



IAEA

60 Years

Atoms for Peace and Development

Justification of Medical Exposure

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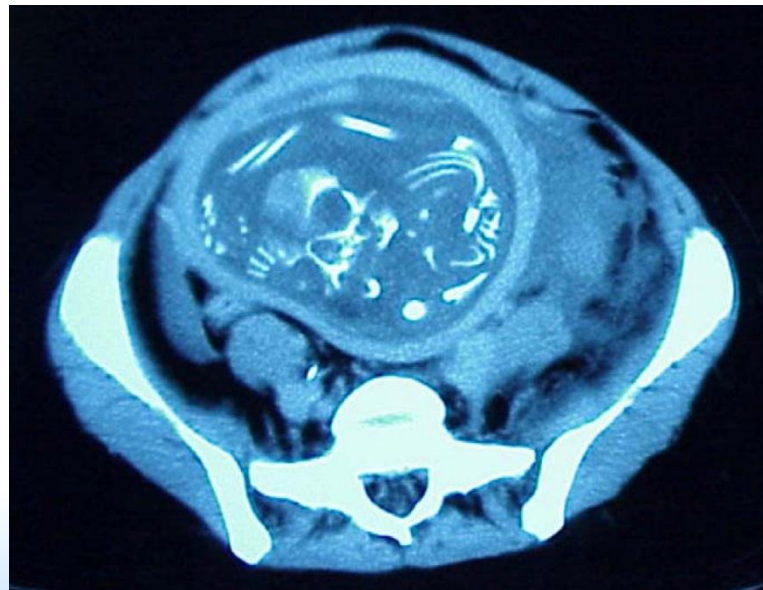
Division of Radiation, Transport and Waste Safety

24 October 2016

Ionizing radiation in medical imaging

The use of ionizing radiation in diagnostic imaging brings tremendous benefits to the global population

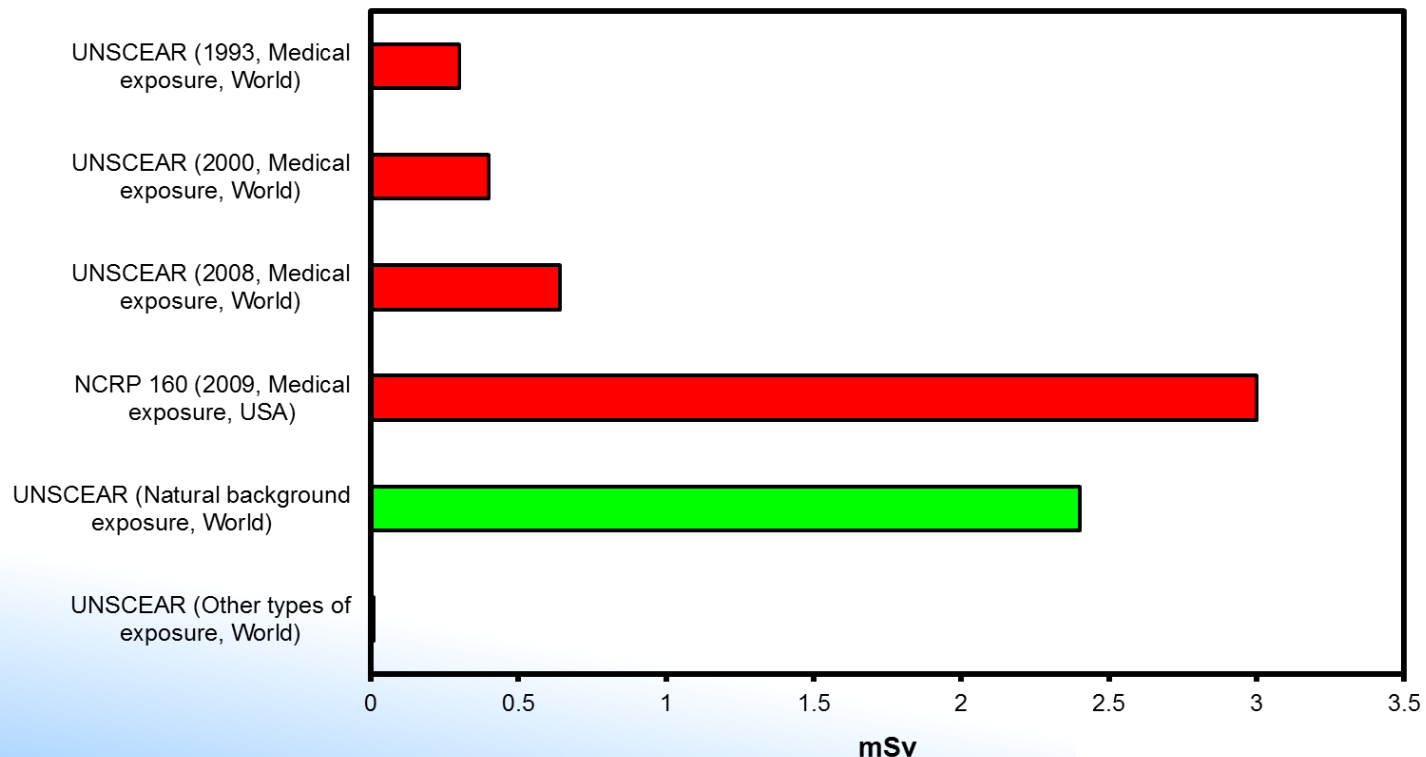
- An estimated **33 million** diagnostic nuclear medicine procedures annually in the world*
- An estimated **3.6 billion** diagnostic radiology procedures annually in the world*



