. Upper respiratory tract infection	CXR	Not indicated [C]	There is no documented evidence of the effect of CXR on the management or outcome of upper respiratory tract infection.	I
F06. Acute exacerbation of asthma	CXR	Indicated only in specific circumstances [B]	Patients presenting with asthma but without localizing signs in the chest, pyrexia, or leucocytosis do not require CXR, except when the asthma is life-threatening or fails to respond to treatment adequately.	I
F07. Acute exacerbation of COPD	CXR	Indicated only in specific circumstances [B]	Patients presenting with COPD but without localizing signs in the chest, pyrexia, or leucocytosis do not require CXR, except when the condition is life-threatening or fails to respond to treatment adequately.	I
F08. Pneumonia ***(For children see section L)***	CXR	Indicated [C]	The majority of patients with community-acquired pneumonia will show radiological resolution at four weeks, but this may be prolonged in the elderly, smokers, and those with chronic airway disease. Further CXR after resolution in asymptomatic patients is not indicated. ***(For pneumonia in children see L23)***	I

F. Thoracic system

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
F09. Pneumonia: follow-up ***(For children see section L)***	CXR	Indicated only in specific circumstances [B]	CXR need not be repeated before hospital discharge in those who have made a satisfactory clinical recovery from community-acquired pneumonia. CXR should be arranged after about six weeks for all patients who have persistent symptoms or physical signs or who are at higher risk of underlying malignancy (especially smokers and patients > 50 years), whether or not they are admitted to hospital. ***(For pneumonia in children see L23)***	I
F10. Pleural effusion suspected	CXR	Indicated [C]	CXR may detect small quantities of pleural fluid.	I
	US	Indicated [B]	US may be used to confirm the presence of pleural fluid, characterize it, detect pleural metastases, and guide thoracentesis.	0
	CT	Indicated only in specific circumstances [B]	CT with IV contrast may help in the detection and characterization of pleural fluid.	III
F11. Hemoptysis	CXR	Indicated [B]	All patients presenting with hemoptysis should have a CXR. If this is normal and the hemoptysis was significant and occurred out of the context of a concurrent chest infection, referral for further investigation should be considered.	I
	CT	Not indicated initially [B]	CT should be used in conjunction with bronchoscopy to investigate the majority of patients with hemoptysis. CT may detect malignancies not identified on CXR or bronchoscopy, but is insensitive in detecting mucosal and submucosal disease.	III
F12. ICU patient	CXR	Indicated [B]	A CXR is most helpful when there has been a change in symptoms or insertion or removal of a device. The value of the routine daily CXR is being increasingly questioned. CT is a useful adjunct to CXR for problem-solving in critically ill patients.	I
F13. Occult lung disease	CT	Specialized investigation [B]	There is evidence to indicate that high resolution CT (HRCT) may be histospecific; valuable information about disease reversibility and prognosis may be gleaned from HRCT.	III

G. Gastrointestinal system

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
G01. Difficulty in swallowing: high dysphagia (lesion may be high or low)	Video- fluoroscopy and Ba study of the esophagus	Indicated [B]	Video recording of swallow is essential. Webs and pouches are well demonstrated. Motility disorders, which must be looked for in prone or supine position, may be seen despite normal endoscopy. Subtle strictures, not seen at endoscopy, best demonstrated by marshmallow or other bolus study. Multi-disciplinary approach with speech therapist and ENT surgeon is optimal.	II
G02. Difficulty in swallowing: low dysphagia (lesion will be low)	Ba swallow	Indicated only in specific circumstances [B]	Endoscopy is required (biopsy of strictures essential). Ba swallow used to demonstrate motility disorder or subtle stricture, if endoscopy normal.	II
	NM	Specialized investigation [B]	Radionuclide esophageal transit study is indicated as an alternative non-invasive assessment of esophageal motility.	II
G03. Heart burn / chest pain: hiatus hernia or reflux	Ba study	Indicated only in specific circumstances [B]	Reflux is common and investigation is only indicated where lifestyle changes and empirical therapy fail. While pH monitoring is the gold standard for reflux, endoscopy alone will reliably show early changes of reflux esophagitis and allows detection and biopsy of metaplasia. Ba studies aimed at assessing esophageal motility prior to anti-reflux surgery do not reliably predict post-operative dysphagia.	II
G04. Esophageal perforation	CXR	Indicated [B]	Will be abnormal in 80% of cases, but pneumo-mediastinum is present in only 60%.	I
	Contrast swallow	Indicated [B]	Non-ionic iodinated contrast is the only safe agent. It is sensitive, but if no leak is seen then proceed to immediate CT.	II
	CT	Indicated [A]	CT is sensitive both for the presence of perforation and for the detection of mediastinal and pleural complications.	III
G05. Acute GI bleeding: hematemesis / melena	Endoscopy	Indicated [A]	Endoscopy provides diagnosis in the majority of cases of upper GI bleeding and can be used to deliver hemostatic therapy.	0
	NM	Specialized investigation [B]	After endoscopy. Red cell labelling can detect bleeding rates as low as 0.1 ml/minute; more sensitive than angiography. Red cell study is most useful in intermittent bleeding.	II
	Angiography	Specialized investigation [B]	In uncontrollable bleeding. Angiography can accurately direct surgery and transcatheter embolization may be used as the primary treatment.	III

Continued

G. Gastrointestinal system

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
G05. Acute GI bleeding: hematemesis / melena	Abdominal XR	Not indicated [B]	Of no value.	I
	Abdominal US	Indicated only in specific circumstances [B]	Useful to look for signs of chronic liver disease.	0
	Ba studies	Not indicate [C]	Precludes angiography.	II
Continued from page 34				
G06. Dyspepsia in the younger patient (e.g. < 45 years)	Ba studies	Indicated only in specific circumstances [B]	Most patients < 45 years can be treated without investigations and will undergo a trial of therapy (anti-ulcer or reflux). If symptoms recur or persist, the Helicobacter pylori status should be assessed serologically or by using the C-14 urea breath test. If positive or patient has alarm symptoms (weight loss, anorexia, iron deficiency anemia, severe pain or non-steroid anti-inflammatory drug use), endoscopy is the investigation of choice.	II
G07. Dyspepsia in the older patient (e.g. > 45 years)	Ba studies	Indicated only in specific circumstances [B]	Endoscopy is the investigation of choice. The main concern is the early detection of cancer. If endoscopy is negative and symptoms persist, then Ba meal should be considered.	II
G08. Ulcer: follow-up	Ba studies	Not indicated [B]	Scarring precludes accurate assessment. Endoscopy is preferred to confirm complete healing and to obtain biopsies where necessary.	II
	NM	Indicated only in specific circumstances [B]	Most centres use C-14 urea breath test to assess effect of treatment for Helicobacter pylori.	I-II
G09. Previous upper GI surgery (recent) to check for anastomotic leaks	Contrast study	Indicated [B]	If water-soluble contrast swallow does not demonstrate a leak in the anastomotic site and there is a clinical concern, then immediate CT should be performed as it is more sensitive. Ba should not be used as the contrast agent.	II
G10. Previous upper GI surgery (not recent): dyspeptic symptoms	Ba studies	Indicated only in specific circumstances [B]	Gastric remnant best assessed by endoscopy (gastritis, ulceration, dysplasia, recurrent tumour, etc.)	II
G11. Previous upper GI surgery (not recent): dysmotility / obstructive symptoms	Ba studies	Indicated [B]	Shows surgical anatomy and may demonstrate dilated afferent loop, narrowed anastomoses, internal hernias, closed loops, etc.	II
Continued				

G. Gastrointestinal system

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
G11. Previous upper GI surgery (not recent): dysmotility / obstructive symptoms ***Continued from page 35***	NM	Specialized investigation [B]	Good method for assessment of gastric emptying, dumping, and stasis.	II
G12. Intestinal blood loss: chronic or recurrent	Ba studies	Not indicated initially [B]	The initial investigation is endoscopy of the upper GI tract and colon. Small bowel follow-through is not sufficiently sensitive for lesions likely to cause chronic bleeding and should not be used.	II
	Ba small bowel enema	Indicated [B]	More sensitive than Ba follow-through for small discrete lesions. However, early results of 'capsule' endoscopy in chronic bleeding suggest that this will be the investigation of choice when small bowel strictures have been excluded.	II
	NM	Indicated [B]	When all other investigations are negative, labelled red cell and/or Meckel's study may be useful in detecting and localizing the site of chronic and/or recurrent bleeding.	II
	CT	Indicated [B]	IV contrast-enhanced CT is a useful technique to look for lesions that may be bleeding (e.g. tumours). CTA may demonstrate bowel angiodysplasia.	III
	Angiography	Specialized investigation [B]	Angiography is sensitive for angiodysplasia (with early filling vein) and to demonstrate tumour neo-vascularity.	III
G13. Acute abdominal pain: perforation / obstruction	Abdominal XR and CXR erect	Indicated [B]	Lateral decubitus abdominal XR indicated to show free gas if CXR has to be supine.	I+I
	US	Indicated [C]	Widely used as a survey following abdominal XR. It is sensitive for free fluid in perforation.	0
(For children see section L) ***(See also G14, G21)***	CT	Indicated [B]	For small sealed perforations and for establishing site and cause of obstruction. ***This recommendation does not apply to children. (For acute abdominal pain in children see L37)***	III
G14. Small bowel obstruction: acute	CT	Indicated [B]	When abdominal XR suggests small bowel obstruction, CT confirms diagnosis, indicates level, and may show cause. When abdominal XR equivocal but small bowel obstruction suspected clinically, volume challenge (i.e. CT with water or methylcellulose ingestion) may be required for complete assessment.	III
(See also G21)	Contrast studies	Indicated only in specific circumstances [B]	Frequently unhelpful.	II

G. Gastrointestinal system

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
G15. Small bowel obstruction: chronic or recurrent	Ba small bowel enema	Indicated [B]	Will reveal presence and level of obstruction in most cases and may suggest a cause.	II
	CT	Indicated [B]	Performed with or without volume challenge. CT will be as diagnostic as a small bowel enema, but may be a better guide to management in complex cases, e.g. in patients with a previous malignancy or following complicated abdominal surgery.	III
(See also G13, G14, G21)				
G16. Suspected small bowel disease (Crohn's disease)	Ba small bowel follow-through	Indicated [B]	A useful survey examination for the diagnosis of small bowel disease, including Crohn's disease.	II
	Ba small bowel enema	Indicated [B]	This is the investigation of choice to establish extent of disease prior to surgery, in cases where fistula is suspected, and to diagnose the cause of obstructive symptoms in patients with known Crohn's disease.	II
	US / CT / MRI	Specialized investigation [B]	Use of these techniques is evolving, e.g. in assessment of disease activity, and they are particularly useful to assess extramural complications.	0 / III / 0
	NM	Specialized investigation [B]	Labelled white cell scintigraphy reveals activity and extent of disease and is complementary to Ba studies.	III
G17. Change of bowel habit to diarrhea and rectal bleeding in the absence of perianal symptoms: colorectal neoplasia	Ba enema	Indicated [B]	Colonoscopy is often the first-line investigation. Ba enema is an alternative to colonoscopy and is widely used as the first-line investigation of change of bowel habit in the absence of rectal bleeding. Ba enema is insufficient with rectal bleeding, but flexible sigmoidoscopy followed by immediate Ba enema is a good alternative to colonoscopy. Defer Ba enema for seven days after full thickness biopsy via a rigid sigmoidoscope. No delay is needed for superficial biopsies taken via flexible sigmoidoscopy.	III
	CT	Specialized investigation [B]	CT has an established and developing role in the demonstration and exclusion of colorectal neoplasia. Its use can range from a minimally invasive approach with no oral contrast and no bowel preparation to full CT colonography. The minimally invasive approach is preferable to Ba enema in frail elderly patients. Accuracy is increased by oral contrast over 24 hours with no purgation. Alternatively, a water enema is helpful. CT colonography with full bowel preparation and air enema is more accurate than Ba enema and closely approaches the accuracy of colonoscopy. It is already the technique of choice for the proximal colon when colonoscopy has been incomplete.	III

