The rapid expansion of CT can be adequately justified through the existing framework of referral criteria

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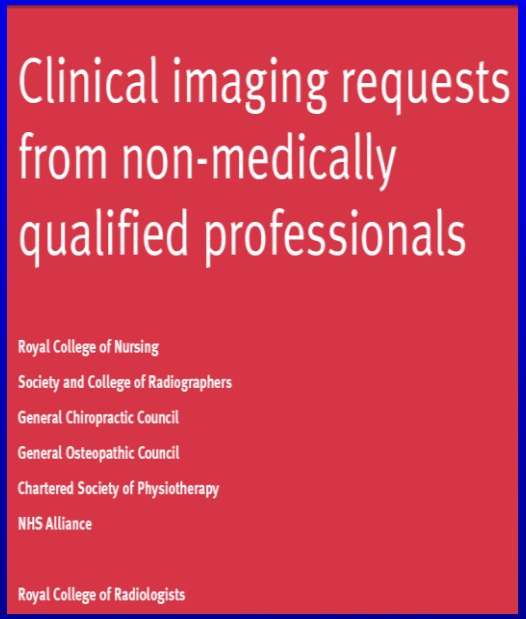
Referral guidelines overview

- **Imaging referral guidelines**
  - **For whom are guidelines intended**
  - **Which ones are available**
  - **How are guidelines developed**
- **Tools to support guidelines**
  - **Clinical Decision Support (CDS)**
  - **Education and Awareness**
  - **Audit for monitoring guideline use**
- **Evidence for reduction of utilisation**

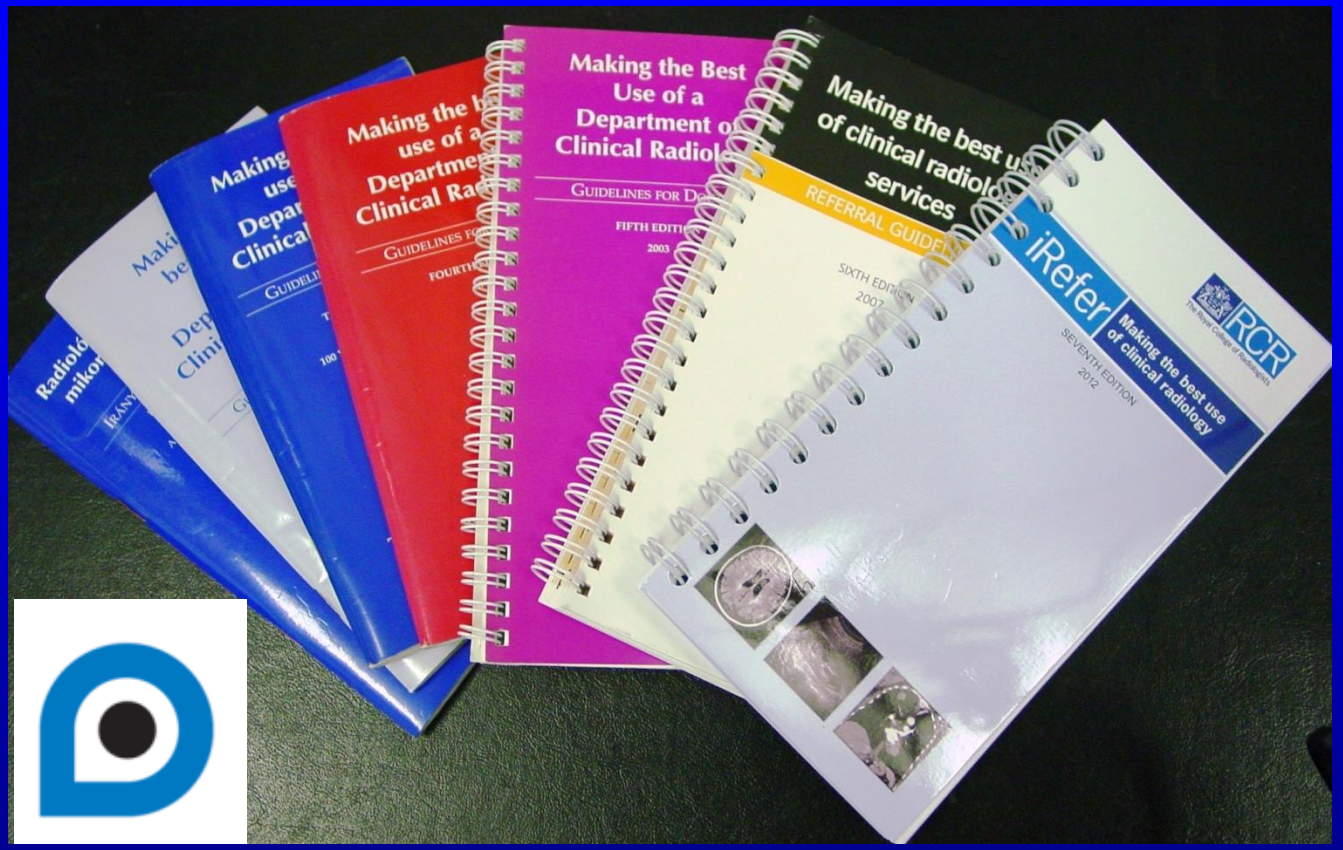
Awareness, appropriateness and audit (Malone, 2011)

Guidelines: for whom?

- For referring practitioners: General Practitioners, doctors-in-training & non-medically qualified health professionals
- For radiology practitioners: ICRP level 2 justification
- For patients: reinforcement of advice
- For Healthcare organisations: decision support, planning and provision



Referral Guidelines: Making the best use of clinical radiology



- The Royal College of Radiologists has published guidelines for >20 years since 1989. 7th edition 2012
- The guideline development process is accredited by NHS Evidence

EC Council Directive: 97/43 Euratom, Article 6.2

http://ec.europa.eu/energy/nuclear/radioprotection/doc/legislation/9743_en.pdf

COUNCIL DIRECTIVE 97/43/EURATOM

of 30 June 1997

on health protection of individuals against the dangers of ionizing radiation in relation to medical exposure, and repealing Directive 84/466/Euratom

Article 6

Procedures

1. Written protocols for every type of standard radiological practice shall be established for each equipment.

2. Member States shall ensure that recommendations concerning referral criteria for medical exposure, including radiation doses, are available to the prescribers of medical exposure.

3. In radiotherapeutic practices, a medical physics

Introduction

After more than 20 years, this seventh edition of imaging referral guidelines from The Royal College of Radiologists (RCR) marks a significant leap forward in guideline development. The enhanced guidelines methodology has been accredited by NHS Evidence, managed by the National Institute for Health and Clinical Excellence (NICE).

The preparation of evidence-based guidelines is a demanding task; one that requires a rigorous approach to established practices and the assimilation of new evidence. In this edition of the guidelines, the Delphi process was used for every guideline further strengthening the evidence base. More details outlining Delphi consensus methodology are to be found in the 'How have the guidelines been developed?' section.

These guidelines are intended purely as a guide for referring clinicians in primary and secondary care. They will be available in paper and electronic format and the RCR is exploring several different means of making them more widely available and easy to use. However, it must be understood that guidelines will never replace good communication and discussion between radiologist and clinician. The guidelines ought not to be used to restrict practice in specific clinical circumstances; rather they should direct the clinician to the test that is most likely to give the answer to the question being asked while taking into consideration the small but significant risk from ionising radiation.

The RCR thanks Dr Denis Remedios for his leadership and all those radiologists, other clinicians and secretarial and administrative staff who have contributed so much over the last four years.

The Royal College of Radiologists (RCR) has produced these guidelines to help clinicians, radiologists, radiographers and other healthcare professionals to determine the most appropriate imaging procedures for a wide range of clinical problems. Practical guidance is based on the best available evidence, together with expert consensus for clinical applicability. The patient's perspective has been taken into consideration with input from the RCR's Clinical Radiology Patients' Liaison Group. All guidelines have had extensive systematic literature reviews and agreement through a Delphi process[1,2] enabling consensus by experts from different geographical areas and types of hospital, including specialist, teaching and general hospitals.

The role of the radiologist (or radiographer acting as radiological practitioner) in justifying the examination remains paramount and is dependent on the components of each clinical case.[3,4,5] These guidelines should not be used as a means of restricting the freedom of radiologists to investigate cases in the most appropriate way, taking into consideration local expertise and provision. Guidelines work best if they are used as part of clinico-radiological dialogue, especially if compliance and improvement are monitored by clinical audit. Suggestions for such audits can be found on the RCR website (www.rcr.ac.uk/crauditlive).

Why are the guidelines needed?

A useful investigation is one in which the result—positive or negative—will inform clinical management and/or add confidence to the clinician's diagnosis. A significant number of radiological investigations do not fulfil these aims and may add unnecessarily to patient irradiation.[6] In order to avoid the wasteful use of radiology, the important questions to be asked are as follows.

1. **HAS IT BEEN DONE ALREADY?**
   Repeating investigations that have already been done: such as at another hospital, in an outpatient department, or in an emergency department. Every attempt should be made to obtain previous images and reports. Transfer of digital data through electronic links will assist in this respect. Although guidelines may not directly address this question, there are other initiatives that do.[7]
2. **DO I NEED IT?**
   Undertaking investigations when results are unlikely to affect patient management or over-investigating: because the anticipated positive finding is usually irrelevant – eg, degenerative spinal disease – or because a positive finding is unlikely. Some clinicians and patients tend to rely on investigations more than others for reassurance.
3. **DO I NEED IT NOW?**
   Investigating too early: for example, before the disease could have progressed or resolved, or before the results could influence treatment. The need for investigation and treatment should be reviewed at a more appropriate time.
4. **IS THIS THE BEST INVESTIGATION?**
   Doing the wrong investigation: imaging techniques undergo rapid change. It is often helpful to discuss an investigation with a specialist in clinical radiology or nuclear medicine before it is requested.
5. **HAVE I EXPLAINED THE PROBLEM?**
   Failing to provide appropriate clinical information and questions that the imaging investigation should answer: deficiencies here may lead to use of the wrong technique, or the report being poorly focused on the clinical problem.

In some clinical situations firm guidelines have been established. The Institute of Medicine defines clinical practice guidelines as:

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

As the term implies, a guideline is not a rigid constraint on clinical practice, but a concept of good practice against which

Guideline Publication Date: November 2011

Print Page

- ACR Homepage
- Q&S Resources Home
- Guidance Resources Home
- Appropriateness Criteria Home
- Practice Guidelines and Technical Standards Home

Additional Resources

- Manual on Contrast Media
- Guidance Document on MR Safe Practices: 2007
- White Paper on Radiation Dose in Medicine
- Radiology Safety Resources

Home | Quality & Safety Resources | ACR Appropriateness Criteria®

ACR Appropriateness Criteria®

The ACR Appropriateness Criteria® are evidence-based guidelines to assist referring physicians and other providers in making the most appropriate imaging or treatment decision for a specific clinical condition. By employing these guidelines, providers enhance quality of care and contribute to the most efficacious use of radiology.

The guidelines are developed by expert panels in diagnostic imaging, interventional radiology, and radiation oncology. Each panel includes leaders in radiology and other specialties. There are 175 topics with over 850 variants in the December 2011 version.

The ACR allows individuals to use the ACR Appropriateness Criteria® for research, scientific, and / or informational purposes only. If you wish to use the ACR Appropriateness Criteria® for other reasons, please contact the ACR at acr_ac@acr.org or 703-648-8900 for permission and licensing information. Click here for terms and conditions.

ACR Appropriateness Criteria® Search Engine

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Anytime, Anywhere™ Application for Mobile Devices

In collaboration with Skyscape, the ACR has developed the Anytime, Anywhere™ application for handheld mobile devices as an alternative solution to radiology benefit management companies or computerized physician order entry systems that do not contain the ACR Appropriateness Criteria® guidance. This application provides instant, point-of-care access to all of the ACR Appropriateness Criteria®, which can be directly downloaded to the iPhone, Blackberry, Palm, or other PDAs, smart phones or mobile devices. The content includes topics from expert panels in breast, cardiac, gastrointestinal, musculoskeletal, neurologic, thoracic, urologic, pediatric, vascular, and women's imaging, as well as interventional radiology and radiation oncology.