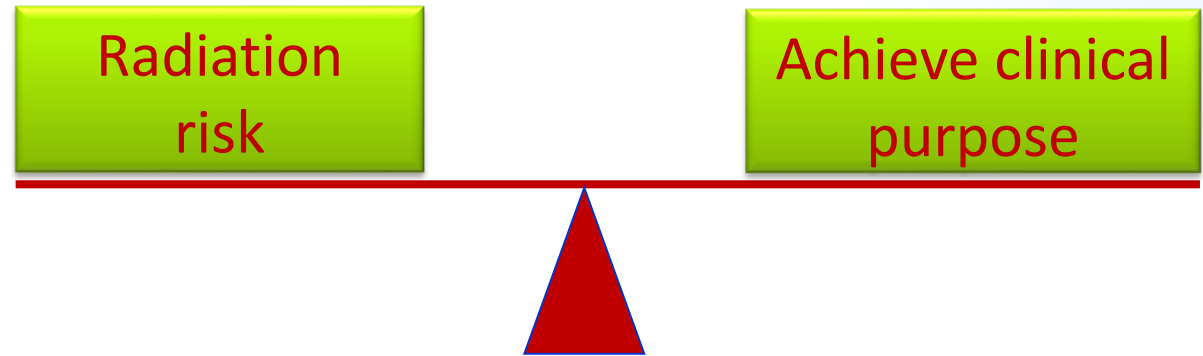
* UNSCEAR 2008 Report

Ionizing radiation in medical imaging

- Evidence that many individual medical procedures are **lacking in justification and optimization**, giving rise to a very significant **unnecessary exposure** of the world's population
- A **substantial fraction (20% to 40%)** of individual radiological examinations may be **unnecessary**