G. Gastrointestinal system

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
G18. Large bowel obstruction: acute	Abdominal XR	Indicated [B]	May suggest diagnosis and indicate likely level.	I-II
	Contrast enema	Indicated [B]	Water-soluble or air-contrast enema can confirm diagnosis and level of obstruction and may indicate likely cause. In some cases interpretation is difficult and if no abnormality is seen it is important to understand that although this may indicate pseudo-obstruction, a significant obstructing lesion may have been missed.	III
	CT	Specialized investigation [B]	The value of CT, particularly in sick and very frail patients, is becoming established. It is likely that it will prove a more accurate and less uncomfortable alternative to water soluble enema.	III
G19. Inflammatory bowel disease of the colon: acute exacerbation	Abdominal XR	Indicated [B]	Often sufficient to determine disease severity and extent.	I-II
	Ba enema	Indicated [B]	Unprepared 'instant' enema complements abdominal XR and confirms extent of disease. It is contraindicated in toxic megacolon.	III
	NM	Indicated [B]	Labelled white cell study will reveal activity and extent of disease.	III
(See also G25)	MRI	Specialized investigation [B]	MRI is extremely valuable in guiding surgical management of patients with anorectal sepsis.	0
G20. Inflammatory bowel disease of colon: long-term follow-up	Ba enema	Indicated only in specific circumstances [B]	Ba enema has a limited role after complex surgery and in the evaluation of fistulae. Colonoscopy is the most reliable investigation to identify complications including dysplasia, stricture, and carcinoma.	III
General abdominal problems				
G21. Acute abdominal pain warranting hospital admission for consideration of surgery	Abdominal XR and CXR erect / US	Indicated [B]	Local policy will determine strategy. Supine abdominal XR (for gas pattern, etc.) is usually sufficient; erect abdominal XR is indicated only in specific circumstances. Erect CXR is used for exclusion of perforation. US is widely used as a preliminary survey e.g. appendicitis.	I-II / 0
(See also G13, G14, G15, G30, G32)	CT	Indicated [B]	CT is increasingly used.	III

G. Gastrointestinal system

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
G22. Palpable mass	Abdominal XR	Indicated only in specific circumstances [C]	Rarely of value.	I-II
	US	Indicated [B]	Often solves the problem.	0
	CT	Indicated [B]	Where US is inconclusive and to provide more complete assessment of disease extent prior to definitive treatment.	III
G23. Malabsorption	Ba small bowel meal / follow-through	Indicated only in specific circumstances [B]	Imaging is not required for the diagnosis of celiac disease but may be indicated for other causes of small bowel malabsorption or when biopsy is normal / equivocal.	II
	NM	Specialized investigation [B]	Numerous NM investigations are available, which should establish presence of malabsorption. Some of these are non-radiological (e.g. breath test).	II
G24. Constipation	Abdominal XR	Indicated only in specific circumstances [B]	May be useful in geriatric and psychiatric specialties to show extent of fecal impaction. ***(For constipation in children see L38)***	II
	Intestinal transit studies	Specialized investigation [B]	A simple investigation using radio-opaque shapes can confirm normal intestinal transit.	I-II
	NM	Specialized investigation [B]	Important before colectomy is undertaken.	III
(For children see section L)	Evacuation proctography	Specialized investigation [B]	In some patients constipation is secondary to a disorder of evacuation, which can be demonstrated and characterized by this investigation.	II
G25. Abdominal sepsis; pyrexia of unknown origin	US	Indicated [C]	Seek early radiological advice. US is often used first and may be definitive, particularly when there are localizing signs; it is especially good for subphrenic / subhepatic spaces and pelvis.	0
	CT	Indicated [C]	CT is probably best test overall. Infection and tumour are usually identified or excluded. It also allows biopsy of nodes or tumour and drainage of collections (especially recent post-operative when US is difficult).	III
	NM	Indicated [C]	NM is particularly good when there are no localizing features. Labelled white blood cell (WBC) study is good for chronic post-operative sepsis; Ga will accumulate at sites of tumour (e.g. lymphoma) and infection.	III

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
Liver, gallbladder and pancreas				
G26. Detection of hepatic metastases	US	Indicated [B]	Will often be the initial investigation. US is reliable for lesions > 2 cm in diameter, but for smaller lesions the sensitivity is reduced. Developments in therapy for hepatic metastases, particularly in colorectal cancer, dictate the use of more sensitive tests. US, however, will often be used as the first-line exclusion of hepatic metastases.	0
	CT	Indicated [B]	CT is significantly more sensitive than US for detection of liver metastases, particularly smaller lesions. It is essential for accurate staging of patients with metastases being considered for liver resection.	III
	MRI	Specialized investigation [B]	With liver-specific contrast agents MRI is even more sensitive than CT in detecting metastases, but it is also useful in accurate characterization of small lesions. It is widely used in the pre-operative assessment of candidates for liver resection.	0
G27. Solitary hepatic lesion on US, hemangioma, metastases, other ***(See also L15)***	CT / MRI	Specialized investigation [B]	Both techniques reliably show characteristic features of hemangioma and many other solitary hepatic lesions.	III / 0
G28. Known cirrhosis, complications	US	Indicated [B]	Very sensitive for ascites. US may show varices, particularly in the splenic hilum in portal hypertension. It is the initial screening test for hepatoma.	0
	CT	Specialized investigation [B]	Particularly when US is equivocal in the presence of raised alpha feto-protein and in the staging of hepatoma.	III
	MRI	Specialized investigation [B]	With liver-specific contrast agents MRI is at least as sensitive as CT for hepatoma.	0
G29. Jaundice	US	Indicated [B]	US reliably differentiates between obstructive and non-obstructive jaundice, but bile duct dilatation may be subtle in early obstruction. When US indicates obstructive jaundice, subsequent investigation will depend on the level of obstruction, presence or absence of stones in the gall bladder and ducts, as well as the clinical situation.Early discussion with radiologist is required.	0
	ERCP	Specialized investigation [B]	If US shows duct stones, proceed to ERCP for confirmation and therapy. ERCP remains the gold standard for intrahepatic duct changes in sclerosing cholangitis.	II

Continued

G. Gastrointestinal system

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
G29. Jaundice ***Continued from page 40***	CT	Specialized investigation [B]	Frequently the next investigation for US-proven obstructive jaundice, particularly if US level of obstruction is below the hilum. For pancreatic cancer CT reliably predicts unresectability. In malignant hilar-level obstruction, CT may provide staging information critical to the planning of surgery or palliative therapy.	III
	MRI, including MRCP	Specialized investigation [B]	In hilar-level obstruction, MRCP (magnetic resonance cholangiopancreatography) is now the investigation of choice following US. MRCP reliably and non- invasively depicts the pattern and extent of duct involvement, thus facilitating planning of curative surgery or interventional treatment. In malignant hilar-level obstruction, MRI may provide staging information critical to the planning of surgery or palliative treatment. If US shows gallstones, but no definite duct stones, then MRCP is indicated prior to ERCP.	0
	Endoscopic US	Specialized investigation [B]	Is the most accurate method for detection of small duct stones and small papillary or peri-ampullary tumours. It allows biopsy of pancreas without risk of tumour seeding.	0
G30. Biliary disease (e.g. gallstones, post-cholecystectomy pain)	Abdominal XR	Not indicated [C]	Only shows about 10% of gallstones.	I-II
	US	Indicated [B]	Is the investigation of choice for the demonstration or exclusion of gallstones and acute cholecystitis. It is the initial investigation of biliary pain but cannot reliably exclude common duct stones. Cholecystography is virtually never used.	0
	CT	Specialized investigation [B]	Has a limited role in cholelithiasis but is useful in the evaluation of gallbladder wall and gallbladder masses.	III
	MRCP	Specialized investigation [B]	Indicated in stone disease where the symptoms, signs, and/or liver function tests suggest the possibility of duct calculi not confirmed by US, and in the investigation of post-cholecystectomy pain.	0
(See also G21)	NM	Specialized investigation [B]	Biliary scintigraphy shows cystic duct obstruction in acute cholecystitis.	II
G31. Post-operative biliary leak ***Continued***	US	Indicated [B]	First investigation of suspected leak. US will show the size and anatomical position of collections.	0
	ERCP	Indicated [B]	Definitive investigation to detect and demonstrate the site of the leakage and for treatment by stent placement.	II

G. Gastrointestinal system

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
G31. Post-operative biliary leak ***Continued from page 41***	NM	Specialized investigation [B]	HIDA scan will show activity at site of leak.	II
G32. Pancreatitis: acute ***(See also G21)***	Abdominal XR	Indicated [C]	Presents as non-specific acute abdominal pain. Abdominal XR is needed to exclude other causes.	I-II
	US	Indicated [B]	Must be performed early to identify patients with gallstones, indicating a diagnosis of gallstone pancreatitis in which case early ERCP may be considered.	0
	CT	Indicated [B]	CT with IV contrast enhancement is used early in severe cases to assess extent of necrosis, which is helpful in prognosis. In follow-up, it is used to detect and monitor complications, and for this purpose it is superior to US. US is used to monitor more chronic pseudocysts, to avoid high radiation dose of CT.	III
G33. Pancreatitis: chronic	Abdominal XR	Indicated [B]	To show calcification (calcified duct stones) but is of limited value in exclusion.	I
	US / CT	Indicated [B]	US may be definitive, particularly in thin patients. CT is highly sensitive for pancreatic calcification but poorly sensitive for early parenchymal changes.	0 / III
	ERCP / MRCP	Specialized investigation [B]	ERCP shows duct morphology. MRCP (particularly with secretin) shows moderate and severe ductal changes and may indicate exocrine function. MRCP does not reliably show minor side branch changes in mild chronic pancreatitis.	II / 0
G34. Pancreatic tumour	US	Indicated [B]	US is good at detecting the primary lesion in thin patients, particularly for lesions in the head and body, but is insufficient where precise staging is required.	0
	CT	Indicated [B]	CT is of value in diagnosis, when US is inconclusive, and in staging, where IV contrast-enhanced spiral CT reliably predicts unresectability.	III
	Endoscopic US	Specialized investigation [B]	May provide detailed staging information in candidates for surgical resection after CT and allows image-guided biopsy of pancreatic masses.	0
	ERCP	Specialized investigation [B]	Demonstrates anatomy of strictures and facilitates tissue diagnosis and intervention, e.g. stent placement in selected cases.	II