Diagnostic Imaging Topics

Topics with an asterisks (*) include pediatric imaging recommendations.

Search: GO

Diagnostic Imaging Pathways

A Clinical Decision Support Tool and Educational Resource for Diagnostic Imaging

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New Radiation Training Module

We are proud to present the Diagnostic Imaging Pathways iPad Application ("DipHD"). More information can be found here.

Last Updated: December 2011. What's New.

Note: Links will open in a new window.

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Guide du bon usage des examens d'imagerie médicale

http://beclere.sfrnet.org/sitewebpub.nsf

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Problème clinique	Examen	Recommandation [grade]	COMMENTAIRES	Dose
D. Système locomoteur				
Ostéomyélite 01 D	IRM	Indiqué [B]	L'IRM met bien en évidence les foyers d'infection.	0
	Scintigraphie	Indiqué [C]	La scintigraphie osseuse double/triple phase est très sensible, y compris dans la détection de foyers multiples, mais peu spécifique. Il est parfois nécessaire de recourir à d'autres radiopharmaceutiques (gallium, leucocytes marqués...).	II / III
	RS	Indiqué [B]	Les radiographies sont indiquées initialement, et pour suivre l'évolution sous traitement.	I
	TDM	Examen spécialisé [C]	La TDM est utile pour repérer un séquestre et pour le suivi.	II
	Echographie	Indiqué [C]	L'échographie peut mettre en évidence une collection, notamment sous-périostée en cas d'ostéomyélite aiguë des os longs, en particulier chez l'enfant (voir 20 M, chapitre Pédiatrie).	0
Tumeur osseuse primitive	RS	Indiqué [B]	La radiographie simple reste l'élément fondamental de diagnostic et de caractérisation de la lésion.	I
	IRM	Indiqué [B]	L'IRM est la méthode de choix pour le bilan d'extension locale. Elle doit être réalisée	0

EC Referral Guidelines 2000

Abstract

The newly revised medical exposure directive (97/43/Euratom) lays down the general principles of radiation protection of individuals in relation to medical exposure. Member States had to transpose it into national legislation until 13 May 2000. Article 6(2) of the directive requires Member States to ensure that recommendations concerning referral criteria for medical exposure are available to the prescribers of medical exposure.

This booklet sets out referral guidelines that can be used by health professionals qualified to refer patients for imaging, in order to ensure that all examinations are well justified and optimised.

This booklet has evolved from that previously published by the UK Royal College of Radiologists in 1998 and is entitled: Making the best use of a department of clinical radiology: guidelines for doctors. These referral guidelines have been adapted by experts representing European radiology and nuclear medicine, in conjunction with the UK Royal College of Radiologists, and may now be adopted as models for the Member States.

These referral guidelines are not binding on Member States, and form part of a number of technical guides drawn up to facilitate implementation of the medical exposure directive. Local variations may be required according to healthcare practice and provision.

Continued use of recommendations of this kind should improve clinical practice and lead to a reduction in the number of referrals for investigation and consequently to a reduction in associated medical radiation exposure.

Price (excluding VAT) in Luxembourg: EUR 16

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European Commission

RADIATION PROTECTION 118

RADIATION PROTECTION 118

Referral guidelines for imaging

EN



N06: Headache: chronic

These features significantly increase the odds of finding a significant abnormality on MRI or CT:

- *Recent onset and rapidly increasing frequency and severity of headache*
- *Headache causing patient to wake from sleep*
- *Associated dizziness, lack of co-ordination, tingling or numbness*
- *Headache precipitated by coughing, sneezing or straining*
- *Patients with malignancy or who are immunocompromised*
- *Recent onset headache in patients older than 50.*

Investigation	Dose	Recommendation [Grade]	Comment
MRI / CT	None / ☢☢	Indicated only in specific circumstances [B]	Imaging is not usually useful for isolated headache without abnormal neurological features (see clinical problem). Cervical spine XRs or paranasal sinus imaging are usually unhelpful even when neck signs suggest origin from the neck as they do not alter management.

Guideline Publication Date: November 2011

Date of origin: 1996
Last review date: 2009

American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Headache**

Variant 1: **Chronic headache. No new features.**

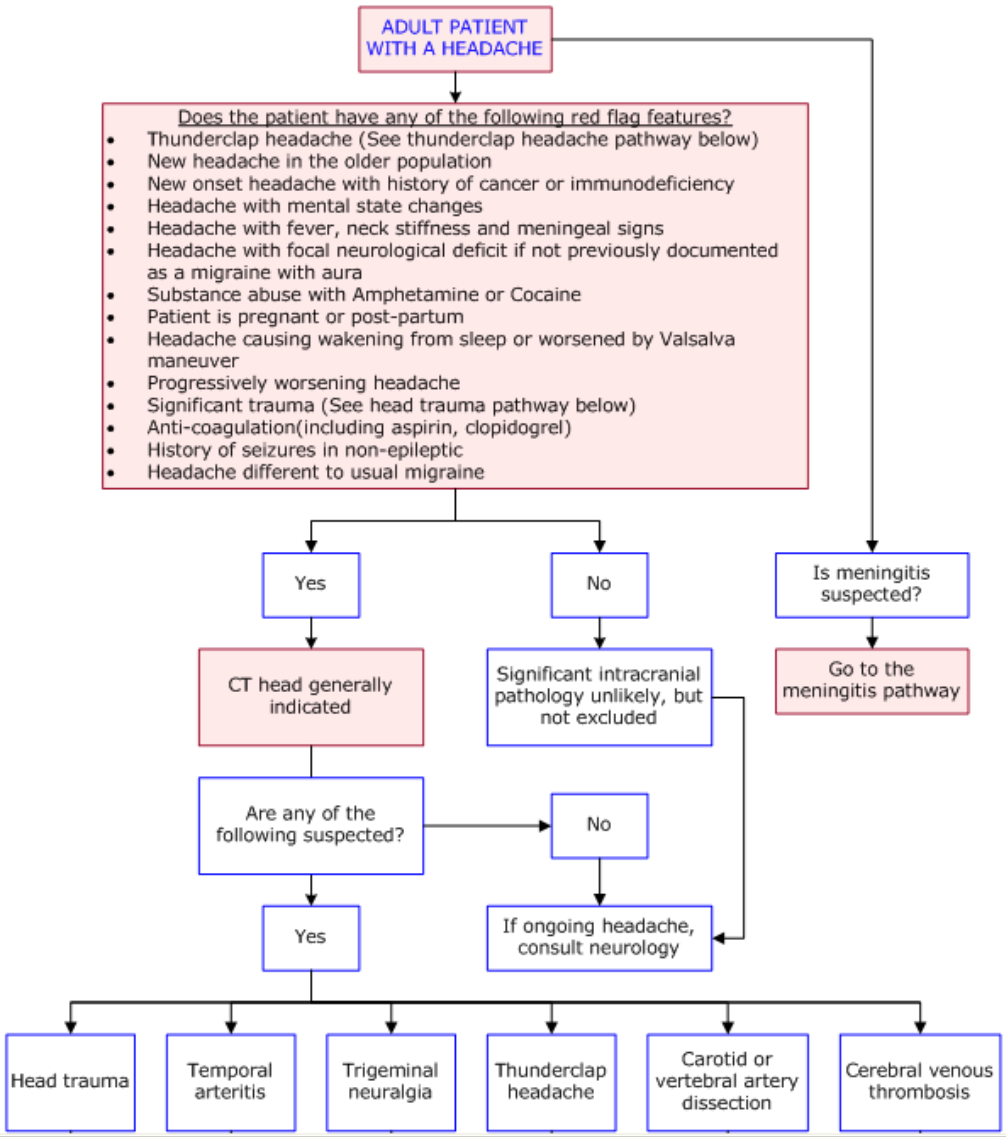
Radiologic Procedure	Rating	Comments	RRL*
MRI head without and with contrast	4	See statement regarding contrast in text under "Anticipated Exceptions."	O
MRI head without contrast	4		O
CT head without contrast	4		☢☢☢
CT head without and with contrast	4		☢☢☢
MRA head with or without contrast	2		O
Arteriography cervicocerebral	2		☢☢☢
CTA head with contrast	2		☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Variant 2: **Chronic headache with new features.**

Radiologic Procedure	Rating	Comments	RRL*
MRI head without and with contrast	8	See statement regarding contrast in text under "Anticipated Exceptions."	O
MRI head without contrast	7		O
CT head without contrast	5	If new features highly suggestive of intracranial hemorrhage, see variant 3. If MRI unavailable or contraindicated.	☢☢☢
MRA head with or without contrast	5	Selected cases when vascular disease suspected. See statement regarding contrast in text under "Anticipated Exceptions."	O
CT head without and with contrast	4	If MRI unavailable or contraindicated.	☢☢☢
CTA head with contrast	4	Not generally appropriate for screening or first study. To be used in combination with CT. For problem solving.	☢☢☢
Arteriography cervicocerebral	2	Not used as a primary diagnostic tool.	☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Diagnostic Imaging Pathways - Headache

Pathway Diagram





M04: Chronic lumbar back pain with no clinical or serological indicators of infection or neoplasia (ie, no red flags)

M05: Acute back pain with potentially serious (red flag) features

Serious (red flag) features:

a. *Neurological*
   - *Sphincter and gait disturbance*
   - *Saddle anaesthesia*
   - *Severe or progressive motor loss*
   - *Widespread neurological deficit*

b. *Other*
   - *Age 55 years*
   - *Previous malignancy*
   - *Systemic illness*
   - *HIV*
   - *Weight loss*
   - *IV drug use*
   - *Steroid use*
   - *Structural deformity*
   - *Non-mechanical pain (no relief with bed rest)*
   - *Fever*
   - *Thoracic pain*

M06: Acute back pain without

Investigation	Dose	Recommendation [Grade]	Comment
MRI	None	Indicated [B]	MRI is the imaging investigation of choice and is indicated immediately in patients with acute neurological features, and urgently in those with suspected malignancy or infection.
XR	☢	Indicated only in specific circumstances [C]	Plain radiograph may be required preoperatively. MR is preferable as the firstline investigation in patients with red flag signs, since it has a stronger negative predictive value.
CT	☢☢	Indicated only in specific circumstances [C]	CT is useful to guide soft tissue and bone biopsy and may identify sequestra in infection.
NM (bone scan)	☢☢	Indicated only in specific circumstances [B]	NM is non-specific and should be viewed with plain radiographs. It is useful to show the full extent of disease, especially with metastatic deposits.

Guideline Publication Date: November 2011

American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Low Back Pain**

Variant 1: **Uncomplicated acute low back pain and/or radiculopathy, nonsurgical presentation. No red flags (red flags defined in text).**

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without contrast	2		O
X-ray lumbar spine	2		☢☢☢
Myelography and postmyelography CT lumbar spine	2	In some cases postinjection CT imaging may be done without plain-film myelography.	☢☢☢☢
X-ray myelography lumbar spine	2		☢☢☢
Tc-99m bone scan with SPECT spine	2		☢☢☢
CT lumbar spine without contrast	2		☢☢☢
MRI lumbar spine without and with contrast	2		O
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Variant 2: **Patient with one or more of the following: low-velocity trauma, osteoporosis, focal and/or progressive deficit, prolonged symptom duration, age >70 years.**

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without contrast	8		O
CT lumbar spine without contrast	6	MRI preferred. CT useful if MRI is contraindicated or unavailable, and/or for problem solving.	☢☢☢
X-ray lumbar spine	6		☢☢☢
Tc-99m bone scan with SPECT spine	4	SPECT/CT may be useful for anatomic localization and problem solving.	☢☢☢
MRI lumbar spine without and with contrast	3		O
Myelography and postmyelography CT lumbar spine	1	In some cases postinjection CT imaging may be done without plain-film myelography.	☢☢☢☢
X-ray myelography lumbar spine	1		☢☢☢
X-ray discography lumbar spine	1		☢☢
X-ray discography and post-discography CT lumbar spine	1		☢☢☢

Diagnostic Imaging Pathways - Low Back Pain

Pathway Diagram



Investigation	Dose	Recommendation [Grade]	Comment
US	None	Indicated [B]	There are many causes of acute abdominal pain. US is a useful first investigation but needs to be guided by clinical findings.
AXR	☢	Specialised investigation [C]	AXR is rarely of value and is best performed under specialist guidance. Generally AXR is not undertaken before US.
CT	☢☢☢	Specialised investigation [B]	Although CT is more sensitive than US for the diagnosis of appendicitis, specificities are similar and the strategy for imaging should take into account radiation dose and clinical features.
MRI	None	Indicated only in specific circumstances [C]	Following abdominal US, when TVUS is not feasible, MRI is occasionally helpful for evaluating pelvic masses in girls.