A need for radiation protection in medicine



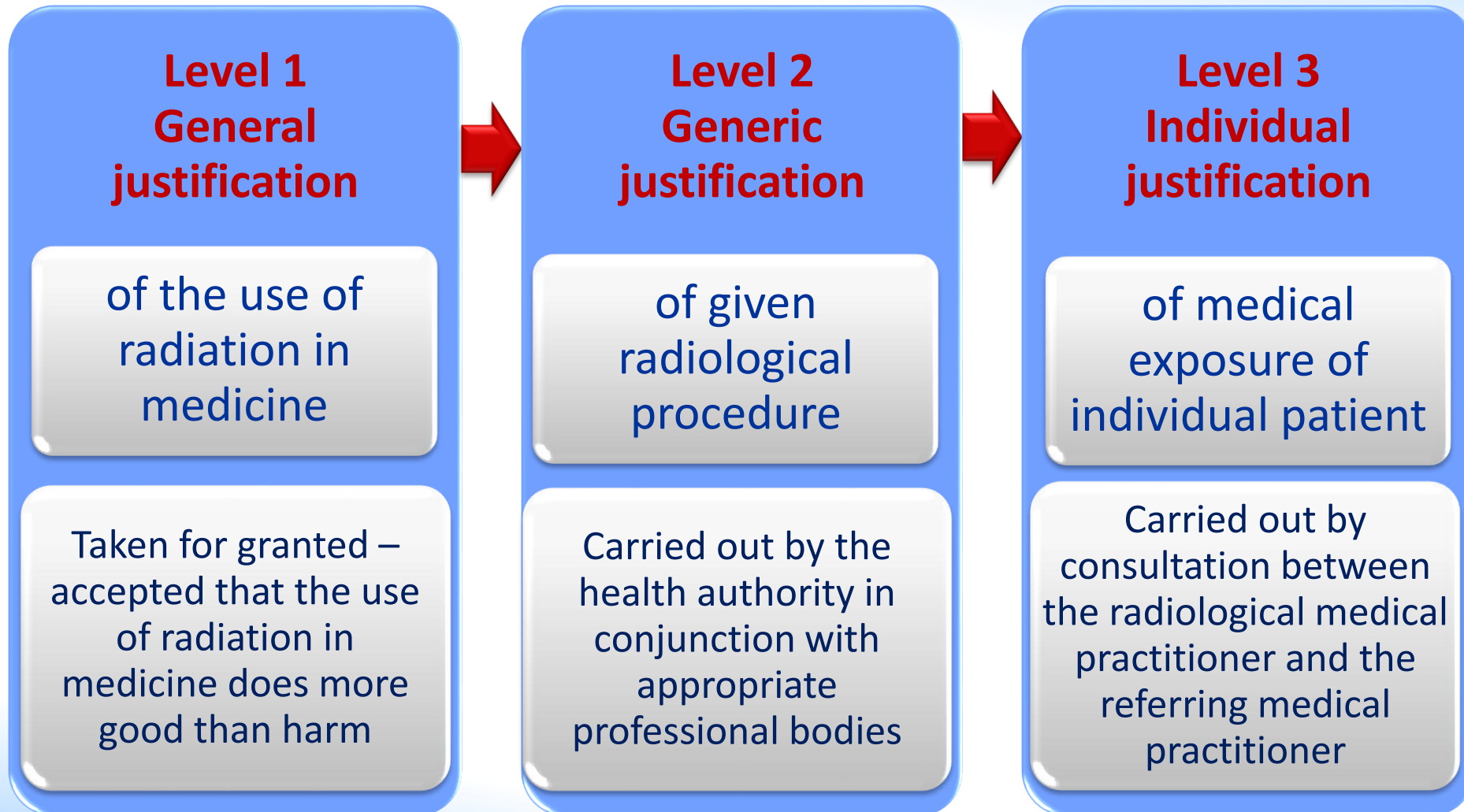
- ICRP principles of radiation protection
 - Dose limits don't apply to medical exposures
 - Justification - net benefit for the patient
 - Optimization - achieve clinical purpose with appropriate dose management

Radiation risk debate

- **Radiation exposure in medicine has risk but we need more research in the area of low dose exposure over time**
- **Radiation in medicine saves lives**
- **Radiation in medicine is a wonderful tool when used appropriately:**
 - fast, no sedation or anaesthesia
 - great anatomical accuracy
 - better, safer surgery
 - more accurate staging in oncology
 - best for lungs, bone detail
- **When justified, benefits outweigh the risks**



Justification: perform only appropriate



A priority for the IAEA

Justification of medical exposure in diagnostic imaging

1. International BSS
2. Safety Guide on medical uses
3. Technical Meetings on justification
4. Other actions
5. Bonn Call-for-Action

Key-points on justification

- The justification of medical exposure for an individual patient shall be carried out by means of **consultation between the radiological medical practitioner and the referring medical practitioner**, as appropriate, with account taken, in particular for patients who are pregnant or breast-feeding or are paediatric, of:
 - (a) The appropriateness of the request;
 - (b) The urgency of the radiological procedure;
 - (c) The characteristics of the medical exposure;
 - (d) The characteristics of the individual patient;
 - (e) Relevant information from the patient's previous radiological procedures.
- **Relevant national or international referral guidelines shall be taken into account for the justification** of the medical exposure of an individual patient in a radiological procedure.