H. Urological, adrenal and genitourinary systems

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
H01. Hematuria, macro- or microscopic	IVU (IVP)	Indicated [B]	There is wide variation in local policy. Imaging strategies should be agreed with local nephrologists and urologists. Neither IVU (IVP) nor US and abdominal XR is ideal for detecting upper urinary tract causes of bleeding: in most patients both IVU (IVP) and US should be used, either together or in sequence.	II
	US and Abdominal XR / CT	Indicated [B]	In young patients with microscopic hematuria only US and abdominal XR may be used to evaluate the upper tracts: this strategy misses some upper tract pathology, including some calculi. Bladder US detects many bladder tumours but is not sufficiently sensitive to obviate cystoscopy. There has been recent interest in using CT to evaluate the upper tracts in hematuria but there are insufficient data to make a recommendation.	0+I / II
H02. Hypertension without evidence of renal disease ***(See also H03)***	IVU (IVP)	Not indicated [B]	IVU (IVP) is not indicated for the evaluation of hypertension with no evidence of renal disease.	II
H03. Hypertension: in the young adult or in patients unresponsive to medication	NM	Specialized investigation [B]	Captopril renography is best to check for functionally significant renal artery stenosis.	II
	Angiography	Specialized investigation [C]	To show stenosis if surgery or angioplasty is considered as a possible treatment.	III
	CTA	Specialized investigation [B]	CTA is as sensitive as MRA but more invasive (iodinated contrast medium, irradiation).	III
	MRA	Specialized investigation [B]	Imaging is only appropriate if renovascular hypertension is clinically suspected, since the prevalence of renal artery stenosis in essential hypertensives is very low. MRA is the best non-invasive method to visualize the renal arteries directly.	0
	US	Specialized investigation [B]	Doppler US can be sensitive and specific but needs special expertise.	0
H04. Renal failure	Renal US and Abdominal XR	Indicated [B]	US is indicated as the first investigation in renal failure to measure kidney size and parenchymal thickness and to check for pelvicalyceal dilatation indicating possible obstruction. Abdominal XR is necessary to show calculi not detectable by US.	0+I
	CT	Not indicated initially [B]	CT (unenhanced or enhanced, depending on renal function) helps if US is non-diagnostic or does not show the cause of obstruction.	III

Continued

H. Urological, adrenal and genitourinary systems

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
H04. Renal failure	IVU (IVP)	Not indicated [B]		II
Continued from page 43	MRI	Specialized investigation [C]	MRI is a possible alternative to CT and avoids potentially nephrotoxic contrast medium. On rare occasions, obstruction occurs without dilatation seen with any imaging method.	0
H05. Measurement of renal function: • Effective renal plasma flow (ERPF) • Glomerular filtration rate (GFR) • Relative function	NM	Specialized investigation [B]	GFR is preferred by many authorities to assess global renal function: Hippurate OIH labelled with either I-123, I-125 or I-131 is used, but Tc-99m MAG3 may be used as a substitute. GFR may be estimated with both blood sampling and imaging methodologies. Blood sampling methodologies allow for more accurate determination.	II
• Renal transit	NM	Specialized investigation [A]	Single-sample Cr-51 EDTA at 3 hours if well calibrated and GFR > 30 ml / min. Accurate preparation of standards and injection without loss are crucial: 51Cr EDTA clearance, four- sample method.	II
	NM	Specialized [A]	Tc-99m MAG3 and Tc-99m DTPA imaging may be investigation used for measurement of relative renal funtion.	II
	NM	Specialized investigation [B]	Renal Tc-99m MAG3 should be used with an established method of deconvolution analysis for parenchymal transit time index for obstructive nephropathy and mean parenchymal transit time for renovascular disorder.	II
H06. Suspected ureteric colic	CT	Indicated [B]	Unenhanced CT is the method of choice in suspected ureteric colic.	III
	IVU (IVP)	Indicated [B]	IVU (IVP) is a satisfactory alternative to CT.	II
	US / Abdominal XR	Indicated only in specific circumstances [B]	US and abdominal XR may be used where radiation / contrast medium are contraindicated, e.g. in cases of pregnancy and contrast allergy. To maximize US sensitivity, patients should be well hydrated. US is less accurate than CT or IVU (IVP).	0 / I
H07. Renal calculi in absence of acute colic ***Continued***	Abdominal XR / CT	Indicated [B]	Abdominal XR or CT provide the best baseline assessment in patients with renal stone disease. In routine practice abdominal XR is adequate to detect the majority of renal calculi, which contain calcium. For detailed detection of renal calculi, CT is more sensitive.	I / III

H. Urological, adrenal and genitourinary systems

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
H07. Renal calculi in absence of acute colic ***Continued from page 44***	US	Indicated only in specific circumstances [B]	US is less sensitive than either abdominal XR or CT for detecting renal calculi but can detect urate calculi.	0
H08. Renal mass	US	Indicated [B]	US is sensitive at detecting renal masses > 2 cm and accurately characterizes masses as cystic or solid. US helps to characterize some masses indeterminate at CT.	0
	CT	Indicated [B]	CT is sensitive at detecting renal masses of 1.0-1.5 cm or greater and accurately characterizes masses.	III
	MRI	Specialized investigation [B]	MRI (including contrast-enhanced imaging) is as sensitive as contrast-enhanced CT for detecting and characterizing renal masses. MRI should be used if masses are not adequately characterized by CT and US or if iodinated contrast medium is contra-indicated because of diminished renal function or allergy.	0
	IVU (IVP)	Not indicated [B]	IVU (IVP) is less sensitive than US for the detection of renal masses. IVU (IVP) does not characterize renal masses accurately.	II
H09. Urinary tract obstruction	IVU (IVP)	Indicated only in specific circumstances [B]	May be used to define anatomy prior to surgery or other intervention.	II
	US	Indicated [B]	Useful to assess the upper tracts.	0
	NM	Indicated [A]	Tc-99m MAG3 or Tc-99 DTPA with furosemide diuresis is used. Tc-99m MAG3 is preffered when serum creatinine is increased. Output efficiency study provides reliable quantification of furosemide response independent of renal function. Parenchymal transit time index measurements aid assessment of obstructive nephropathy.	II
H10. Urinary tract infection in adults ***(For children see section L)*** ***Continued***	US and Abdominal XR	Indicated only in specific circumstances [B]	The majority of adults with urinary tract infection do not require imaging. Imaging is indicated (1) if infection does not settle rapidly with antibiotics and (2) after infection has settled in men with one proven UTI or women with a proven recurrence of UTI.	0+I
	CT	Specialized investigation [B]	US and abdominal XR offer a good first investigation. Contrast- enhanced CT may be necessary in severe infection not responsive to treatment, since CT detects renal sepsis and changes of pyelonephritis more sensitively than US.	III

H. Urological, adrenal and genitourinary systems

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
H10. Urinary tract infection in adults ***Continued from page 45*** ***(For children see section L)***	IVU (IVP)	Indicated only in specific circumstances [B]	IVU (IVP) may be helpful in the non-acute phase in patients who are suspected of having underlying renal disease (e.g. calculus, papillary necrosis, reflux nephropathy). ***(For urinary tract infection in children see L43)***	II
H11. Renal transplant evaluation	NM	Indicated [B]	Tc-99m-MAG3 studies are more sensitive than US for acute rejection after transplantation. Such changes in renal function usually predate clinical and chemical indices. This study is helpful for detection of renal artery stenosis and obstructive uropathy.	II
H12. Urinary retention	IVU (IVP)	Not indicated [B]	Has low yield.	II
	US	Indicated only in specific circumstances [B]	Renal US is indicated to check for upper tract dilatation (after catheterization to relieve bladder distension), especially if renal function is impaired.	0
H13. Prostatism ***(See also K28)***	IVU (IVP)	Not indicated [B]	US is indicated to check for dilatation of the upper urinary tract.	II
	US	Indicated [B]	Bladder US (with measurement of post-void residual volume and urine flow rate) is indicated in prostatism. Renal US is only necessary if there is a post-void residue, hematuria, raised serum creatinine, or infection.	0
H14. Scrotal mass or pain	US	Indicated [B]	US is indicated for scrotal swelling and when presumed inflammatory scrotal pain does not respond to treatment. Allows differentiation of testicular from extratesticular lesions.	0
H15. Testicular torsion	US	Indicated [B]	Frequently a clinical diagnosis. Urgent management is essential and imaging should not delay intervention when appropriate. Colour Doppler US has a high sensitivity in suspected testicular torsion. Intermittent torsion remains a significant diagnostic problem.	0
H16. Adrenal medullary tumour	US / CT / MRI	Specialized investigation [B]	Whilst US may identify lesions of this type, CT and MRI provide the best anatomical delineation. Imaging is rarely indicated in the absence of biochemical evidence of such tumours.	0 / III / 0
	NM	Specialized investigation [B]	MIBG locates functioning tumours and is particularly useful for ectopic sites and metastases.	II

H. Urological, adrenal and genitourinary systems

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
H17. Adrenal cortical lesions; Cushing's syndrome	CT / MRI, NM, and/or adrenal venous sampling	Specialized investigation [B]	Local advice on the most appropriate examination should be sought. CT / MRI may be able to identify an adrenal cause for Cushing's syndrome. However, nodular adrenal hyperplasia can occur in a significant proportion of patients with ACTH-dependent and ACTH-independent Cushing's syndrome. In such a situation CT may be unable to distinguish adrenal adenoma and nodular hyperplasia, and further investigation with scintigraphy and/or adrenal venous sampling may be required.	III / 0, II / III
H18. Adrenal cortical lesions; primary hyperaldosteronism (Conn's syndrome)	CT / MRI, NM and/or adrenal venous sampling	Specialized investigation [B]	Local advice on the most appropriate examination should be sought. Both CT and MRI can distinguish between a unilateral adrenal adenoma and bilateral adrenal hyperplasia. NM may be useful in distinguishing between adrenal hyperplasia and an adenoma. However, adrenal venous sampling may be required where other imaging techniques are inconclusive.	III / 0, II / III

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
I01. Screening in pregnancy	US	Indicated [B]	Screening in early pregnancy (9-13 weeks) accurately dates a pregnancy by measuring the total crown-rump length. This reduces the intervention rate for infants born at or after full term. US accurately assesses fetal number and chorionicity and improves outcome for multiple pregnancies. Screening for structural abnormality at 18-20 weeks has not been shown to alter perinatal mortality except where selective termination of pregnancy is applied in the presence of gross fetal abnormality. US has a proven value in assessing placenta previa and intrauterine growth restriction. In the specialist care of high-risk pregnancies, Doppler US is essential for the safe practice of intervention and therapeutic procedures such as amniocentesis, fetal blood sampling, and transfusions during pregnancy.	0
I02. Suspected pregnancy	US	Indicated only in specific circumstances [C]	There is no indication that diagnosing pregnancy by US, other than for dating, is appropriate. Pregnancy testing is the most appropriate test. If early pregnancy is symptomatic,e.g. pain or vaginal bleeding, US is indicated.	0
I03. Suspected ectopic pregnancy	US	Indicated [B]	After a positive pregnancy test. Transvaginal US is most accurate. Colour Doppler increases sensitivity.	0
I04. Possible non-viable pregnancy	US	Indicated [C]	Pregnancy test is required. Repeat US after a week may be needed (especially when gestational sac < 20 mm or crown-rump length < 6 mm). Where doubt exists about the viability of a pregnancy, delay in evacuation of the uterus is essential.	0
Uterus: body				
I05. Post-menopausal bleeding: to exclude significant endometrial pathology	US	Indicated [B]	Transvaginal US is indicated to exclude significant endometrial pathology in post-menopausal bleeding. Endometrial thickening > 5 mm requires biopsy for specific diagnosis.	0
I06. Suspected pelvic mass ***(See also K39-K40)***	US	Indicated [C]	Combination of transabdominal and transvaginal US is often required. US should confirm the presence of a lesion and determine the likely organ of origin. Transvaginal scanning should be used to define the anatomy further. MRI is the best second-line investigation, although CT is still widely used.	0