Guideline Publication Date: November 2011

Clinical Condition: Right Lower Quadrant Pain — Suspected Appendicitis

Variant 3: Fever, leukocytosis, pregnant woman.

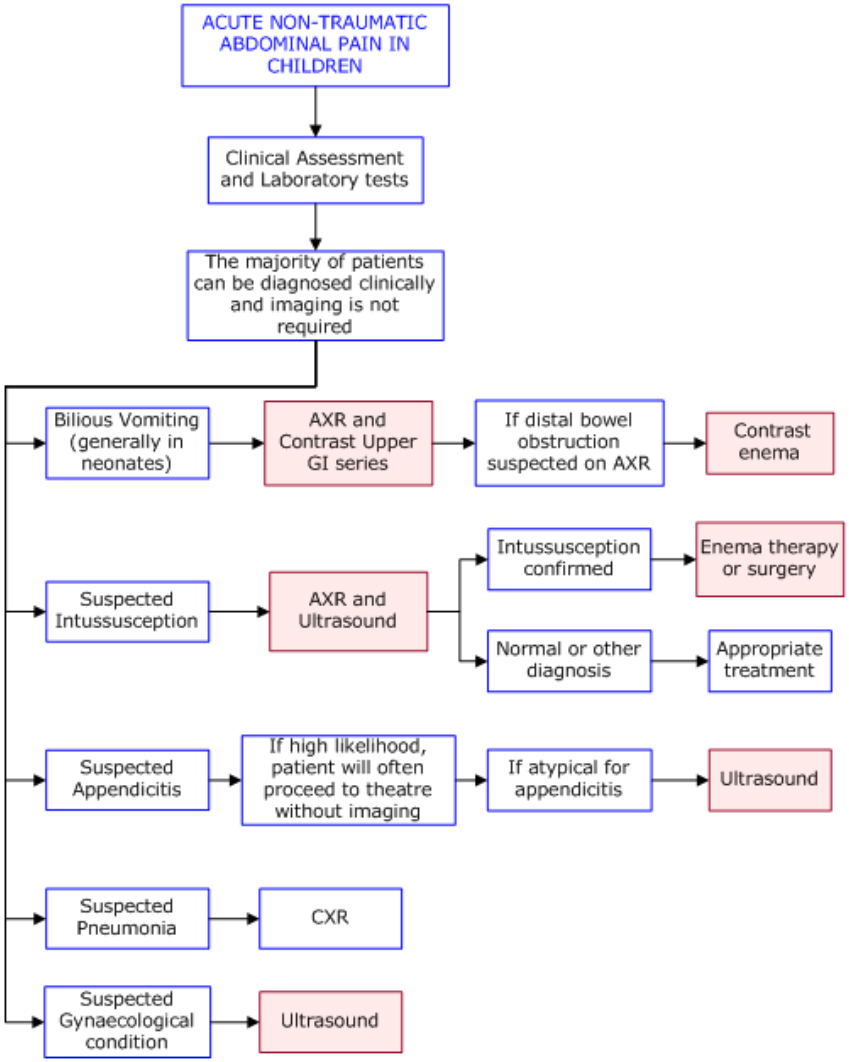
Radiologic Procedure	Rating	Comments	RRL*
US abdomen RLQ	8	With graded compression. Better in first and early second trimester.	O
MRI abdomen and pelvis without contrast	7	May be useful following negative or equivocal US.	O
US pelvis	6		O
CT abdomen and pelvis with contrast	6	Use of oral or rectal contrast depends on institutional preference.	☢☢☢☢
CT abdomen and pelvis without contrast	5	Use of oral or rectal contrast depends on institutional preference.	☢☢☢☢
X-ray abdomen	2		☢☢☢
X-ray contrast enema	2		☢☢☢
Tc-99m WBC scan abdomen and pelvis	2		☢☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Variant 4: Fever, leukocytosis, possible appendicitis, atypical presentation in children (less than 14 years of age).

Radiologic Procedure	Rating	Comments	RRL*
US abdomen RLQ	8	With graded compression.	O
CT abdomen and pelvis with contrast	7	May be useful following negative or equivocal US. Use of oral or rectal contrast depends on institutional preference. Consider limited RLQ CT.	☢☢☢☢
X-ray abdomen	6	May be useful in excluding free air or obstruction.	☢☢☢
US pelvis	5		O
CT abdomen and pelvis without contrast	5	Use of oral or rectal contrast depends on institutional preference. Consider limited RLQ CT.	☢☢☢☢
MRI abdomen and pelvis with or without contrast	5	See statement regarding contrast in text under "Anticipated Exceptions."	O
X-ray contrast enema	3		☢☢☢
Tc-99m WBC scan abdomen and pelvis	2		☢☢☢

Diagnostic Imaging Pathways - Acute Non-Traumatic Abdominal Pain in Children

Pathway Diagram



RCR Criteria for choice of investigations

For a given clinical problem, imaging modalities are listed in the order:

1. **Evidence-based diagnostic impact**

2. **Effective dose**

3. **Cost-effectiveness**

Levels of evidence for primary research question

	Type of study			
	Therapeutic studies—investigating the results of treatment	**Prognostic studies—investigating the effect of a patient characteristic on the outcome of disease**	**Diagnostic studies—investigating a diagnostic test**	**Economic and decision analyses—developing an economic or decision model**
Level I	◎ High-quality randomised controlled trial with statistically significant difference or no statistically significant difference but narrow confidence intervals ◎ Systematic review[1] of level-I randomised controlled trials (and study results were homogeneous[2])	◎ High-quality prospective study[3] (all patients were enrolled at the same point in their disease with ≥80% follow-up of enrolled patients) ◎ Systematic review[1] of level-I studies	◎ Testing of previously developed diagnostic criteria in series of consecutive patients (with universally applied reference "gold" standard) ◎ Systematic review[1] of level-I studies	◎ Sensible costs and alternatives; values obtained from many studies; multiway sensitivity analyses ◎ Systematic review[1] of level-I studies
Level II	◎ Lesser-quality randomised controlled trial (eg, <80% follow-up, no blinding, or imperfect randomisation) ◎ Prospective[3] comparative study[4] ◎ Systematic review[1] of level-II studies or level-I studies with inconsistent results	◎ Retrospective[5] study ◎ Untreated controls from a randomised controlled trial ◎ Lesser-quality prospective study (e.g., patients enrolled at different points in their disease or <80% follow-up) ◎ Systematic review[1] of level-II studies	◎ Development of diagnostic criteria on basis of consecutive patients (with universally applied reference "gold" standard) ◎ Systematic review[1] of level-II studies	◎ Sensible costs and alternatives; values obtained from limited studies; multiway sensitivity analyses ◎ Systematic review[1] of level-II studies
Level III	◎ Case-control study[6] ◎ Retrospective[5] comparative study[4] ◎ Systematic review[1] of level-III studies	◎ Case-control study[6]	◎ Study of non-consecutive patients (without consistently applied reference "gold" standard) ◎ Systematic review[1] of level-III studies	◎ Analyses based on limited alternatives and costs; imperfect estimates ◎ Systematic review[1] of level-III studies
Level IV	Case series[7]	Case series	◎ Case-control study ◎ Poor reference standard	◎ No sensitivity analyses
Level V	Expert opinion	Expert opinion	Expert opinion	Expert opinion

Radiation doses

The annual natural background radiation dose is 2.4mSv

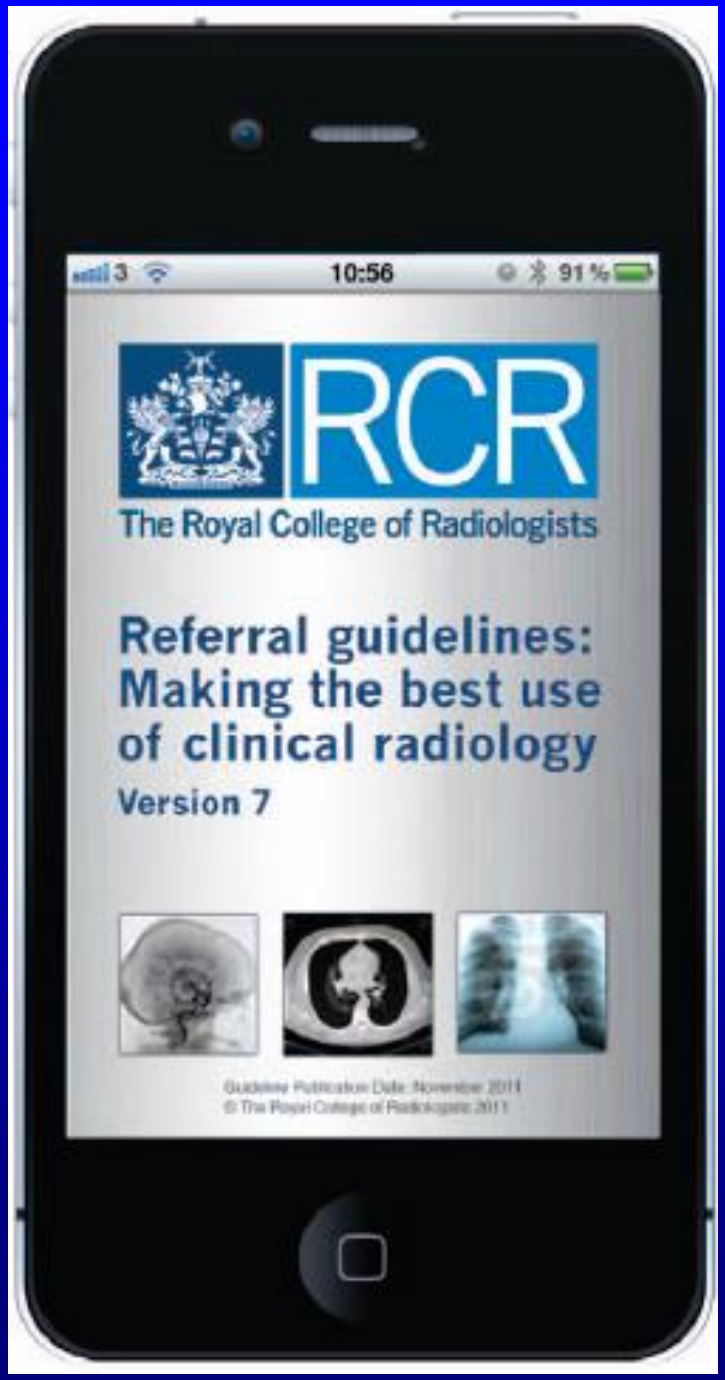
Typical effective dose (mSv)	Examples
0	US, MRI
less than 1	CXR, XR limb, XR pelvis
1-5	IVU, XR lumbar spine, NM (e.g. bone scan), CT head and neck
5-10	CT chest or abdomen, NM (e.g. cardiac)
more than 10	Extensive CT studies, some NM studies (e.g. some PET)

NHS National Tariff 2008-9	Tariff (£)	Average (£)	Reporting Fee(£)
MRI, one area, no contrast	154	MRI 169*	26
MRI, one area, post contrast only	199		
MRI, one area, pre and post contrast only	228		
MRI, 2 or 3 areas, no contrast	171		
MRI, 2 or 3 areas, with contrast	260		
CT, one area, no contrast	105	CT 131	24
CT, one area, post contrast only	131		
CT, one area, pre and post contrast only	152		
CT, 2 or 3 areas, no contrast	132		
CT, 2 areas with contrast	164		32
CT, 3 areas with contrast	176		
CT, More than 3 areas	223		
Dexa Scans	49	49	13
Contrast fluoroscopy procedures <20 mins room usage	147	159	N/A
Contrast fluoroscopy procedures >20 mins and <40 mins room usage	166		
Ultrasound, scan 0-15 mins	63	US 69	N/A
Ultrasound, scan > 15 mins	94		
Nuclear Medicine Band 1	97	228	23
Nuclear Medicine Band 2	151		
Nuclear Medicine Band 3	302		64

RCR Recommendations

- **Indicated-** likely to contribute
- **Specialised investigation-** often complex, time consuming or costly
- **Indicated only in specific circumstances-** only done if appropriate for the individual
- **Not indicated**
- Grading A-C based on evidence level
  - In 6e: 67 grade A, 409 B, 171 C.
  - In 7e: 74 grade A, 633 B, 166 C.