Upcoming Safety Guide on medical uses



- **Safety Guide on Radiation Protection and Safety in Medical Uses of Ionizing Radiation (IAEA Safety Standards)**
 - Co-sponsorship by WHO, PAHO and ILO pursued
 - Accompanying the newly published International Basic Safety Standards, describing how to apply the BSS to medical uses of ionizing radiation (medical, occupational and public radiation protection in this context). Modality specific chapters.
 - Intended primarily for regulators and end-users, but also of relevance for e.g. professional bodies.
 - Went to Radiation Safety Standards Committee at the end of 2014, and received comments by MS and organizations early 2015. Went to Commission on Safety Standards (CSS) in early 2016. To be reported on at CSS 6-8 April 2016 for final endorsement.
 - Justification of medical exposures gone through in more detail in the Safety Guide, also the role of the medical radiation technologist

Technical Meetings on justification

- Technical Meetings and Consultancies on justification
 - Consultancies resulting in the proposal of AAA (Awareness, Appropriateness, Audit) to strengthen justification of medical exposure in diagnostic imaging
 - Effective communication about risk
 - Up-to-date referral guidelines / appropriateness criteria / clinical imaging guidelines
 - Clinical audit of justification
 - Joint IAEA/EC International Workshop (Sep '09) resulting in 16 agreed points as a conclusion (in proceedings)
 - TM's on justification of medical exposure and the use of appropriateness criteria, together with main developers of these criteria, and also on exposure tracking

Proceedings Series

Justification of diagnostic medical exposures: some practical issues. Report of an International Atomic Energy Agency Consultation

^{1,2}J MALONE, PhD, FIPEM, ³R GULERIA, MD, DM, ⁴C CRAVEN, ⁵P HORTON, PhD, FInstP, ⁶H JÄRVINEN, ⁷J MAYO, MD, ⁸G O'REILLY, MSc, PhD, ⁹E PICANO, MD, PhD, ¹⁰D REMEDIOS, FRCR, ¹¹J LE HERON, FACPSEM, ¹¹M REHANI, PhD, ¹¹O HOLMBERG, PhD and ¹¹R CZARWINSKI, MSc

Justification of Medical Exposure in Diagnostic Imaging

Proceedings of an International Workshop
Brussels, 2–4 September 2009



STATEMENT CONCERNING THE INCREASED USE OF COMPUTED TOMOGRAPHY IN THE NORDIC COUNTRIES

The Nordic Radiation Protection co-operation

The Nordic radiation protection authorities are concerned about the increased use of computed tomography (CT). They want to draw attention to the potential risks involved and avert unjustified CT examinations by implementing the "triple A" concept: Awareness, Appropriateness and Audit. The Nordic authorities have agreed to issue this joint statement directed to the professional societies and health authorities, notwithstanding the distinct recognition of the large benefits of CT as a diagnostic tool.

Introduction

The background for this statement is the increased number of Computed Tomography (CT) scanners taken into use in radiology, which first of all is for the benefit of patients. However, the increase of the diagnostic capacities and capabilities has resulted in a considerable increase in the number of CT procedures (Figure 1).