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
I07. Pelvic pain, including suspected pelvic inflammatory disease and suspected endometriosis ***(See also G25)***	US	Indicated [C]	Especially when clinical examination is difficult or impossible. US has a poor predictive power when diagnosing pelvic inflammatory disease. CT can also be very valuable for assessing pelvic masses and other pathologies such as abscesses.	0
	MRI	Specialized investigation [B]	Can be useful to localize the larger foci of endometriosis.	0
I08. Lost IUCD	US	Indicated [C]	To confirm or refute the presence of the IUCD in uterus.	0
	Abdominal XR	Indicated only in specific circumstances [C]	Indicated only when IUCD is not seen in uterus on US.	I-II
I09. Recurrent miscarriages	US	Indicated [C]	Will show the major uterine congenital and acquired problems and is useful to identify polycystic ovaries.	0
	MRI	Specialized investigation [C]	Supplements US for uterine anatomy.	0
I10. Infertility	US	Indicated [C]	For follicle tracking during treatment. For assessment of tubal patency, US is not yet widely practised. Some centres use MRI and/or laparoscopy and/or hysterosalpingography.	0
I11. Suspected cephalopelvic disproportion	XR pelvimetry	Not indicated [B]	The need for pelvimetry is increasingly being questioned. Local policy should be determined in agreement with obstetricians. MRI or CT should be used wherever possible.	II
	MRI / CT	Specialized investigation [C]	MRI is best as it avoids x-irradiation. CT generally offers a lower dose than standard XR pelvimetry.	0 / I

Head: General

Head injury

- The primary aim of clinical and radiological assessment is to identify those patients with clinically important brain injury and, most crucially, those with an intracranial hematoma requiring urgent neurosurgical management.
- The large majority of these are classified as mild with a low risk of intracranial hematoma. Skull radiography to triage patients with mild head injury, shows sensitivity for detection of intracranial hematoma may be as low as 38%. CT has both sensitivity and specificity close to 100% but carries a high radiation burden and major resource implications if used indiscriminately.
- A number of attempts have been made to derive clinical decision rules that can identify patients who are not at risk of a neurosurgical hematoma or other clinically important brain injury and do not require cranial imaging. The Canadian Head CT Rule was derived from a cohort of more than 3,000 patients using a methodologically sound multivariate analysis of several risk factors. Coagulopathy, focal neurological deficit, post-traumatic seizure, and clinically suspected open or depressed skull fracture were considered a priori indications. Five further clinical risk factors identified 100% of patients who required neurosurgical intervention, with a further two factors identifying 98.4% with clinically important brain injury.
- At the time of publication of these Guidelines the validation study of this rule has not yet been completed and it therefore constitutes Level 2 evidence. These Guidelines adopt the Canadian Head CT Rule as the basis for selection of patients for CT scanning, but may be subject to change as new evidence emerges.
- If CT is normal or the patient does not qualify for a CT scan and no other clinical risk factors or social factors are present, the risk of complications requiring hospital care is low enough to warrant discharge to the care of a responsible adult with head injury instructions.
- There are implications for population radiation dose and cost, although routine CT followed by patient discharge if CT is negative may be cost-effective. CT scanning protocols should be optimized to minimize dose, especially in children.
- In circumstances where, for whatever reason, CT is not promptly available, skull radiographs may still have a role. Other local circumstances may require modification of these Guidelines.
- MRI, SPECT, and transcranial Doppler US are specialized investigations in head injury whose role is still under evaluation.

Associated injuries

- Assessment of the cervical spine including imaging if indicated (see sections J7-11) is essential in all head-injured patients. The opportunity to perform CT of the cervical spine while the patient is having a head scan should be carefully considered, especially if the patient is unconscious. Multi-slice CT scanners enable the whole cervical spine to be scanned at high resolution and multi-planar reformats to be generated with relative ease. Sensitivity to fractures is superior to plain radiographs.
- Occipital condylar fractures are uncommon, but serious injuries are associated with high-energy blunt trauma to the head and/or upper cervical spine. They are difficult to diagnose clinically although they should be suspected in any patient showing signs of lower cranial nerve palsy after injury. Demonstration on plain radiographs is extremely difficult and radiological diagnosis requires good quality CT. This region should be routinely reviewed on 'bone windows' in head-injured patients, with additional high resolution imaging if necessary.

Children

- The Canadian Rule was derived from a cohort that did not include children. Children have a lower risk of intracranial hematoma than adults, and it is considered safe to apply the rule to this age group. If non-accidental injury is suspected, a skull radiograph as part of a skeletal survey is required. In children 0-2 years old, CT of the head is mandatory. In addition, MRI of the brain may be required later to further document timing of the injury.

  (For non-accidental injury in children see L15)

Trivial head injury

- Patients with head injury who are fully orientated, have no history of loss of consciousness or amnesia nor any other clinical risk factors have a negligible risk of a clinically important brain injury and do not require imaging.

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
Head injury				
J01. Head injury: Any of the following clinical features indicates that there is a risk of a clinically significant brain injury requiring neuro-surgical intervention: • GCS < 13 at any point since the injury • GCS 13 or 14 with failure to regain GCS 15 within 2 hours of injury	SXR	Not indicated [B]	When CT is not available SXR could be justified for triage. An important exception is in the case of suspected non-accidental injury in children, where SXR is routinely indicated as part of a skeletal survey. In children 0-2 years old, CT of the head is mandatory. ***(For non-accidental injury in children see L15)***	I
• Suspected open or depressed skull fracture • Any sign of basal skull fracture (hemotympanum, 'racoon eyes', CSF otorrhea, Battle's sign) • More than one episode of vomiting • Age > 64 years • Post-traumatic seizure • Coagulopathy, including anti- coagulant therapy • Focal neurological deficit	CT	Indicated [B]	CT should be performed within 1 hour except in patients with only retrograde amnesia of > 30 minutes and/or dangerous mechanism of injury as risk factors. These patients are not at risk of a hematoma requiring neurosurgical intervention and CT may be delayed for up to 8 hours. Deterioration in GCS by 1 point, particularly if on the motor score, may warrant an urgent CT. If a patient with a normal initial CT fails to regain GCS 15 within 24 hours, a further CT or MRI may be appropriate.	II
The following two features in the absence of any of the above indicates a risk of a clinically significant brain injury that does not require neuro-surgical intervention: • Retrograde amnesia of greater than 30 minutes • Dangerous mechanism of injury: pedestrian struck by motor vehicle, occupant ejected from a motor vehicle, fall from a height > 3 feet or 5 stairs ***(For children see section L)***				

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
Face and orbits				
J02. Nasal trauma	SXR / XR facial bones / XR nasal bones	Not indicated [B]	XRs are unreliable in diagnosing nasal fractures and, even when positive, they do not usually influence patient management. They may be requested at ENT / maxillofacial follow-up depending on local policy.	I / I / I
J03. Blunt orbital trauma	XR facial bones	Indicated [B]	Especially where a blowout injury is suspected. MRI or direct coronal CT may be required by specialists where there is persistent diplopia or XRs and clinical signs are equivocal.	I
J04. Orbital trauma: penetrating injury	XR orbits	Indicated [B]	Indicated for suspected radio-opaque (metallic) intraorbital foreign body.	I
	CT	Specialized investigation [B]	Indicated for suspected poorly opaque (small or non-metallic) intraorbital foreign body.	II
	US	Specialized investigation [B]	Indicated for anterior intraocular foreign bodies.	0
	MRI	Specialized investigation [B]	Hazardous with metal intraorbital foreign bodies. Specialized investigation is needed in cases when there is a strong clinical suspicion but failure of localization or identification of the foreign body on other imaging.	0
(See also A16, A17)				
J05. Middle third facial injury	CT	Specialized investigation [B]	Patient cooperation is essential to obtain views of diagnostic quality. Consider delay if patient is uncooperative.	II
	XR facial bones	Indicated [B]	Discuss with maxillofacial surgeon, who may request low dose CT at an early stage in management of complex injuries.	I
J06. Mandibular trauma	XR mandible or OPG	Indicated [A]	Panoramic XR is not appropriate in uncooperative or multiply injured patients.	I
Cervical spine				
J07. Conscious patient with head and/or facial injury only	XR cervical spine	Indicated only in specific circumstances [A]	XR will not be necessary, provided that all five of the following criteria are met: • No midline cervical tenderness • No focal neurological deficit • Normal alertness • No intoxication • No painful, distracting injury.	I

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
J08. Unconscious patient with head injury	XR cervical spine, CT	Indicated [B]	Good quality XRs should demonstrate the whole of the cervical spine down to T1 / 2. If the cervico-thoracic junction is not clearly seen or there are any possible areas of fracture then CT is required. Where available, spiral CT may be used as an alternative to XR, and is essential if the cervico-thoracic junction is not clearly seen on XR. Both techniques may be difficult in the severely traumatized patient, and manipulation must be avoided.	I, II
J09. Neck injury with pain	XR cervical spine	Indicated [B]	Discuss with department of clinical radiology.	I
	CT / MRI	Specialized investigation [B]	May be valuable when XR is equivocal or lesion complex.	II / 0
J10. Neck injury with neurological deficit	XR cervical spine	Indicated [B]	For orthopedic assessment. XR must be of good quality to allow accurate interpretation.	I
	MRI	Indicated [B]	MRI is the best and safest method of demonstrating intrinsic cord damage, cord compression, ligamentous injuries, and vertebral fractures at multiple levels. Some constraints with life support systems.	0
	CT	Specialized investigation [B]	CT myelography may be considered if MRI is not practicable.	II
J11. Neck injury with pain but XR initially normal; suspected ligamentous injury	XR cervical spine	Specialized investigation [B]	Views taken in flexion and extension (consider fluoroscopy) as achieved by the patient with no assistance and under medical supervision.	I
	MRI	Specialized investigation [C]	MRI demonstrates ligamentous injuries.	0
Thoracic and lumbar spine				
J12. Trauma without pain or neurological deficit	XR	Not indicated [A]	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 alter management is low.	I
J13. Trauma with pain, no neurological deficit, or patient not able to be evaluated	XR	Indicated [B]	Threshold to XR is low when there is pain / tenderness, a significant fall, a high-impact road traffic accident, and presence of other spinal fracture, or when it is not possible to clinically evaluate the patient. If XR suggests instability or posterior element fractures, CT or MRI is essential.	I