US DoH & Hum Services, Agency for Health Care Policy and Research. The Agency, 1993



MBUR7 Reference:	-			
Clinical/Diagnostic problem	**Investigation**	**Dose**	**Recommendation [Grade]**	**Comment**
Chronic lumbar back pain with no clinical or serological indicators of infection or neoplasia (ie, no red flags) *(For children see P11)*				Lumbar imaging for low-back pain without suggestion of serious underlying conditions does not improve clinical outcomes.
	MRI	None	Indicated only in specific circumstances [C]	MRI is the preferred investigation for the diagnosis of most spinal diseases and is helpful to identifying those patients who may benefit when planning surgical intervention.
	XR	☢	Indicated only in specific circumstances [C]	XR is only indicated if presentation suggests osteoporotic collapse in the elderly.
	CT	☢☢	Specialised investigation [C]	CT is used when MR is contraindicated and when further assessment of spondylolyses is required.
	NM	☢☢	Specialised investigation [C]	NM is non-specific, and has been largely supplanted by MR and CT in the assessment of chronic back pain. It may show occult osteoid osteomas and spondylolyses.

MeSH terms / keywords used for literature search	{back pain} OR {lower back pain} OR {low back pain} OR {backache}

Literature search:	Search Period: 1999-2009 Refs Found: 130 Refs Used: 9 Refs from Previous Eds: 0				
Literature search & Delphi Questionnaires (not for publication):	M04-M06 back pain - Literature search.doc	M04 Round 1 Delph Questionnaire.doc	M04 Delphi Round 2 Questionnaire ph&d	DELPHI RESPONSE TABLE M04.xls	
Composition of review panel (not for publication):					

Existing NICE, SIGN & ACR Appropriateness Criteria:	Low Back Pain http://www.acr.org/SecondaryMainMenuCategories/quality_safety/app_criteria/pdf/ExpertPanelonNeurologicImaging/LowBackPainDoc7.aspx Low back pain; early management of persistent non-specific low back pain. NICE May 2009 http://www.nice.org.uk/nicemedia/pdf/CG88NICEGuidelineWord.doc
Highest level of evidence:	I

Table 2. Typical effective doses from diagnostic medical exposure[21,23]

Diagnostic procedure	Typical effective dose (mSv)	Equivalent number of chest X-rays	Approx equivalent period of natural background radiation*
Radiographic examinations			
Limbs and joints (except hip)	<0.01	<1	<2 days
Chest (single PA)	0.015	1	2.5 days
Skull	0.07	5	12 days
Thoracic spine	0.4	30	2 months
Lumbar spine	0.6	40	3 months
Mammography (2 view)	0.5	35	3 months
Pelvis	0.3	20	1.5 months
Abdomen	0.4	30	2 months
IVU	2.1	140	11.5 months
Barium swallow	1.5	100	8 months
Barium meal	2	130	11 months
Barium enema	2.2	150	1 year
CT head	1.4	90	7.5 months
CT chest	6.6	440	3 years
CT KUB (for renal stones)	5.5	370	2.5 years
CT abdomen	5.6	370	2.5 years
CT abdomen & pelvis	6.7	450	3 years

doses from some CT examinations are particularly high and the use of CT is still rising. CT contributes at least half of the collective dose from all X-ray equipment and practice. It is thus particularly important that requests for CT are thoroughly justified, taking into account the age and sex of a patient,[24] and those techniques that minimise dose while retaining essential diagnostic information are adopted. Indeed, it is estimated that the additional lifetime risk of developing fatal cancer attributable to chest, abdominal and pelvic CT examination in an adult may be as high as one in 2,000.[25] However, the overall risk of cancer in the general population is nearly one in three; the excess risk of a single CT examination is very small by comparison and should be more than offset by the clinical gain.

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 3).[23,26]

Table 3. Band classification of the typical doses of ionising radiation from common imaging procedures[23,26]

Symbol	Typical effective dose (mSv)*	Examples	Lifetime additional risk of fatal cancer/exam
None	0	US; MRI	0
☢	<1	CXR; XR limb, pelvis, lumbar spine; mammography	<1:20,000
☢☢	1–5	IVU; NM (eg, bone); CT head and neck	1: 20,000–1:4,000
☢☢☢	5.1–10	CT chest or abdomen; NM (eg, cardiac)	1: 4,000–1: 2,000
☢☢☢☢	>10	Extensive CT studies, some NM studies (eg, some PET-CT)	> 1: 2,000

ACR Appropriateness Criteria dose information

Table 1. Relative radiation level designations along with common example examinations for each classification

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range	Example Examinations
O	0	0 mSv	Ultrasound; MRI
☢	<0.1 mSv	<0.03 mSv	Chest radiographs; Hand radiographs
☢☢	0.1-1 mSv	0.03-0.3 mSv	Pelvis radiographs; Mammography
☢☢☢	1-10 mSv	0.3-3 mSv	Abdomen CT, Nuclear medicine bone scan
☢☢☢☢	10-30 mSv	3-10 mSv	Abdomen CT without and with contrast; Whole body PET
☢☢☢☢☢	30-100 mSv	10-30 mSv	CTA chest abdomen and pelvis with contrast; Transjugular intrahepatic portosystemic shunt placement

*The RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, the region of the body exposed to ionizing radiation, the imaging guidance that is used, etc). The RRLs for these examinations are designated as NS (not specified).

References

1. Royal College of Radiologists. Making the best use of a department of clinical radiology: guidelines for doctors. 5th ed. London: The Royal College of Radiologists; 2003.
2. Martin CJ. Effective dose: how should it be applied to medical exposures? *Br J Radiol* 2007; 80(956):639-647.
3. International Commission on Radiological Protection, 1990 Recommendations of the International Commission on Radiological Protection, ICRP Publication 60. Ann ICRP 1991;21:1-3.
6. ICRP Publication 80: Radiation Dose to Patients from Radiopharmaceuticals. Rev ed: Elsevier; September 1, 1999.
7. Mettler FA, Jr., Huda W, Yoshizumi TT, Mahesh M. Effective doses in radiology and diagnostic nuclear medicine: a catalog. *Radiology* 2008; 248(1):254-263.
8. Wall BF, Hart D. Revised radiation doses for typical X-ray

http://www.fda.gov/cdrh/ct/2000survey.html; 2007:In publication: CRCPD publication no. E-07-02.

Guidelines appraisal

- Appraisal of Guidelines Research & Evaluation (AGREE)- instrument http://www.agreetrust.org/
- Guidelines International Network (GIN)- promotes systematic approach http://www.g-i-n.net/
- NHS Evidence Accreditation Scheme- quality mark (RCR MBUR guideline process approved)

http://www.evidence.nhs.uk/Accreditation/Pages/Accreditation.aspx

Information for
Health Professionals
Member States
Patients and Public

Member Area
• Member States Area
• Drafts Management Area

Social Media

International Workshop on Justification of Medical Exposure in Diagnostic Imaging, Brussels, Belgium, 2-4 September 2009

Albert Borschette Conference Centre(CCAB)
36. rue Froissart, Brussels, Belgium

Jointly Sponsored by the
European Commission(EC) and the International Atomic Energy Agency(IAEA)

Announcement [pdf]
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General information
Getting there [pdf]

Contact Secretariat

Background

Recommendations, standards and directives from the International Commission on Radiological Protection (ICRP), the IAEA, the EC, and most radiation protection legal systems position justification as a cornerstone for medical radiation protection. Both the IAEA and the European Union (EU) have active radiation protection programmes for patients, and successfully promote this area through education, training, scientific and technical projects, publications and educational/advisory materials, including those freely downloadable from the web.

Despite these initiatives, the approach to and compliance with justification is weak in diagnostic radiology and nuclear medicine. Work within the EU SENTINEL Project and a number of IAEA consultations confirm that the problem exists. It is also probable that there are significant justification problems in radiological practice in the developing world. In the West, recent studies indicate that >20% of examinations may not be appropriate; this can be as high as 45% in special cases, and up to 75% for specific techniques. This situation should be tackled promptly, particularly as tools are now available to improve it. The sense of urgency about the problem is reinforced by newer high dose activities in radiology, newly available tools for justification and clinical audit, the ongoing revision of the IAEA Basic Safety Standards (BSS), the recasting of the European Directives, and the requirement for an effective regulatory approach in a sensitive area.

These developments are happening against a background of worryingly increasing medical radiation doses, and the American College of Radiology (ACR) white paper noting "The rapid growth of CT and certain nuclear medicine studies may result in an increased incidence of radiation-related cancer in the not-too-distant future". These concerns provide additional motivation for dealing with justification. Finally there is a need to align medical justification with contemporary ethical and social thinking.

A workshop is the next logical step and will encourage:

- Building on the work already undertaken in the EU and by the IAEA;
- Developing strategies for improving justification in practice, and for improving its regulation and accountability;

Canadian Association of Radiologists
L'Association canadienne des radiologistes

International Guidelines Symposium

Agenda

Thursday, April 22, 2010		
7:30-8:00	**Welcome Coffee**	
8:00-8:15	Greetings	**Dr. Martin Reed**, Symposium Chair and Chair, CAR Guidelines Working Group
8:15-9:15	The World of Guideline Development: Sharing the Issues, Developing the Solutions Together	**Dr. Sara Twaddle**, President of Guidelines International Network (GIN)
9:15-10:00	The ACR Appropriateness Criteria: Aims, Scope, Methods and Utilization	**Dr. Michael Bettmann**, Chair of the Appropriateness Criteria Committee, American College of Radiology
10:00-10:30	**Mid-morning Coffee Break**	
10:30-11:15	Referral Guidelines in the UK: Making the Best Use of Clinical Radiology Services	**Dr. Denis Remedios**, Chair of the Guidelines Working Party, Royal College of Radiologists, UK
11:15-12:00	Diagnostic Imaging Pathways: An Australian Experience	**Dr. Richard Mendelson**, Editor, Diagnostic Imaging Pathways, Australia
12:00-13:15	**Lunch**	
13:15-14:00	The French Guidelines for the Clinical Use of Medical Imaging	**Dr. Philippe Grenier**, Professor of Radiology and Chair of the Committee for Referral Guidelines Société Française de Radiologie, France