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
J14. Trauma: with neurological deficit with or without pain	XR	Indicated [B]	Initial investigation, but CT / MRI is essential.	I
	CT	Indicated [B]	Detailed analysis of bone injury is achieved with CT with or without reconstructions.	II
	MRI	Indicated [B]	Whole-spine MRI is indicated when there are multilevel or ligamentous injuries and cauda equina injuries.	0
Pelvis and sacrum				
J15. Fall with inability to weight-bear	XR pelvis and Lateral XR hip	Indicated [C]	Physical examination may be unreliable. 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 is normal or equivocal.	I+I
J16. Urethral bleeding and pelvic injury	Retrograde urethrogram	Indicated [C]	To show urethral integrity, leak, or rupture. Cystography or delayed post-contrast CT should be considered if urethra is normal and hematuria is present to assess for other urinary tract injuries. There is increasing first use of MRI in the non-acute situation.	II
J17. Trauma to coccyx or coccydynia	XR	Indicated only in specific circumstances [C]	Normal appearance is often misleading and findings do not alter management.	I
Upper limb				
J18. Shoulder injury	XR	Indicated [B]	Some dislocations present subtle findings. As a minimum, orthogonal views are required. US, MRI, and CT may play a role in complex cases or soft tissue injury. Consider assessment of rotator cuff in over-50s who mobilize poorly following a first dislocation.	I
J19. Elbow trauma	XR	Indicated [B]	To show effusion. Routine follow-up XRs are not indicated in cases of effusion with no obvious fracture. MRI is a specialist investigation.	I
J20. Wrist injury: suspected scaphoid fracture	XR	Indicated [B]	Four-view series is needed where scaphoid fracture suspected.	I
	MRI / NM / CT	Indicated [B]	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.	0 / II / II

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
Lower limb				
J21. Knee trauma: fall / blunt trauma	XR	Indicated only in specific circumstances [B]	When blunt trauma or a fall is the mechanism of injury. XR is warranted when age < 12 or > 50 years or patient cannot walk four weight-bearing steps. CT / MRI may be needed where further information is required.	I
J22. Acute ankle injury	XR	Indicated only in specific circumstances [B]	Features which justify XR include: inability to weight-bear immediately and in the emergency room, point tenderness over the medial malleolus, and/or the posterior edge and distal tip of the lateral malleolus.	I
J23. Foot injury	XR	Indicated only in specific circumstances [A] - Mid-foot [B] - Fore-foot	Indicated only if there is true bony tenderness or ongoing inability to weight-bear. Demonstration of a fore-foot injury rarely influences management. Only rarely are XRs of foot and ankle indicated together; both will not be done without good reason. If XRs are not taken, advise return in one week if symptoms are not improved. For complex mid-foot injuries, CT is required.	I
J24. Stress fracture	XR	Indicated [B]	Although often unrewarding.	I
	NM / MRI / CT	Indicated [B]	Provides a means of early detection as well as a visual account of the biomechanical properties of the bone. Some centres use US here.	II / 0 / II
Imaging of a foreign body				
J25. Soft tissue injury: foreign body, e.g. metal, glass, painted wood	XR	Indicated [B]	All glass is radio-opaque. Remove blood-stained or soiled dressings first where possible.	I
	US	Indicated [B]	US may be indicated for radiolucent foreign body or where XR is difficult.	0
J26. Soft tissue injury: foreign body, e.g. plastic, wood	XR	Indicated only in specific circumstances [B]	Plastic is not radio-opaque: wood is rarely radio-opaque.	I
	US	Indicated only in specific circumstances [B]	Soft tissue US may show non-opaque foreign body.	0

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
J27. Swallowed foreign body suspected in pharyngealor upper esophageal region. ***(See also J28 and J29)*** ***(For children see section L)***	XR	Indicated only in specific circumstances [C]	After direct examination of oropharynx (where most foreign bodies lodge), and if foreign body is likely to be opaque. Differentiation from calcified cartilage can be difficult. Most fish bones are invisible on XR.	I
	Abdominal XR	Indicated only in specific circumstances [B]	Maintain a low threshold for laryngoscopy or endoscopy, especially if pain persists after 24 hrs. ***(For possible inhaled or swallowed foreign body in children see L26, L31).***	II
J28. Swallowed foreign body: smooth and small, e.g. coin	CXR	Indicated [B]	The minority of swallowed foreign bodies will be radio-opaque. In children a single, slightly over-exposed, frontal CXR to include neck should suffice. In adults, a lateral CXR may be needed in addition if frontal CXR is negative.	I
	Abdominal XR	Indicated only in specific circumstances [B]	The majority of foreign bodies that impact do so at the cricopharyngeus muscle. If the foreign body has not passed within 6 days, abdominal XR may be useful for localization.	I
J29. Sharp or potentially poisonous swallowed foreign body, e.g. battery	Abdominal XR	Indicated [B]	Most swallowed foreign bodies that pass the esophagus eventually pass through the remainder of the gastrointestinal tract without complication. However, the location of a battery is important, as leakage can be dangerous.	I
(For children see section L)	CXR	Indicated only in specific circumstances [B]	Indicated only if abdominal XR is negative. ***(For children see L31)***	I
Chest **J30.** Chest trauma: minor	CXR	Indicated only in specific circumstances [B]	The demonstration of a rib fracture does not alter management.	I
J31. Chest trauma: moderate	CXR	Indicated [B]	Frontal CXR for pneumothorax, fluid, or lung contusion.	I
	CT	Specialized investigation [C]	May be required.	III
J32. Stab injury	CXR	Indicated [C]	PA and/or other views to show pneumothorax, lung damage, or fluid. US is useful for pleural and pericardial fluid.	I
J33. Sternal fracture	Lateral XR sternum	Indicated [C]	In addition to CXR, lateral XR of the sternum is required. Think of thoracic spinal and aortic injuries too.	I

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
Abdomen (including kidney)				
J34. Blunt or stab injury	Abdominal XR supine and CXR erect / US	Indicated [B]	Supine abdominal XR and erect CXR are indicated. US valuable for detecting hematoma and possible injuries to some organs, e.g. spleen and liver.	I / I / 0
	CT	Specialized investigation [C]	CT may be needed.	III
J35. Renal trauma	IVU (IVP)	Indicated only in specific circumstances [B]	Adults with blunt renal trauma, microscopic hematuria, and no shock or major associated intra-abdominal injuries can safely be spared imaging.	II
	US	Indicated only in specific circumstances [B]	US can be useful in the initial assessment of patients with suspected renal injury, but a negative US does not exclude renal injury.	0
	CT	Indicated [B]	CT is the imaging technique of choice in patients with major injury +/- hypotension, +/- macroscopic hematuria. Delayed (excretory phase) CT must be included to assess the collecting system.	III
Major trauma				
J36. Major trauma: general screen in the unconscious or confused patient ***(See also J01, J37 and J38)***	XR cervical spine / CXR / XR pelvis / CT head	Indicated [B]	Patient's condition must be stabilized as 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.	I / I / I / III
J37. Major trauma: abdomen / pelvis	CXR, XR pelvis	Indicated [B] blood loss.	Pneumothorax must be excluded. Pelvic fractures which increase pelvic volume are often associated with major	I+I
	US / CT	Indicated [B]	Sensitive and specific, but time-consuming and may delay surgery. CT should precede peritoneal lavage. US widely used in the emergency room to show free fluid plus solid organ injury. US has replaced lavage in most circumstances, but has a low sensitivity for splenic injury. If doubt remains, CT should follow US.	0 / III
J38. Major trauma: chest	CXR	Indicated [B]	Allows immediate management (e.g. pneumothorax).	I
	CT chest	Indicated [B]	Especially useful to exclude mediastinal hemorrhage and aortic injury. Low threshold for proceeding to arteriography.	III

K. Cancer

Many of the clinical problems related to the diagnosis of cancer have already been partly covered within the individual system sections. Brief notes are provided here about the use of imaging in the diagnosis, staging, and follow-up in some of the common primary malignancies. Pediatric malignancies are not included as their management is always at specialist level.

A CXR is necessary at presentation for most malignant lesions to identify possible pulmonary metastases.

CXR is also part of many follow-up protocols (e.g. testicular lesions). Follow-up investigations to monitor progress (e.g. post-chemotherapy) are often required. Some are driven by trial protocols rather than clinical need and thus should be appropriately funded. Concern about radiation dose in diagnostic imaging is generally less relevant in this section.

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
Mouth and pharynx				
K01. Diagnosis	MRI / CT	Indicated [B]	Diagnosis is commonly made by clinical examination, supported by MRI or CT when there is high suspicion of occult disease.	0 / II
K02. Staging	MRI / CT	Indicated [B]	Imaging is not commonly needed for diagnosis. Staging should include cervical node groups; colour Doppler US may improve N staging. Chest may be examined by XR or (preferably) CT, but clinical effectiveness of M staging is unproven.	0 / II
	PET	Specialized investigation [C]	To identify recurrent disease in previously treated patients.	IV
Parotid				
K03. Diagnosis	US	Indicated [B]	Useful for superficial lobe tumours. If FNAC (fine-needle aspiration cytology) is required, US can be used for guidance. If US is unable to visualize the entire tumour, then MRI is the investigation of choice for extent.	0
	MRI / CT	Specialized investigation [B]	MRI is preferred for the assessment of parotid masses. Limitations in ability to identify calcification maje CT better for inflammatory disease. MRI cannot reliably differentiate benign from malignant lesions and does not obviate the need for a tissue diagnosis in indeterminate cases. However, MRI is better than CT for soft tissue resolution. Dental amalgam may also be a problem on CT. CT should be used if MRI is impracticable and for suspected inflammatory disease.	0 / II
	PET	Not indicated [B]	PET is poor at differentiating benign from malignant lesions.	IV
K04. Staging	MRI / CT	Indicated [B]	MRI should be used in preference to CT for the staging of parotid masses because of its superior soft tissue resolution, multiplanar capability, and ability to define both the extent of disease and any intracranial involvement.	0 / II

Continued

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
K04. Staging ***Continued from page 58***	PET	Specialized investigation [C]	May have a role in staging tumours as it will identify metastases in normal-sized lymph nodes.	IV
Larynx **K05.** Diagnosis	CT / MRI	Indicated only in specific circumstances [B]	Clinical endoscopy and biopsy for diagnosis.	II / 0
K06. Staging	CT / MRI	Indicated [B]	Where available, MRI is preferable to CT for T staging. Either can be used for N staging.	II / 0
	US	Specialized investigation [B]	Can be used for T and N staging and follow-up in centres with appropriate expertise.	0
Thyroid **K07.** Diagnosis	NM	Indicated [B]	For detection of residual / recurrent differentiated thyroid cancer after thyroidectomy.	II
	US	Indicated [B]	Used in combination with or to guide FNAC.	0
K08. Staging	CT / MRI	Indicated [B]	To assess large primary tumours, detect distant metastases, and for medullary thyroid carcinoma in MEN syndromes.	II / 0
	NM	Indicated [B]	For the detection of residual / recurrent disease after thyroidectomy.	IV
	US	Indicated [B]	Where appropriate expertise is available.	0
Lung **K09.** Diagnosis	CXR	Indicated [A]	Lung cancer can have several different clinical presentations and, if it is suspected, CXR is indicated. A proportion of cancers will be radiographically occult despite the presence of malignant cells in the sputum.	I
	CT	Indicated [B]	CT has not yet been proven to be of benefit as a screening tool for lung cancer. CT will increase sensitivity of detection of early tumours.	III

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
K10. Staging	CT	Indicated [A]	When correlated with histological findings, CT has an overall accuracy of up to 80% in the detection of mediastinal lymphadenopathy. Mediastinal lymph node biopsy will be required in some cases to confirm the CT findings prior to thoracotomy. PET is more accurate *(see below)*.	III
	MRI	Indicated only in specific circumstances [C]	In the majority of patients with lung cancer MRI does not offer any benefits over CT. However, it is of value in patients with superior pulmonary sulcus (Pancoast's) tumours. MRI may also be of value in demonstrating the vascular anatomy of the mediastinum in those patients allergic to iodinated contrast media. Studies have shown MRI to be better than CT at differentiating tumour from distal atelectasis.	0
	PET	Indicated [B]	FDG-PET is significantly more accurate than CT or MRI in the staging of patients with non-small-cell lung cancer and has a high negative predictive value for nodal metastases.	IV
Esophagus				
K11. Diagnosis	Ba swallow	Indicated [B]	Before endoscopy in dysphagia, Ba studies are sensitive for the diagnosis of esophageal cancer.	II
K12. Staging	CT	Indicated [B]	Many patients present with advanced disease that is inoperable. CT can be used as the initial investigation to exclude these patients. Endoscopic US is needed for more accurate TNM staging, particularly if this will alter the surgical approach.	III
	Endoscopic US	Indicated [B]	Requires expertise. If available, it can be the initial investigation. Often used if CT suggests patient is operable, to plan most appropriate surgery.	0
	PET	Specialized investigation [B]	PET is of use in the pre-surgical assessment of patients with esophageal cancer in order to detect metastases.	IV
Stomach				
K13. Diagnosis	Endoscopy / Ba meal	Indicated [B]	Endoscopy and double contrast Ba meal are equally sensitive in the diagnosis of advanced gastric cancer. Endoscopy allows biopsy for histology.	0 / II
K14. Staging	CT	Indicated [B]	CT is currently the best staging investigation if active treatment is planned. Endoscopic US is useful for local staging. Laparoscopy is most sensitive for small peritoneal deposits.	III

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
Liver: primary lesion				
K15. Diagnosis	US	Indicated [B]	The majority of lesions will be identified by US.	0
	MRI / CT	Specialized investigation [B]	Indicated if biochemical markers are elevated and US is negative or the liver is very cirrhotic. Enhanced MRI and arterial-phase CT are most accurate in delineating tumour extent.	0 / III
K16. Staging	MRI / CT	Indicated [B]	MRI is probably the optimal investigation for assessing the involved segments and lobes. CT arterial portography and intra-operative US are useful where available.	0 / III
Liver: secondary lesion				
K17. Diagnosis	US	Indicated [B]	US will reliably detect metastases > 2 cm and can guide biopsy.	0
	CT / MRI	Indicated [B]	Indicated when US findings are negative and clinical suspicion is high. MRI is better for characterizing lesions. CT arterial portography is sensitive but not specific, but many now use triple-phase spiral CT techniques following IV enhancement. CT and MRI often form part of other staging and follow-up protocols.	III / 0
	PET	Specialized investigation [C]	Indicated when other imaging is equivocal, to exclude other metastatic disease prior to surgery.	IV
Pancreas				
K18. Diagnosis	US / CT	Indicated [B]	Much depends on local expertise and the patient's body habitus. US is usually successful in thin patients; CT is better in the more obese patient. Biopsy can be performed using US or CT. Endoscopic US is the most sensitive.	0 / III
	MRI / MRCP / ERCP	Specialized investigation [C]	MRI for clarification of problems. MRCP or ERCP may also be needed. Interest in PET is increasing.	0 / 0 / II
K19. Staging	MRI / CT	Indicated [B]	Especially if radical surgery is contemplated. There is wide local variation: some centres use angiography; others, spiral CT.	0 / III
	PET	Specialized investigation [B]	Of use in cases where there is a significant possibility of distant spread.	IV

Continued

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
K19. Staging ***Continued from page 61***	Endoscopic US	Specialized investigation [B]	Should be reserved for those patients in a tertiary referral centre whose disease is deemed resectable on the basis of CT / MRI.	0
Colon and rectum				
K20. Diagnosis	Ba enema / colonoscopy	Indicated [B]	Much depends on local availability and expertise.	III / 0
	CT	Specialized investigation [C]	Increasing interest in CT, particularly in the elderly and infirm.	III
K21. Staging	CXR, US	Indicated [B]	For pulmonary and liver metastases. Endoluminal US is useful for local rectal spread.	I, 0
	CT, MRI	Indicated [B]	Local pre-operative staging to assess rectal lesions before pre-operative radiotherapy. Many centres now treat liver secondaries aggressively, which may necessitate MRI and/or detailed CT. MRI and CT are often complementary; both can assess other abdominal spread. Interest in PET is increasing.	III, 0
K22. Follow-up	US	Indicated [B]	For liver metastases. Preliminary evidence now supports routine imaging follow-up in asymptomatic patients.	0
	CT / MRI	Indicated [B]	For liver metastases and local recurrence.	III / 0
	PET	Specialized investigation [A]	PET is the best imaging technique for the evaluation of suspected local recurrence in patients with colorectal cancer and is of use in the assessment of patients prior to hepatic resection for metastases.	IV
Kidney				
K23. Diagnosis	CXR	Indicated [C]	To look for pulmonary metastases.	I
	US	Indicated [B]	US is a sensitive detector of renal masses > 2 cm and accurately characterizes masses as cystic or solid. US helps to characterize some masses indeterminate at CT.	0
	IVU (IVP)	Not indicated [B]	Less sensitive than US for the detection of renal masses. However, this is the method of choice for detecting transitional cell carcinoma of the pelvicalyceal system or ureters.	II
Continued	CT	Indicated [B]	A sensitive detector of renal masses 1.0 -1.5 cm and accurately characterizes masses.	III

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
K23. Diagnosis ***Continued from page 62***	MRI	Specialized investigation [B]	Contrast-enhanced MRI is as sensitive as contrast-enhanced CT for detecting and characterizing renal masses. MRI should be used if masses are not adequately characterized by CT and US or if iodinated contrast medium is contraindicated because of diminished renal function or allergy to iodinated contrast agents.	0
K24. Staging	CT / MRI	Indicated [B]	MRI is better at detecting advanced stages, e.g. renal vein involvement. CT and MRI are equivalent at staging T1 disease.	III / 0
	PET	Not indicated [C]	Current evidence with PET demonstrates no advantages for staging or detection of renal carcinoma.	IV
K25. Recurrence	CT	Indicated [B]	For symptoms suggesting relapse around nephrectomy bed. Routine follow-up is not recommended.	III
Bladder				
K26. Diagnosis	IVU (IVP)	Indicated only in specific circumstances [B]	Cystoscopy is the investigation of choice to diagnose bladder tumours.	II
	US	Indicated only in specific circumstances [B]	Not sufficiently accurate to assess small (< 5 mm) bladder tumours, but enables assessment of upper tract.	0
K27. Staging	IVU (IVP)	Indicated [B]	To assess kidneys and ureters for further urothelial tumours.	II
	CXR	Indicated [C]	To look for pulmonary metastases.	I
	MRI	Indicated [B]	Sensitive and specific and useful in invasive transitional cell carcinoma. CT is less specific than MRI, but of use if MRI is not practicable.	0
	PET	Specialized investigation [C]	Role yet to be clarified.	IV
Prostate				
K28. Diagnosis	US	Indicated [B]	Some variation according to local availability and expertise. TRUS (transrectal ultrasonography) is widely used together with guided biopsies.	0

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
K29. Staging	MRI	Specialized investigation [B]	Some variation exists in the range of investigative and therapeutic policies. MRI with appropriate coils is sensitive for assessment before possible radical prostatectomy. Staging is continued into the abdomen when pelvic disease is found. CT is of no value for local staging.	0
	NM	Indicated [B]	To assess skeletal metastases, when PSA (prostate-specific antigen) is significantly elevated.	II
Testicle				
K30. Diagnosis	US	Indicated [B]	In suspected testicular malignancy and when presumed inflammatory disease does not respond to treatment.	0
K31. Staging	CT chest, abdomen, and pelvis	Indicated [B]	CT is the mainstay of staging, and at initial diagnosis should include the chest, abdomen and pelvis. Pelvis can be omitted if all risk factors, including abdominal nodal disease, have been excluded. For non-seminomatous germ cell tumours, thoracic CT is more sensitive in the detection of pulmonary metastases than CXR.	III-IV
K32. Follow-up	CT	Indicated [B]	If risk factors for pelvic nodal disease have been excluded, pelvic CT may be omitted. The appearance of residual masses may assist in decisions on whether to undertake surgery. MRI has no clear advantage over CT, apart from reducing radiation burden. CT of previously involved areas can demonstrate morphological evidence of enlargement of masses.	III-IV
	PET	Specialized investigation [B]	When a marker rises following treatment, F-18 FDG-PET may be helpful in identifying the site of relapse.	IV
Ovary				
K33. Diagnosis	US	Indicated [B]	Most ovarian lesions are initially identified on clinical examination or US. Transabdominal US supplemented by transvaginal US and colour Doppler are used in their evaluation.	0
	MRI abdomen and pelvis	Specialized investigation [B]	MRI is useful for problem solving, as it is more accurate than US in determining the presence of malignancy. Surgery is still required in some cases to distinguish benign from malignant disease.	0

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
K34. Staging	CT abdomen and pelvis	Specialized investigation [B]	Many specialists request imaging in addition to staging by laparotomy.	III
	MRI abdomen and pelvis	Specialized investigation [B]	MRI is useful when enhanced CT is contraindicated, the patient is pregnant, or for problem solving.	0
	PET	Specialized investigation [C]	Indicated in difficult management situations to assess distant and local spread.	IV
K35. Follow-up	CT abdomen and pelvis	Specialized investigation [B]	CT / MRI defines extent, but normal findings do not exclude recurrence. CT is used to assess treatment response.	III
	MRI abdomen and pelvis	Specialized investigation [B]	MRI is useful for surgical planning and problem solving.	0
	NM	Specialized investigation [C]	Clinical examination and the serum Ca-125 radioimmunoassay are used to detect recurrent disease.	II
Uterus: cervix				
K36. Diagnosis	MRI	Indicated only in specific circumstances [B]	Usually a clinical diagnosis. MRI may assist in complex cases.	0
K37. Staging	MRI	Indicated [B]	MRI provides better demonstration of tumour and local extent than CT, and is also better for pelvic nodes. Para-aortic nodes and ureters must also be examined. Some centres now use TRUS for local invasion.	0
	PET	Indicated only in specific circumstances [C]	PET is useful in difficult situations to define the extent of disease with accompanying image registration.	IV
K38. Relapse	MRI abdomen and pelvis	Specialized investigation [B]	MRI provides better information in the pelvis than CT. Biopsy (e.g. of nodal mass) is easier with CT.	0