World Health Organization

Medical imaging specialists call for global referral guidelines

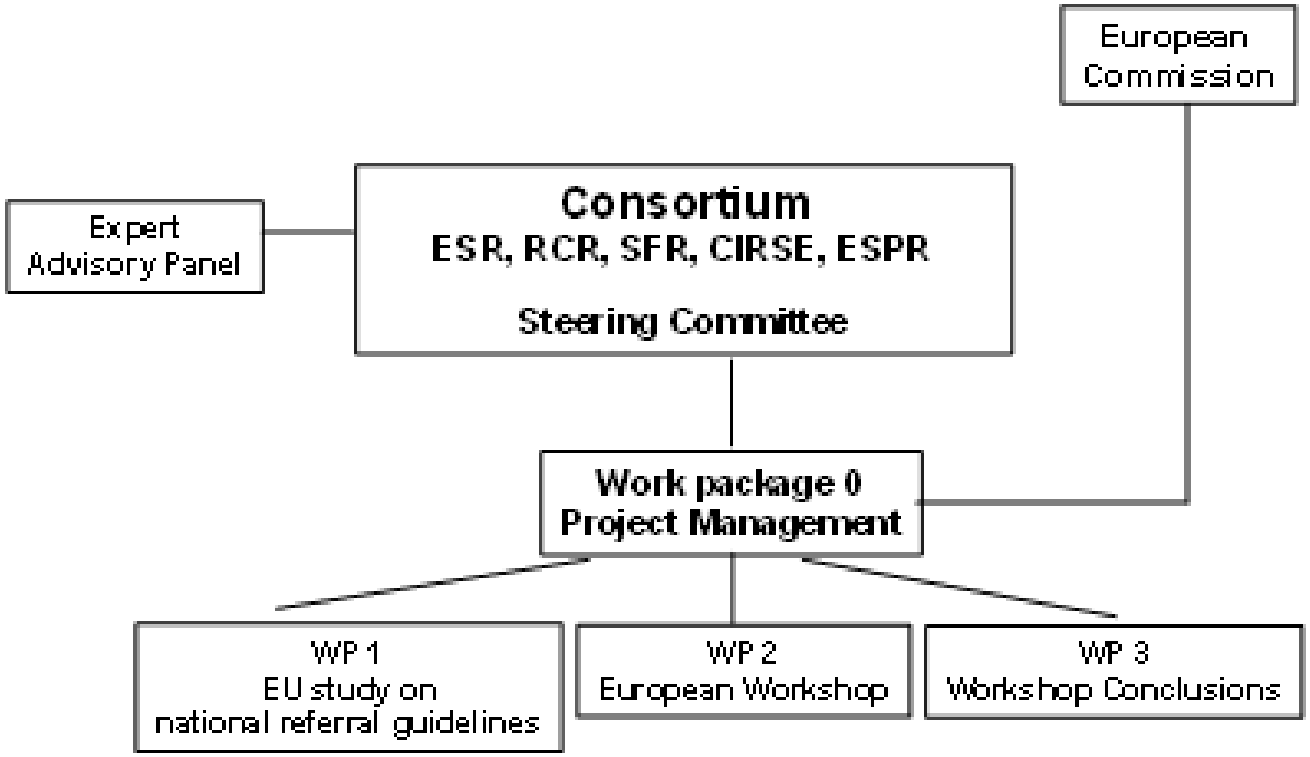
Key representatives of the world's leading medical imaging societies have recommended that a common set of global referral guidelines for appropriate use of medical imaging be produced, in the first such global meeting of experts convened under WHO auspices in nearly two decades.

Experts from international, regional and national professional societies as well as the International Atomic Energy Agency and the European Commission, met in the WHO-hosted consultation in Geneva, 1-3 March, 2010. The consultation, "Referral Guidelines for Appropriate Use of Radiation Imaging", was held in the context of the WHO Global Initiative on Radiation Safety in Health Care Settings (Global Initiative), launched in December 2008.

Their call comes in the wake of trends that have seen diagnostic imaging and interventional radiology procedures being used more and more to accurately diagnose a wide range of illnesses and injuries and provide life-saving treatment.

EC Guidelines project:

1. Study on implementation of imaging referral guidelines in EU
2. European workshop for feed-back



Technical Meeting on Radiation Protection of Patients through the Development of Appropriateness Criteria in Diagnostic Imaging

6 - 8 March 2012; Starting Tuesday 6 March 2012 at 09:30

Vienna International Centre (IAEA Headquarters); Room A2712

Background:

It is widely acknowledged that imaging is overused in clinical care, as well as inappropriately used. This is of concern to radiologists, to referring clinical healthcare providers and to patients, as well as to regulatory bodies. Although the availability and use of imaging has revolutionized medical care, it is almost inevitable that there will be some constraints on the use of imaging, because of concerns of both cost and of radiation exposure. To make the use of imaging more rational and appropriate, it is likely that constraint and guidance will come from various sources. Such efforts to change behavior and utilization are most likely to be successful if they come from professional medical groups, representing those who perform as well as order imaging. Several different organizations, among them the American College of Radiology, the Royal College of Radiologists of the UK, the Canadian Association of Radiologists, and the State of Western Australia, currently produce and disseminate guidelines. All such efforts share the goal of increasing the percentage of cases in which imaging is appropriately used in medical care, as supported by high-quality clinical guidelines. There are many organizations, in addition to those noted, that use or support the use of imaging guidelines. Although there are methodological differences, consensus appears to be emerging as to valid methodology for producing such guidelines for clinical care. It is widely accepted that such guidelines should be evidence-based to as large an extent as possible, supplemented as needed by expert opinion. It is also clear that interpretation of evidence may vary, and available evidence is rarely if ever complete or of uniformly high quality. In promulgating guidelines, many organizations suggest that it is necessary to include other advisors

Proceedings/plan-of-action published in peer-reviewed journal by participating members/organizations as well as publication/electronic dissemination of guidance on methodology by the IAEA and other organizations. Follow-up will consist of evaluation of the extent to which this aim of intersocietal, international collaboration has been achieved, and to define further steps to enhance collaboration in the production and dissemination of clinical imaging guidelines.

Referral guidelines and clinician involvement : the challenges

- Dissemination of Referral Guidelines
  - Widely and freely available to end-users

  "If they haven't heard it you haven't said it" McLuhan
- Implementation of guidance
  - decision support tools?

  "We shape our tools and thereafter our tools shape us" McLuhan
- Uptake
  - need buy-in by users and preferably ownership

  "Computers can do better than ever what needn't be done at all. Making sense is still a human monopoly" McLuhan
- Monitoring
  - clinical audit, feedback and education

  "We drive into the future using only our rearview mirror " McLuhan

Evidence for referral guidelines

- Following RCR guidelines, overall referrals fell 13%
  BMJ. 1993 Jan 9;306(6870):110-1
- RCGP Randomised controlled trial showed fewer referrals and better conformance
  Oakeshott, Kerry, Williams. Br J Gen Pract. 1994 Sep;44:427-8.
- Randomised trial with an educational reminder messages in reports is effective in reduction by up to 20% & does not affect quality of referrals.
  Eccles , Steen , Grimshaw , Thomas , McNamee , Soutter, Wilsdon , Matowe , Needham , Gilbert. The Lancet, 2001; 357: 1406 – 1409.
- Over 12 consecutive months no evidence of the effect of the intervention wearing off
  Ramsay, Eccles, Grimshaw, Steen. Clin Radiol. 2003 Apr;58(4):319-21
- Emerging evidence to show 2-20% improvement in conformance with clinical decision support tools.

Frequency and Collective Dose for Medical and Dental X-ray Examinations in the UK, 2008

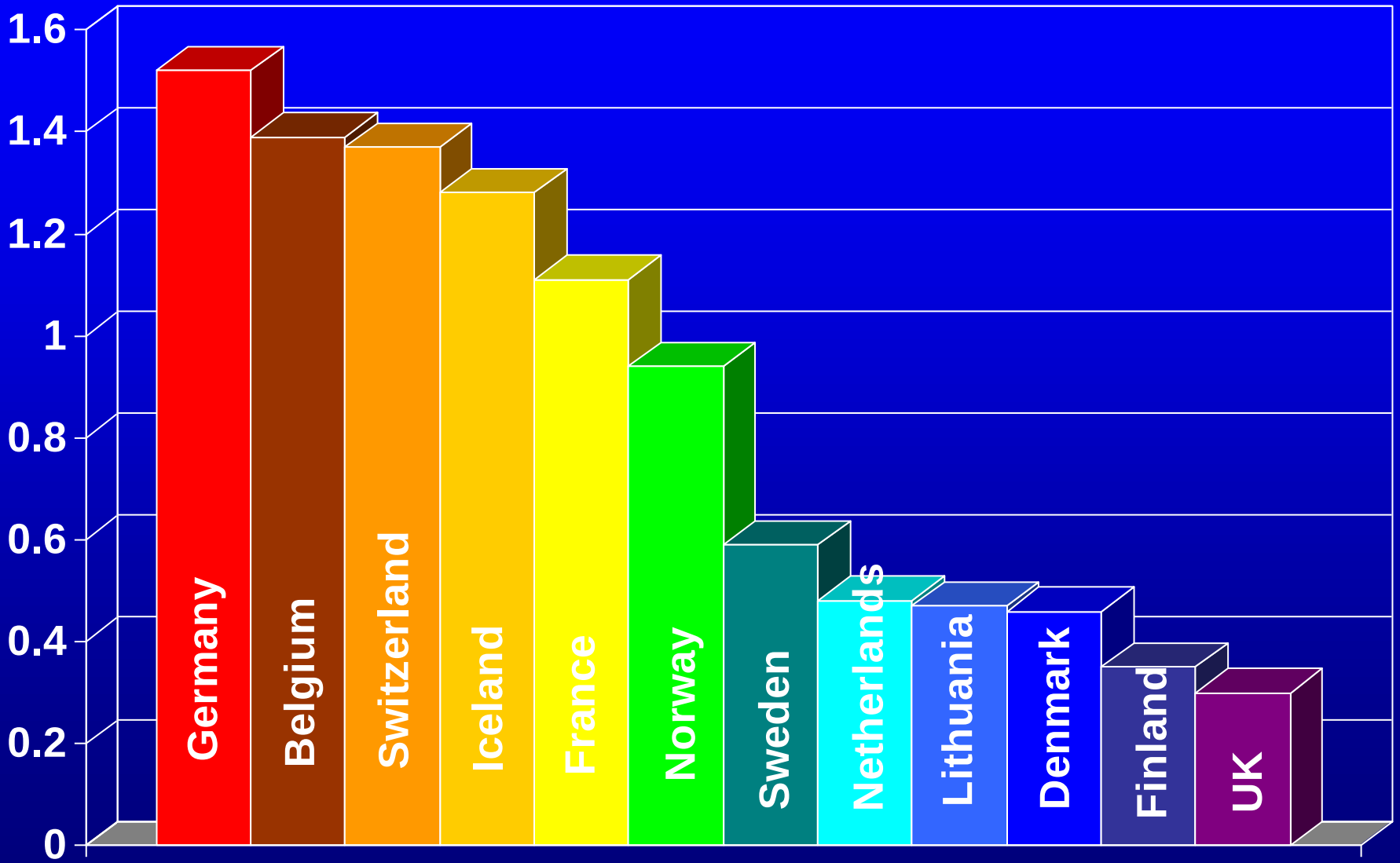
D Hart, B F Wall, M C Hillier and P C Shrimpton

http://www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1287148001641

ABSTRACT

This report presents the results of a study of frequency and collective dose for medical and dental X-ray examinations in the UK in 2008. The frequency data were collected from the radiology information systems (RIS) at a sample of 29 NHS Trusts in England. The total number of medical and dental X-ray examinations carried out in the UK, both inside and outside the NHS, is estimated by extrapolation to be 46 million in 2008, a 10% rise on the number for the financial year 1997/98. Combining effective doses (2007 definition) for specific X-ray examinations with the frequency of those examinations gives an estimate of collective dose for the UK in 2008 of 24,700 man Sv (± 12%). A very similar figure of 24,250 man Sv is obtained if the 1991 definition of effective dose is used. The UK per caput dose is therefore around 0.4 mSv per year, which has increased by 23% over that for 1997/98. This increase is mainly due to the greater prevalence of computed tomography (CT) examinations, which now account for 68% of the collective dose from all medical and dental X-ray examinations. Conventional radiographic and fluoroscopic examinations contribute only 19% of the collective dose, despite constituting 90% of all X-ray examinations. Angiography and interventional procedures contribute about 5% and 8%, respectively, to the UK collective dose from all X-ray examinations. Despite the increase in the annual UK per caput dose from 0.33 to 0.4 mSv, it is still low in comparison with other countries having similar levels of healthcare. This is due to both a lower frequency of X-ray examinations per head of population and generally lower doses per examination in the UK.

Per caput annual collective dose /mSv



The world health report

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World Health Organization Assesses the World's Health Systems

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World Health Organization Assesses the World's Health Systems

The World Health Organization has carried out the first ever analysis of the world's health systems. Using five performance indicators to measure health systems in 191 member states, it finds that France provides the best overall health care followed among major countries by Italy, Spain, Oman, Austria and Japan.

The findings are published today, 21 June, in The World Health Report 2000 – Health systems: Improving performance*.

*Copies of the Report can be ordered from bookorders@who.ch.