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
Uterus: body				
K39. Diagnosis	US / MRI	Indicated [B]	MRI can give valuable information about benign and malignant lesions.	0 / 0
K40. Staging	MRI	Indicated [B]	MRI is the optimum technique for staging endometrial carcinoma.	0
	CT	Not indicated [B]	CT is of limited value for local staging and is therefore unlikely to affect management.	III
Lymphoma				
K41. Diagnosis	CT	Indicated [B]	Diagnosis will usually be made by excision biopsy of a lymph node, but CT demonstration of extensive nodal enlargement may strongly suggest the diagnosis of lymphoma. For disease confined to the torso it will also allow the selection of a site for image-guided biopsy.	III-IV
	NM	Specialized investigation [B]	Ga-67 can show foci of occult disease (e.g. mediastinum). PET is used in some centres.	II
K42. Staging	CT	Indicated [B]	Depending on the site of disease, the head and neck may also need to be examined.	III-IV
	MRI	Indicated only in specific circumstances [B]	While MRI is not indicated routinely as an initial staging test, it shows nodal sites as well as CT and can image marrow burden of disease, which has prognostic implications.	0
	PET	Specialized investigation [B]	FDG-PET is as accurate as CT.	IV
K43. Follow-up	CT	Indicated [B]	CT of areas affected at staging for Hodgkin's disease. If there is clinical suspicion of relapse or progression, it is appropriate to examine chest, abdomen and pelvis, especially for non-Hodgkin's lymphoma.	III-IV
	MRI	Not indicated initially [B]	MRI may help assess the nature of a residual mass detected at CT.	0
	NM / PET	Specialized investigation [B]	Studies directly comparing Ga-67 and FDG-PET are limited. It is clear that FDG-PET is more sensitive and specific than Ga-67, especially for small masses and below the diaphragm. With Ga-67 a pre-treatment image must be obtained.	III / IV
	CXR	Indicated [B]	For initial assessment of response in overt thoracic disease the CXR is entirely appropriate.	I

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
Musculoskeletal tumours				
K44. Diagnosis	XR and MRI	Indicated [B]	Imaging and histology are complementary. Best before biopsy.	I+0
(See also section D)	NM	Indicated [B]	To ensure that a lesion is solitary.	III
K45. Staging	MRI and CT chest	Specialized investigation [C]	MRI is best for local spread and extent. CT is used to detect lung metastases.	0+III
(See also section D)	PET	Specialized investigation [C]	PET is best imaging technique for detecting metastases from an unknown primary tumour.	IV
Metastases from unknown primary tumour				
K46. Diagnosis of primary lesion 'Carcinoma, unknown primary' is a diagnosis of exclusion and not a diagnosis in its own right. Histology review is key to identifying likely sites of primary tumours and treatable tumours, e.g. lymphomas, germ cell tumours, and head and neck primary tumours. The site of initially identified metastases determines the likely origin, e.g. disease in upper cervical lymph nodes is likely to come from head and neck primaries, disease in axillary lymph nodes from breast carcinoma, and cancer cells in ascites from ovarian carcinoma in women.	CXR	Indicated [B]	CXR can help to identify the source of the occult primary.	I
	CT chest, abdomen, and pelvis	Specialized investigation [B]	CT is the most sensitive investigation in determining the primary site. This may allow effective treatment, e.g. for lung cancer, and palliation. It also allows entry into clinical trials and has unquantified psychological benefits to patient and doctor.	IV
	Mammography	Indicated only in specific circumstances [C]	Breast cancer survival is better from occult breast cancer metastases. Even in the presence of metastases, it is worthwhile to diagnose and treat cancer of the breast.	I
	MRI breast	Specialized investigation [B]	MRI may demonstrate a primary breast carcinoma with axillary lymph node metastases despite a normal mammogram and US.	0
	PET head and neck, supra-diaphragmatic, or whole body	Specialized investigation [C]	After full work-up, including CT or MRI.	IV

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
Central nervous system				
L01. Congenital disorders: head	MRI	Indicated [B]	Definitive exam for all malformations, avoiding x- irradiation. CT may be needed to define bone and skull base anomalies. Sedation or GA may be required for infants and young children, and in some cases therefore CT may be preferred.	0
L02. Congenital disorders: spine	MRI	Indicated [B]	Definitive exam 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.	0
L03. Abnormal head appearance: hydrocephalus	US	Indicated [B]	US indicated where anterior fontanelle is open. Where sutures are closed / closing, MRI is indicated (older children). CT may be appropriate if MRI is not available.	0
	SXR	Specialized investigation [C]	SXR and low-dose CT with 3-D reconstructions are indicated in craniostenosis.	I
L04. Epilepsy	MRI	Specialized investigation [A]	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.	0
	PET / NM / SPECT / rCBF	Specialized investigation [B]	Useful in pre-surgical evaluation.	II-IV
(See also A19)	SXR	Not indicated [B]	Poor yield.	I
L05. Deafness in children	MRI and/or CT	Specialized investigation [C]	Both MRI and CT may be necessary in children with congenital and post-infective deafness.	0 / II
L06. Hydrocephalus ?shunt malfunction	XR	Indicated [B]	XR should include whole shunt system.	I
(See also A10)	US / MRI	Indicated [B]	US if practicable; MRI in older children (or CT if MRI unavailable). Neurosurgeons may still want cross-sectional imaging even if US is performed. New programmable valves cause problems in MRI. US of abdomen is indicated if CSF (cerebrospinal fluid) collection is likely.	0 / 0

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
L07. Developmental delay ?cerebral palsy	MRI	Specialized investigation [C]	Remains a controversial area with regard to whom to screen and why. Further studies are needed to improve the accuracy of predicting patient outcome using newer MRI techniques of diffusion, spectroscopy and functional imaging with PET, SPECT and MRI.	0
L08. Headache	SXR	Not indicated [C]	If headache is persistent or associated with clinical signs, refer patient for specialized investigations.	I
(See also A06, A07, A13)	MRI / CT	Specialized investigation [B]	In children MRI is preferable if available because of absence of x-irradiation. (See A06 for possible meningitis and encephalitis, and see also A07 and A13)	0 / II
L09. Sinusitis ***(See also A13)***	XR sinus	Indicated only in specific circumstances [B]	Not indicated at < 5 years old as the sinuses are poorly developed; mucosal thickening can be a normal finding in children.	I
Neck and spine				
L10. Torticollis without trauma	XR	Indicated only in specific circumstances [B]	Muscular causes are most common, but when history and examination are atypical, XRs are advised.	I
	CT	Indicated only in specific circumstances [B]	Persistent torticollis for one week justifies further imaging following consultation.	II
	US	Indicated [B]	In congenital torticollis, US of neck muscles is a useful diagnostic tool in confirming sternocleidomastoid tumour in infants. If US is negative, XR and cross-sectional imaging are indicated.	0
L11. Back pain	MRI / CT	Indicated [B]	Persistent back pain in children may have an underlying cause and justifies investigation. Choice of imaging following consultation. Back pain with scoliosis or neurological signs merits MRI / CT.	0 / II
(See also C07-C08)	NM	Indicated [C]	Bone scanning with SPECT can be used to localize the site of abnormality for further anatomic imaging.	II
L12. Spina bifida occulta	US / MRI	Not indicated [C]	A common variation and not in itself significant. Investigation is only indicated if neurological signs are present.	0 / 0

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
L13. Hairy patch, sacral dimple	US / MRI	Indicated only in specific circumstances [B]	Isolated sacral dimples and pits may be safely ignored (< 5 mm from midline; < 25 mm from anus). US of the neonatal lumbar spine and canal is the initial investigation of choice if there are other stigmata of spinal dysraphism or associated congenital abnormalities, e.g. cloacal exstrophy anorectal malformation spectrum (CEARMS). MRI is indicated if neurological signs are present, or there is a discharging lesion.	0 / 0
L14. Neonatal hypothyroidism	NM	Specialized investigation [B]	Tc-99m or I-123 thyroid scintigraphy is the most accurate diagnostic test to detect thyroid dysgenesis or one of the inborn errors of T4 synthesis in patients with congenital hypothyroidism.	II
Musculoskeletal				
L15. Non-accidental injury / child abuse	Skeletal survey	Indicated (age 0-2 years) [A]	Age 0-2 years, CT of the head is mandatory Age 3-5 years, XR clinically suspicious area. Age > 3 years skeletal survey is not generally indicated, as children > 3 years can usually describe where pain is located. Examinations should be performed by radiographers trained in pediatric radiographic techniques.	II
(For head injury see section J)	NM	Indicated [B]	Bone scintigraphy is indicated in children < 2 years if the skeletal survey is equivocal. Abnormal bone findings must always be correlated with clinical history, physical examination, and pertinent XRs.	II
L16. Limb injury: opposite side for comparison	Comparison XRs of the joint on the contralateral side	Not indicated [B]	Seek radiological advice.	I
L17. Short stature, growth failure	XR for bone age	Indicated [A]	Child aged 1 year and over: left (or non-dominant) hand / wrist only. XR may need supplementing with further specialized investigations. Skeletal survey if dysplasia is suspected. MRI of hypothalamus-pituitary fossa if central hormone failure is a possibility.	I
L18. Irritable hip	US	Indicated [B]	US will confirm presence of an effusion but will not discriminate sepsis from transient synovitis.	0
	XR	Not indicated initially [C]	XR, which may include a frog lateral view, is required if slipped upper femoral epiphysis or Perthes' disease is suspected or if symptoms persist. If symptoms persist, then follow-up should be as for the limping child	I
(See also L19, L21)	NM	Indicated [B]	Skeletal scintigraphy can detect joint inflammation and specific patterns on Legg-Calvé-Perthes disease in patients with persistent pain. MRI is more specific but requires sedation and longer time.	I

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
L19. Limping	US	Indicated [B]	US will confirm the presence of an effusion but will not discriminate sepsis from transient synovitis.	0
	XR	Not indicated initially [B]	Children with a limp need proper clinical assessment. If pain persists, or localizing signs are present, XR is indicated.	I
	NM	Not indicated initially [B]	XR and US should be performed before NM. NM is useful for localization when XR and US are normal. The age of the child is an important factor in limiting the diagnostic possibilities.	II
	MRI	Specialized investigation [C]	Should only be used after discussion with radiologist.	0
L20. Focal bone pain	XR	Indicated [B]	XR should be the first-line investigation, though MRI and NM are more sensitive than XR in detecting occult infection or fracture.	I
	NM	Specialized investigation [B]	XR should be obtained initially. Skeletal scintigraphy is useful if pain is not well localized. A negative multiphasic study does not exclude active arthritis.	II
	MRI	Specialized investigation [C]	Particularly useful if the child can localize the site of the pain.	0
	US	Specialized investigation [C]	US can detect occult infection.	0
L21. Clicking hip: dislocation	US	Indicated [A]	US is indicated where there is clinical doubt about developmental dysplasia of the hip but not for routine screening. XR may be necessary in the older child.	0
L22. Osgood-Schlatter disease	XR	Indicated only in specific circumstances [C]	Although bony radiological changes are visible in Osgood-Schlatter disease, these overlap with normal appearances. Associated soft tissue swelling should be assessed clinically rather than radiographically.	I
Cardiothoracic				
L23. Acute chest infection	CXR	Indicated only in specific circumstances [A]	CXR indicated if symptoms persist despite treatment or in severely ill children. If CXR is performed and demonstrates simple pneumonia, routine follow-up CXR is not required.	I