The U.S. health system spends a higher portion of its gross domestic product than any other country but ranks 37 out of 191 countries according to its performance, the report finds. The United Kingdom, which spends just six percent of GDP on health services, ranks 18 th . Several small countries – San Marino, Andorra, Malta and Singapore are rated close behind second- placed Italy.

WHO Director-General Dr Gro Harlem Brundtland says: "The main message from this report is that the health and well- being of people around the world depend critically on the performance of the health systems that serve them. Yet there is wide variation in performance, even among countries with similar levels of income and health expenditure. It is essential for decision- makers to understand the underlying reasons so that system performance, and hence the health of populations, can be improved."

REVIEW ARTICLE

Effects of Computerized Physician Order Entry and Clinical Decision Support Systems on Medication Safety

A Systematic Review

Rainu Kaushal, MD, MPH; Kaveh G. Shojania, MD; David W. Bates, MD, MSc

Background: Iatrogenic injuries related to medications are common, costly, and clinically significant. Computerized physician order entry (CPOE) and clinical decision support systems (CDSSs) may reduce medication error rates.

Methods: We identified trials that evaluated the effects of CPOE and CDSSs on medication safety by electronically searching MEDLINE and the Cochrane Library and by manually searching the bibliographies of retrieved articles. Studies were included for systematic review if the design was a randomized controlled trial, a nonrandomized controlled trial, or an observational study with controls and if the measured outcomes were clinical (eg, adverse drug events) or surrogate (eg, medication errors) markers. Two reviewers extracted all the data. Discussion resolved any disagreements.

Results: Five trials assessing CPOE and 7 assessing isolated CDSSs met the criteria. Of the CPOE studies, 2 demonstrated a marked decrease in the serious medication error rate, 1 an improvement in corollary orders, 1 an improvement in 5 prescribing behaviors, and 1 an improvement in nephrotoxic drug dose and frequency. Of the 7 studies evaluating isolated CDSSs, 3 demonstrated statistically significant improvements in antibiotic-associated medication errors or adverse drug events and 1 an improvement in theophylline-associated medication errors. The remaining 3 studies had nonsignificant results.

Conclusions: Use of CPOE and isolated CDSSs can substantially reduce medication error rates, but most studies have not been powered to detect differences in adverse drug events and have evaluated a small number of "homegrown" systems. Research is needed to evaluate commercial systems, to compare the various applications, to identify key components of applications, and to identify factors related to successful implementation of these systems.

Arch Intern Med. 2003;163:1409-1416

J Am Med Inform Assoc 2003;**10**:523-530 doi:10.1197/jamia.M1370

The Practice of Informatics

Synthesis of Research Paper

Ten Commandments for Effective Clinical Decision Support: Making the Practice of Evidence-based Medicine a Reality

David W Bates, MD, MSc, Gilad J Kuperman, MD, PhD, Samuel Wang, MD, PhD, Tejal Gandhi, MD, MPH, Anne Kittler, BA, Lynn Volk, MHS, Cynthia Spurr, RN, MBA, Ramin Khorasani, MD, Milenko Tanasijevic, MD, Blackford Middleton, MD, MSc, MPH

1. Speed- sub-second “screen flips”
2. Anticipate needs, deliver in real time
3. Fit into users’ workflow
4. Little things make a big difference
5. Recognise physicians resist stopping
6. Changing direction better than stopping
7. Simple interventions work best
8. Ask for additional info only if essential
9. Monitor impact, get feedback, respond
10. Manage & maintain knowledge-based system

Limiting growth of CT usage with guidelines & decision support

Radiology. 2009 Apr;251(1):147-55. Epub 2009 Feb 12.

Effect of computerized order entry with integrated decision support on the growth of outpatient procedure volumes: seven-year time series analysis.

Sistrom CL, Dang PA, Weilburg JB, Dreyer KJ, Rosenthal DI, Thrall JH.

Department of Radiology, University of Florida Health Center, PO Box 100374, Gainesville, FL 32610, USA. sistrc@radiology.ufl.edu

Abstract

PURPOSE: To determine the effect of a computerized radiology order entry (ROE) and decision support (DS) system on growth rate of outpatient computed tomography (CT), magnetic resonance (MR) imaging, and ultrasonography (US) procedure volumes over time at a large metropolitan academic medical center.

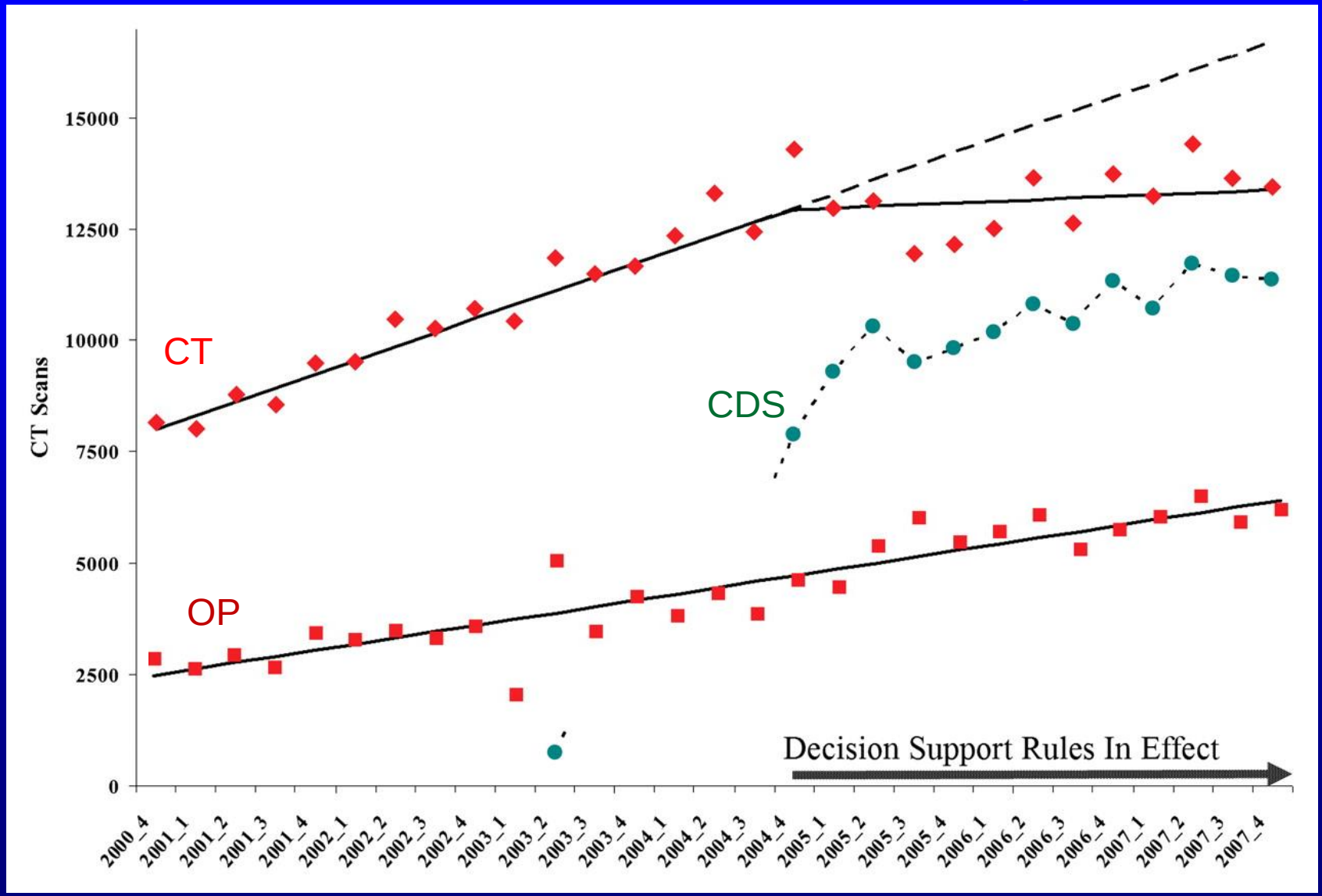
MATERIALS AND METHODS: Institutional review board approval was obtained for this study of deidentified aggregate administrative data. The research was compliant with HIPAA; informed consent was waived. This was a retrospective study of outpatient advanced imaging utilization before, during, and after implementation of a Web-based ROE and DS system. Dependent variables were the quarterly volumes of outpatient CT, MR imaging, and US examinations from quarter 4 of 2000 through quarter 4 of 2007. Outpatient visits during each quarter were included as control variables. These data were analyzed as three separate time series with piecewise linear regression for simultaneous estimation of quarterly examination volume trends before and after ROE and DS system implementation. This procedure was repeated with log-transformed quarterly volumes to estimate percentage growth rates.

RESULTS: There was a significant decrease in CT volume growth (274 per quarter) and growth rate (2.75% per quarter) after ROE and DS system implementation ($P < .001$). For MR imaging, growth rate decreased significantly (1.2%, $P = .016$) after ROE and DS system implementation; however, there was no significant change in quarterly volume growth. With US, quarterly volume growth ($n = 98$, $P = .014$) and growth rate (1.3%, $P = .001$) decreased significantly after ROE implementation. These changes occurred during a steady growth in clinic visit volumes in the associated referral practices.

CONCLUSION: Substantial decreases in the growth of outpatient CT and US procedure volume coincident with ROE implementation (supplemented by DS for CT) were observed. The utilization of outpatient MR imaging decreased less impressively, with only the rate of growth being significantly lower after interventions were in effect.

Sistrom et al. Radiology: Volume 251: Number 1—April 2009, 147

Out-patient & CT activity: pre and post decision support guidance



Sistrom C L et al. Radiology 2009;251:147-155

Why do guidelines and decision support work?

- **"Gatekeeping effect" - new (and sometimes more difficult) set of steps are required to request exam**

- **"Educational effect" new process attempts to change practice patterns (and behaviour) or at least provide some educational feedback**

J Am Coll Radiol. 2012 Feb;9(2):129-36.

Adoption and meaningful use of computerized physician order entry with an integrated clinical decision support system for radiology: ten-year analysis in an urban teaching hospital.

Ip IK, Schneider LI, Hanson R, Marchello D, Hultman P, Viera M, Chiango B, Andriole KP, Menard A, Schade S, Seltzer SE, Khorasani R.

Center for Evidence-Based Imaging, Brigham and Women's Hospital, Boston, MA 02120;, USA. iip@partners.org

Abstract

PURPOSE: The aim of this study was to assess whether an integrated imaging computerized physician order entry (CPOE) system with embedded decision support for imaging can be accepted clinically.

METHODS: The study was performed in a health care delivery network with an affiliated academic hospital. After pilot testing and user feedback, a Web-enabled CPOE system with embedded imaging decision support was phased into clinical use between 2000 and 2010 across outpatient, emergency department, and inpatient settings. The primary outcome measure was meaningful use, defined as the proportion of imaging studies performed with orders electronically created (EC) or electronically signed by an authorized provider. The secondary outcome measure was adoption, defined as the proportion of imaging studies that were ordered electronically, irrespective of who entered the order in the CPOE system. Univariate and multivariate regression analyses were performed to estimate trends and the significance of practice settings, examination modality, and body part to outcome measures. Chi-square statistics were used to assess differences across specialties.

RESULTS: A total of 4.1 million imaging studies were performed during the study period. From 2000 to 2010, significant increases in meaningful use (for EC studies, from 0.4% to 61.9%; for electronically signed studies, from 0.4% to 92.2%; $P < .005$) and the adoption of CPOE (from 0.5% to 94.6%, $P < .005$) were observed. The use of EC studies was greatest in the emergency department and inpatient settings. Meaningful use varied across specialties; surgical subspecialties had the lowest rates of EC studies.

CONCLUSIONS: Imaging CPOE with embedded decision support integrated into the IT infrastructure of the health care enterprise and clinicians' workflow can be broadly accepted clinically.

Advances in Knowledge

- Implementation of evidence-based computerized clinical decision support in the emergency department was associated with a 20.1% decrease (P = .0379) in the use of CT pulmonary angiography.
- Diagnostic yield of CT pulmonary angiography for pulmonary embolism increased 69.0% (P = .0323) in the emergency department after clinical decision support was implemented.

Effect of Computerized Clinical Decision Support on the Use and Yield of CT Pulmonary Angiography in the Emergency Department[1]

Ali S. Raja, MD, MBA, MPH
Ivan K. Ip, MD, MPH
Luciano M. Prevedello, MD
Aaron D. Sodickson, MD, PhD
Cameron Farkas
Richard D. Zane, MD
Richard Hanson
Samuel Z. Goldhaber, MD
Ritu R. Gill, MBBS
Ramin Khorasani, MD, MPH

Radiology: Volume 262: Number 2—February 2012 ▪ *radiology*

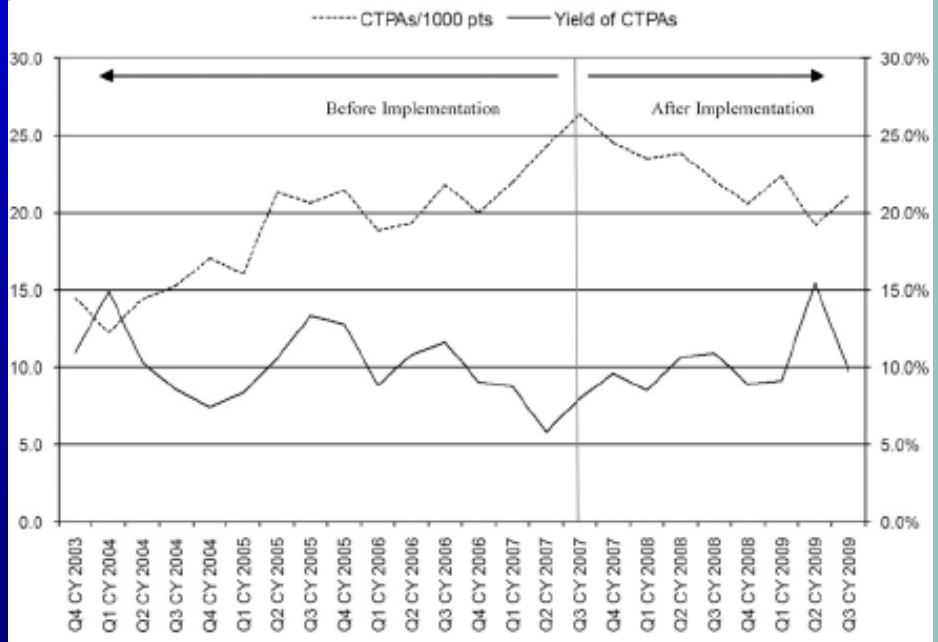


Figure 3: Graph shows CT pulmonary angiography (*CTPA*) use and yield before and after CDS implementation. *CY* = calendar year, *Q1* = first quarter, *Q2* = second quarter, *Q3* = third quarter, *Q4* = fourth quarter.

Purpose: To determine the effect of evidence-based clinical decision support (CDS) on the use and yield of computed tomographic (CT) pulmonary angiography for acute pulmonary embolism (PE) in the emergency department (ED).

Materials and Methods: Institutional review board approval was obtained for this HIPAA-compliant study, which was performed between October 1, 2003, and September 30, 2009, at a 793-bed quaternary care institution with 60000 annual ED visits. Use (number of examinations per 1000 ED visits) and yield (percentage of examinations positive for acute PE) of CT pulmonary angiography were compared before and after CDS implementation in August 2007. The authors included all adult patients presenting to the ED and developed and validated a natural language processing tool to identify acute PE diagnoses. Linear trend analysis was used to assess for variation in CT pulmonary angiography use. Logistic regression was used to determine variation in yield after controlling for patient demographic and clinical characteristics.

Results: Of 338230 patients presenting to the ED, 6838 (2.0%) underwent CT pulmonary angiography. Quarterly CT pulmonary angiography use increased 82.1% before CDS implementation, from 14.5 to 26.4 examinations per 1000 patients ($P < .0001$) between October 10, 2003, and July 31, 2007. After CDS implementation, quarterly use decreased 20.1%, from 26.4 to 21.1 examinations per 1000 patients between August 1, 2007, and September 30, 2009 (P = .0379). Overall, 686 (10.0%) of the CT pulmonary angiographic examinations performed during the 6-year period were positive for PE; subsequent to CDS implementation, yield by quarter increased 69.0%, from 5.8% to 9.8% (P = .0323).

Conclusion: Implementation of evidence-based CDS in the ED was associated with a significant decrease in use, and increase in yield, of CT pulmonary angiography for the evaluation of acute PE.



CC04: Suspected pulmonary embolism (PE)

Wells' criteria:

- *Symptoms of DVT: 3 pt*
- *No alternate diagnosis: 3 pt*
- *Heart rate >100/min: 1.5 pt*
- *Immobilisation or surgery: 1.5 pt*
- *Previous DVT or PE: 1.5 pt*
- *Haemoptysis: 1 pt*
- *Malignancy: 1 pt*

Score of ≤6 need D-dimer first

CC05: Suspected pericarditis or pericardial effusion

CC06: Chronic stable angina

CC07: Suspected valvular heart disease

CC08: Suspected heart failure and/or myocarditis

CC09: Congenital heart disease

CC10: Assessment of asymptomatic patients for cardiovascular risk

CC11: Abdominal aortic aneurysm

CC12: Suspected deep vein thrombosis (DVT) +

CC13: Ischaemic leg

Investigation	Dose	Recommendation [Grade]	Comment
Additional comments: To diagnose or to exclude thromboembolic disease, it is helpful to use an agreed protocol combining clinical features, pre-test probability and results of D-dimer assay in order to utilise imaging appropriately. In patients with high clinical suspicion but indeterminate CTPA or VQ scan, US/CT/MRI venography may help to diagnose thromboembolic disease. Choice of technique will depend upon local expertise and radiation risk. Routine CT venography with CTPA does not change the outcome.			
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.
CT pulmonary angiography (CTPA)	☢☢☢	Indicated [A]	Investigation of choice in patients with high clinical suspicion or those with moderate to low pre-test probability but positive D-dimer assay particularly in those with existing pulmonary abnormalities on CXR. Allows diagnosis of alternative causes of chest pain, assessment of right ventricle and main pulmonary artery.
NM (ventilation-perfusion scintigraphy)	☢☢	Indicated [B]	VQ scintigraphy is an alternative to CTPA in patients without pre-existing pulmonary disease and with normal CXR. In view of the lower radiation dose, VQ

Guideline Publication Date: November 2011

CDSS in Radiology: Advantages & barriers

Advantages

- Improved use of effective test
- Reduced radiation dose
- Reduction in unnecessary tests
- Audit trail for feedback

Barriers

- Computer access to imaging request
- Guidelines do not fit all patients
- Clinical condition may have different guidelines applied
- Clinician buy-in

Awareness:

efficacy, safety, cost

Daily Mail, 8.9.11

GPs TOLD: RATION CANCER SCANS

By Sophie Borland

Cancer plan undermined by PCTs

By Stephen Robinson, 08 September 2011

When the government unveiled its £750 million cancer strategy for England in December 2010, the emphasis fell squarely on early diagnosis.

http://www.gponline.com/News/article/1089232/cancer-plan-undermined-pcts/

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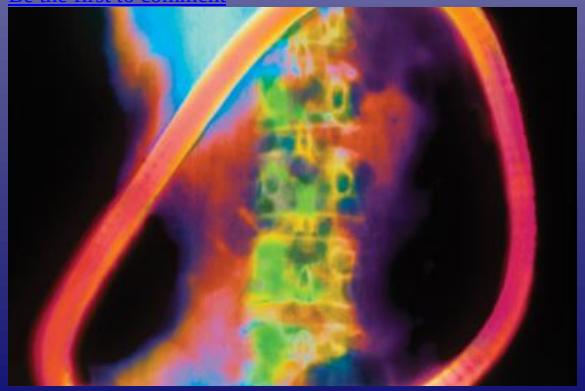

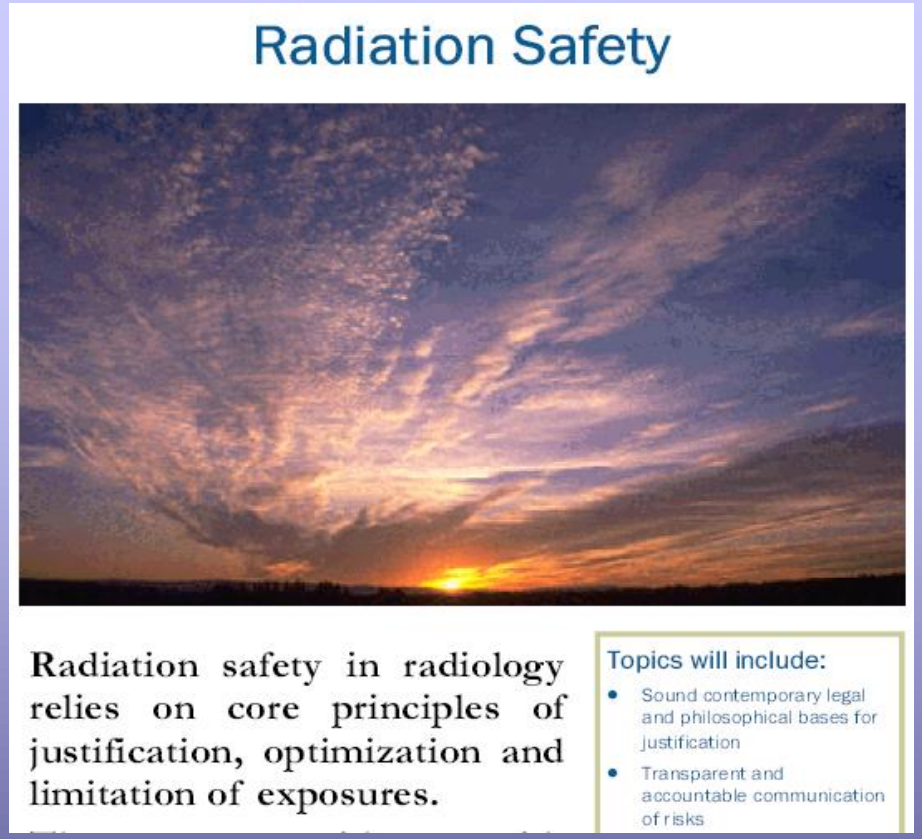

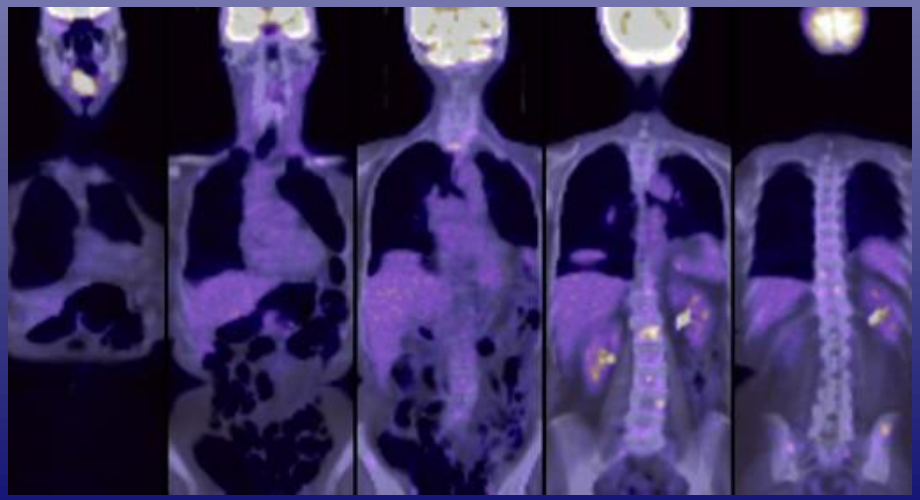

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Referring Medical Practitioners

Radiological imaging is a major and increasing source of radiation exposure worldwide. Computed tomography (CT) is the largest contributor to medical radiation dose patients receive. Typically, CT scans impart doses to organs that are 100 times higher than doses imparted by other lower dose modalities such as chest X rays. In general, CT examinations may involve doses (typically an average of 8 mSv) which may be equal to the dose received by several hundreds of chest X rays (about 0.02 mSv/chest X ray).