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
L24. Recurrent productive cough	CXR	Indicated only in specific circumstances [C]	In general, children with recurrent productive cough have CXRs which are normal or show peribronchial thickening. Routine follow-up CXR is not indicated unless atelectasis is seen on initial CXR. Suspected cystic fibrosis or immune deficiency require specialist referral.	I
L25. Cystic fibrosis	NM	Indicated only in specific circumstances [B]	Perfusion lung scintigraphy is useful in selected cases, especially if surgery is contemplated.	II
L26. Inhaled foreign body (suspected) ***(See also section J27, J28 and B06)***	CXR	Indicated [B]	CXR is indicated, though often normal. If there is clinical suspicion of an inhaled foreign body, bronchoscopy is mandatory. While air trapping is the foreign bodies, it is not always seen. To demostrate it fluoroscopy is often a better and easier alternative to expiratory XR.	I
L27. Wheeze ***(See also L26)***	CXR	Indicated only in specific circumstances [B]	In most children with wheeze, the CXR is either normal or shows features of uncomplicated asthma or bronchiolitis, such as hyperinflation or peribronchial cuffing. In selected cases, such as those with fever or localized crackles, the CXR may be useful in guiding patient management.	I
L28. Acute stridor	Lateral XR soft tissue neck	Indicated only in specific circumstances [B]	Epiglottitis and croup are clinical diagnoses. Lateral neck XRs may be of value in children with a stable airway in whom an obstructing foreign body or retropharyngeal abscess is possible.	I
L29. Heart murmur	CXR / US	Indicated only in specific circumstances [C]	Specialist referral is needed; cardiac US may be indicated.	I / 0
Gastrointestinal				
L30. Intussusception	US-guided or fluoroscopy-guided hydrostatic / pneumatic reduction	Indicated [A]	US has high sensitivity in diagnosing intussusception but is operator-dependent. It is useful in assessing blood flow and identifying 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.	0 / II

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
L31. Swallowed foreign body	Abdominal XR	Indicated only in specific circumstances [C]	Only for sharp or potentially poisonous foreign body, e.g. battery.	I
(See also B06, J27-J29)	CXR, including neck	Indicated [B]	If there is doubt whether the foreign body has passed, an abdominal XR after six days may be indicated.	I
L32. Blunt abdominal trauma	Abdominal XR	Indicated only in specific circumstances [B]	Clinical assessment of the patient should be used to determine which patients require further evaluation by imaging. Abdominal XR is of limited use after minor trauma unless there are positive physical signs suggestive of intra-abdominal pathology or injury to the spine or bony pelvis.	I
	US	Indicated only in specific circumstances [B]	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.	0
	CT	Specialized investigation [B]	CT with IV contrast 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.	III
L33. Projectile vomiting in infants	US	Indicated [A]	US can confirm the presence of hypertrophic pyloric stenosis, especially where clinical findings are equivocal. However, it requires specialized expertise, and when that is not available a barium study may be appropriate.	0
L34. Recurrent vomiting	Contrast meal + / - follow-through	Indicated only in specific circumstances [C]	Recurrent vomiting in children can be caused by a wide variety of conditions, many of which cannot be diagnosed radiologically. An upper GI contrast study is not indicated for the diagnosis of simple gastro-esophageal reflux. Where significant gastro-esophageal 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-stained vomit, the case for contrast studies is much stronger.	II
	NM	Specialized investigation [B]	Gastric emptying may be measured with Tc-99m - labelled solid or fluid meal. This may be combined with scintigraphic evaluation of gastro-esophageal reflux.	II

L. Pediatrics

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
L35. Persistent neonatal jaundice	US	Specialized investigation [B]	Early (< 10 weeks) and prompt investigation is essential. The absence of dilatation in the intrahepatic bile ducts does not exclude obstructive cholangiopathy.	0
	NM	Specialized investigation [B]	Hepatobiliary scintigraphy with Tc-99m - labelled IDA derivatives. This cannot confirm biliary atresia if there is no bowel activity.	II
L36. GI bleeding (per rectum)	Abdominal XR	Indicated only in specific circumstances [C]	Imaging strategy depends on the age of the patient and severity of bleeding, diagnostic possibilities, and clinical presentation. Abdominal XR is required if necrotising enterocolitis is suspected.	I
	US	Specialized investigation [C]	US for diagnosis of intussusception and demonstration of duplication cysts. Upper or lower GI endoscopy is often the most useful next investigation. Consider a small bowel enema if the suspected pathology is inaccessible to endoscopy.	0
	NM	Specialized investigation [C]	NM is used for detecting active bleeding sites including Meckel's diverticulum. Angiography is used for investigation of rapid hemorrhage or chronic hemorrhage not found by other means.	II
L37. Acute abdominal pain	US	Specialized investigation [C]	Acute abdominal pain can be due to a diverse range of causes. US can be helpful in further assessment but needs to be guided by clinical findings.	0
	Abdominal XR	Indicated only in specific circumstances [C]	Rarely of value and best performed under specialist guidance. Generally abdominal XR is not undertaken prior to US.	II
L38. Constipation	Abdominal XR	Indicated only in specific circumstances [C]	There is a wide variation in the amount of fecal residue shown on the abdominal XR and good correlation with constipation has not been proven. Additionally there is inter-observer variation in interpretation. Abdominal XR can help specialists in the management of intractable constipation and to establish the extent of Hirschprung disease.	II
	Contrast enema	Indicated only in specific circumstances [B]	Non-radiological investigations, i.e. rectal manometry and biopsy are preferred. Contrast enema may have a role if these are not available and referral is difficult.	II
L39. Palpable abdominal / pelvic mass	US	Indicated [C]	Indicated in the evaluation of all suspected abdominal masses. If the presence of a mass is confirmed, the patient should be referred to a specialist centre.	0

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
Genitourinary				
L40. Continuous wetting	US	Indicated [B]	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.	0
	XR lumbosacral spine	Indicated [B]	Indicated in children with abnormal neurology or skeletal examination, in addition to those with bladder wall thickening / trabeculation demonstrated on US or neuropathic vesicourethral dysfunction on video-urodynamics.	II
	NM	Indicated only in specific circumstances [B]	DMSA imaging is useful in the detection and location of the dysplastic kidney and upper moiety of a duplex system.	II
	IVU (IVP)	Indicated only in specific circumstances [B]	To confirm the ectopic infrasphincteric ureters in girls with a known duplex system on US and/or DMSA imaging.	II
	CT / MRI	Specialized investigation [B]	CT / MRI may be of value to locate the dysplastic kidney or dysplastic occult moiety when US and DMSA imaging have failed. MRI urography, if available, is an alternative to IVU (IVP).	III / 0
L41. Impalpable testis	US	Indicated [B]	To locate testis within the inguinal canal.	0
	MRI / laparoscopy	Specialized investigation [C]	MRI may be of value after US to locate intra- abdominal testis, but laparoscopy is generally preferred.	0
L42. Fetal renal pelvic dilatation	US	Indicated [B]	Ideally US should be performed post-partum at 72 hours and again at 4 to 6 weeks. Other imaging investigations including MCUG (micturating cystouretography) and diuretic renography should be performed as per local protocol.	0
	NM	Specialized investigation [B]	In cases of persistent postnatal pelvic dilatation, MAG-3 diuretic renography is essential to estimate renal uptake function (differential function) as well as drainage.	II

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
L43. Proven urinary tract infection	US	Specialized investigation [C]	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 influences decisions. There is much current emphasis on minimizing radiation dose; hence an abdominal XR is not indicated routinely (calculi are rare). Expert US is the key investigation in all imaging strategies at this age.	0
	NM	Specialized investigation [A]	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 out-patient setting, to exclude a scar a DMSA study should be done 3 to 6 months after a proven urinary tract infection. NM will establish function and exclude obstruction.	II
	XR cystography	Specialized investigation [A]	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.	II
	NM	Specialized investigation [B]	NM can also be used for direct or indirect cystography.	II

M. Breast disease

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
Asymptomatic patients				
M01. Screening women < 40 years old	Mammography	Not indicated [B]	Screening mammography may have a role in selected individuals with extreme family histories and other risk factors such as previous breast cancer. For example, where the family history is of premenopausal breast cancer, referral for mammography at an age five to ten years younger than the first degree relative who developed breast cancer may be advised.	I
M02. Screening women 40 years old and over	Mammography	Indicated [A]	CAR recommends screening for asymptomatic women age 40 and over. Currently available data support a range of screening guidelines based on age including recommendations for screening to begin at age 40 or 50. However, all women age 50 to 70 should have screening at one to two year intervals. Women over age 70 should have screening mammography at one to two year intervals if they are in good health.	I
M03. Breast screening in women who have had augmentation mammoplasty	Mammography	Indicated [C]	Screening mammography should include implant displacement views.	I
Symptomatic patients				
M04. Clinical suspicion of carcinoma	Mammography	Indicated [B]	Mammography is the primary investigation to be done.	I
	US	Indicated only in specific circumstances [B]	Ultrasound is the initial imaging technique to evaluate palpable masses in women under thirty and in lactating and pregnant women. It is frequently required as determined by the radiologist and may predicate percutaneous biopsy.	0
	NM	Indicated only in specific circumstances [A]	Scintimammography is to be performed only if additional assessment is required where mammography, ultrasound and percutaneous biopsy are inconclusive.	III
	MRI	Indicated only in specific circumstances [B]	May be indicated as part of initial staging for a documented neoplasm. May be indicated when other imaging techniques are inconclusive and in evaluation of infiltrating lobular carcinoma.	0
M05. Augmentation mammoplasty (Clinical suspicion of carcinoma)	Mammography	Indicated [B]	Mammography is indicated when there is clinical suspicion of carcinoma in women with implants.	I

M. Breast disease

Clinical / Diagnostic Problem	Investigation	Recommendation [Grade]	Comment	Dose
M06. Generalised lumpiness, pain or tenderness	Mammography	Indicated only in specific circumstances	May be worthwhile in women > 40 years old with persisting non-suspicious breast symptoms, particularly focal pain or tenderness.	I
	US	Indicated only in specific circumstances [C]	May be indicated in the absence of other signs suggestive of malignancy. Except for focal pain or tenderness, breast US is unlikely to influence management.	0
M07. Long standing nipple retraction	Mammography	Indicated only in specific circumstances	Mammography is indicated as the first investigation when nipple retraction presents.	I
	US	Indicated only in specific circumstances [C]	In the absence of other signs suggestive of malignancy, breast ultrasound is unlikely to influence management.	0
M08. Cyclical mastalgia	Mammography	Not indicated [B]	Should not be performed in women with breast pain which is non-focal, in the absence of clinical signs.	I
M09. Assessment of integrity of silicone breast implants	Mammography	Indicated	Mammography can detect extracapsular rupture.	I
	US	Indicated only in specific circumstances [B]	Ultrasound has limited sensitivity for implant integrity.	0
	MRI	Specialized investigation [B]	Is the most sensitive test to document implant rupture.	0
M10. Suspected Paget's disease	Mammography	Indicated [C]	Mammography will show an abnormality in 50% of women. It is helpful to determine the possibility of image-guided biopsy. When invasive disease is confirmed it will influence the surgical management of the axilla.	I
M11. Breast inflammation	Mammography	Specialized investigation [C]	Can help to exclude specific mammographic signs of malignancy when there is clinical doubt.	I
	US	Indicated only in specific circumstances [C]	Useful to detect possible abscess cavity and for sonographic guided aspiration as well as follow-up.	0
M12 Breast cancer follow-up (surveillance)	Mammography	Indicated [A]	Annual mammography is appropriate and should be complemented with breast clinical examination.	I
	US	Indicated only in specific circumstances [A]	Can assist in investigation of mammographic or clinical abnormalities.	0
	MRI / NM	Indicated only in specific circumstances [A]	May be useful in suspect locoregional recurrence. Occasionally, scintimammography may have a role.	0 / III

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