During an IAEA consultation on justification in 2007, it was estimated that up to 50% of examinations may not be necessary. It should be anticipated that part of the increase in global annual mean dose that has been observed recently is due to unjustified radiological procedures. Direct epidemiological data suggest that medical exposure to low doses of radiation even as low as 10-50 mSv might be associated with a small risk of cancer induction in the long term [Brenner et al., 2003]. The fact that a considerable percentage of people may undergo repeated high dose examinations, such as CT (sometimes exceeding 10 mSv per examination) [Mettler et al., 2008], dictates that caution should be used when referring a patient for radiological procedures in order to make sure the patient is substantially benefitted from the procedure and risk is kept minimal. However, ensuring maximum benefit to risk ratio for the patient is not a trivial task. Referring medical practitioners, in a large part of the world, lack training in radiation protection and in risk estimation. 97% of practitioners who participated in a study underestimated the dose the patient would receive from diagnostic procedures. The average mean dose was about 6 times higher than the physicians had estimated [Shiralkar et al., 2003].

The fundamental principles of radiation protection in medicine are justification and optimization of radiological protection. Referring medical practitioners have a major role in justification. They are responsible in terms of weighing the benefit versus the risk of a given radiological procedure.

1. What is justification and what is the framework?
2. Is the referring medical practitioner responsible for justification of radiological procedures?
3. How should justification be practiced and what knowledge is required for proper justification of a radiological procedure?
4. Is the acquisition of patients' consent important?
5. When is an investigation useful and what are the reasons that cause unnecessary use of radiation?
6. What are the reasons for over-investigating
7. Is there any guidance available?
8. What is the role of radiation protection experts?

Audit Live: Guidelines for standards

RCR The Royal College of Radiologists

Your IVU Radiograph Series
Number of radiographs obtained during intravenous urography (IVU).

IVU Examination Times
Examination times for intravenous urography (IVU).

Resuscitation Skills
Resuscitation skills within the Department of Clinical Radiology. A risk management audit.

Resuscitation Awareness
Audit of practical knowledge of advanced resuscitation skills expected of medical staff in a radiology department

Training in Gall Bladder Ultrasound
Adherence to departmental protocol during routine examination of the gall bladder by those in training.

Needlestick injury
Contaminated needlestick injury to a member of staff or the public is a serious health risk and could lead to litigation.

Pre-Op CXR for Elective Surgery
Pre-operative chest radiographs prior to elective surgery.

Bone Scan Images
Image quality of bone scans.

GP Chest Radiography
Appropriateness of requests for chest radiography from GPs.

Lumbar Spine
Lumbar spine radiography.

Out-of-Hours Imaging
Appropriateness of out-of-hours examinations.

Waiting and Appointment Times
Waiting time of patients prior to appointment.

Staff Dosimetry
Wearing of film badges during fluoroscopic procedures.

Fire Training
Attendance of staff at fire lectures.

Head CT – Lens Exclusion
Exclusion of the lens of the eye in routine head CT examinations.

Security – Staff ID
Departmental security – staff identification (ID).

Investigation of asymptomatic microscopic haematuria in adults
Assessment of compliance with agreed protocol for investigation of asymptomatic microscopic haematuria in adults.

Contrast and Drug Recording
Recording of dose, make, batch number and expiry date for contrast medium used for intravenous urograms (IVUs).

Foreign Body Radiography
Presence of a localising marker in radiography for presence of foreign bodies.

GP referrals: are the reports addressing the questions posed?
Audit of generic reporting and effective communication with GPs.

Consent for a Radiological Examination
Adequacy of consent for radiological procedures.

Pregnancy Questioning
The exclusion of pregnancy in patients who are undergoing radiography (application of the 28 day rule).

Radiology Reporting by Other Doctors
Effectiveness of arrangements to transfer the responsibility for the reporting of specified plain radiographs to referring clinicians.

Finger Doses
Radiation dose to the pulp of the index finger of staff handling syringes containing radionuclides.

Urgent CT Brain Scans and LPs
Lumbar puncture (LP) following requests for urgent CT brain scans.

Radiography in Acute Back Pain
Requests for lumbar spine radiography in patients with acute low back pain.

GP Ultrasound Requests
Indications for GP referrals for ultrasound (US) examination of the upper abdomen.

Majax Call-In
Department of Clinical Radiology call-in list for use in case of a major accident (majax).

Adequate Completion of Radiology Request Forms
Adequacy of completion of radiology request forms.

Gonad Protection II
Use of gonad protection.

Imaging in symptomatic breast disease
An audit to assess compliance with imaging guidelines within the symptomatic breast clinic.

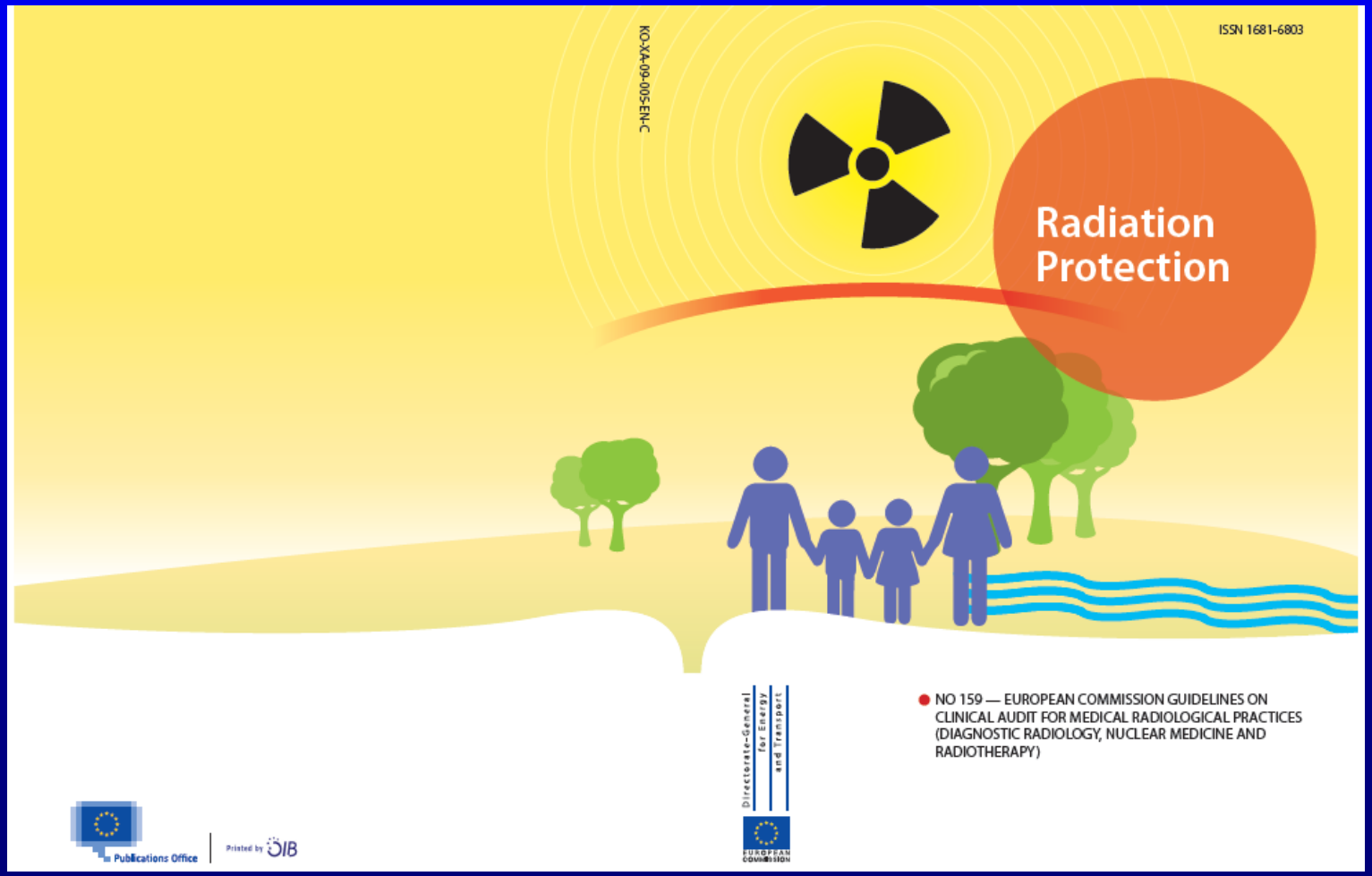
Cancer Staging
Staging of common cancers using CT or MRI.

Reporting: GP referrals for plain radiography
General practitioners depend upon timely and accurate reports for the management of their patients.

An individual radiologist's workload
The number of reports issued by an individual radiologist.

EC guidelines on clinical audit for medical radiological practice

http://ec.europa.eu/energy/nuclear/radiation_protection/doc/publication/159.pdf



Guidelines to reduce CT over-use: Conclusions

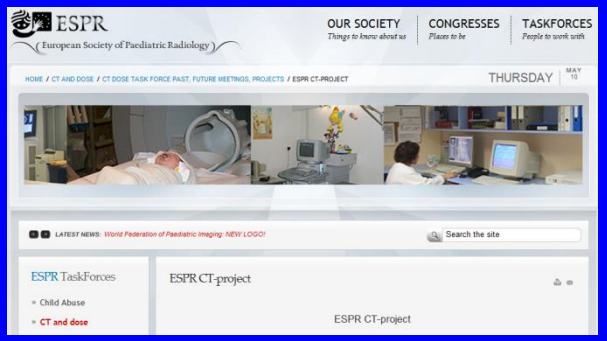
- **Faster justification and access to the best test first for *all* health professionals using evidence-based referral guidelines (& CDS)**
- **Higher level of appropriateness for lower per caput collective doses**
- **Stronger collaboration through education for better outcomes**

"Awareness, appropriateness for all, and audit"

The rapid expansion of CT can be adequately justified through the existing framework of referral criteria: *Rebuttals and summary*

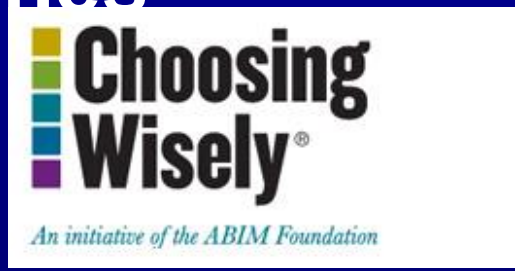
Denis Remedios

Consultant Radiologist, Northwick Park Hospital, London



Guidelines and risk

- Although guidelines cannot estimate an individual's radiation risk, there is an attempt to balance risk & benefit of best evidence-based practice
- Risk assessment facilitated for **all** healthcare workers using guidelines
- Risk communication by referrers to patients reinforced by guidelines



T01: Head injury

The following clinical features indicate a risk of significant brain injury:

- *GCS less than 13 on initial assessment in the emergency department*
- *GCS less than 15 at 2 hours after the injury*
- *Suspected open or depressed skull fracture*
- *Any sign of basal skull fracture (haemotympanum, 'panda' eyes, cerebrospinal fluid leakage from the ear or nose, Battle's sign)*
- *More than one episode of vomiting in adults; three or more episodes of vomiting in children*
- *Post-traumatic seizure*
- *Coagulopathy (history of bleeding, clotting disorder, current treatment with warfarin) providing that some loss of consciousness or amnesia has been experienced; patients receiving antiplatelet therapy may be at increased risk of*

Investigation	Dose	Recommendation [Grade]	Comment
CT	☢☢	Indicated [B]	Head CT should be available in all hospitals responsible for

Guidelines for CT

- When combined with clinical red flags, guidelines are an efficient tool for identifying those with high pre-test probability with greatest benefit from test
- Helpful for clinical problem & for selective screening eg Ca, CV risk
- May include hints for optimisation eg low dose CT KUB,

Guidelines to justify CT

For

- Balance of risk & evidence-based benefit
- All health workers who refer can use
- Alternative lo dose test may be recommended
- Useful to select those for screening
- Allows for growth in appropriate CT use
- May reduce by 20%

Against

- ICRP level 2 rather than level 3 justification
- Not all medical conditions are covered