Technical Meetings on justification

- Meetings on justification of medical exposure and the **role of clinical imaging guidelines (CIG)** in strengthening justification of medical diagnostic imaging, **jointly with the WHO**
- Only few organizations have capacity to develop and maintain these guidelines – meetings concluded on **adopting and adapting** these



One example of promoting justification

10 Pearls: **Appropriate referral** for CT examinations



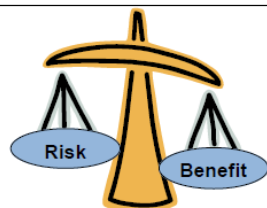
1. Avoid inappropriate examinations by asking yourself:

- Has it been done already?
- Do I need it?
- Do I need it now?
- Is this the best examination?
- Have I explained the clinical problem?

Adapted from: iRefer: Making the best use of clinical radiology. Royal College of Radiologists
<http://www.rcr.ac.uk/content.aspx?PageID=995>

More information at:
https://rpop.iaea.org/RPOP/RPoP/Content/InformationFor/HealthProfessionals/6_OtherClinicalSpecialties/referring-medical-practitioners/index.htm

2. Discussion with the radiologist may help strengthen the justification process and reduce unhelpful imaging



3. Inform and discuss with the patient the benefits and risks of the examination

4. Keep informed about the appropriateness criteria and referral guidelines and use them in daily practice



Diagnostic Imaging Pathways
<http://www.imagingpathways.health.wa.gov.au/includes/index.html>



ACR
Appropriateness Criteria®
<http://www.acr.org/ac>

<http://www.rcr.ac.uk/content.aspx?PageID=995>



Related Poster!
10 Pearls: Radiation protection of patients in CT
<https://rpop.iaea.org/RPOP/RPoP/Content/Documents/Whitepapers/poster-ct-radiation-protection.pdf>

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Computed Tomography
Ensuring appropriate referrals

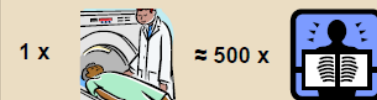
<http://rpop.iaea.org>

10 Pearls: **Appropriate referral** for CT examinations

5. Consult the radiologist/medical physicist and seek information at:

- https://rpop.iaea.org/RPOP/RPoP/Content/InformationFor/HealthProfessionals/6_OtherClinicalSpecialties/referring-medical-practitioners/index.htm
- <https://rpop.iaea.org>

CT scans are among the most common radiation dose burdening examinations for patients



The effective dose from one chest CT scan may be equal to the corresponding dose of about 500 PA chest X rays



6. Be particularly careful to avoid inappropriate paediatric examinations. Some tissues in children are more sensitive to radiation and they have a longer lifespan over which cancer effects may be expressed

7. While the risk of cancer due to the x-rays from CT scans is very low, there is evidence that multiple CT scans can slightly increase the risk in children

Minimize the number of CT scans, especially in children



Doctor, don't you think I should have a new chest CT scan? Just to be on the safe side



No Ms Williams, I really think that this examination will not add something to the correct assessment of your condition

9. Resist patient wishes to be examined when you feel it is not necessary



8. Always ask if the woman of reproductive age could be pregnant



Tell me please: Have you had any other CT scans recently?

10. Repeat scanning of the patient to save time because previous records are not readily available is not part of a good practice



Related Poster!
10 Pearls: Radiation protection of patients in CT
<https://rpop.iaea.org/RPOP/RPoP/Content/Documents/Whitepapers/poster-ct-radiation-protection.pdf>

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Computed Tomography
Ensuring appropriate referrals

<http://rpop.iaea.org>

RPOP Website

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Be Informed About the Safe Use of Ionizing Radiation in Medicine

Information to help health professionals achieve safer use of radiation in medicine for the benefit of patients

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Member States
Patients and Public

Additional Resources
Publications
International Standards
Training | Poster | Movie

Special Groups
Pregnant Women
Children

Member Area
Member States Area
Drafts Management Area

Latest Literature

MALONE J, DEL ROSARIO-PEREZ M, VAN BLADEL L, JUNO SE, HOLMBERG O, BETTMANN MA. Clinical imaging guidelines part 2: risks, benefits, barriers, and solutions. J Am Coll Radiol. 12 2 (Feb 2015) 158-65. doi: 10.1016/j.jacr.2014.07.024. Abstract >

REMEDIOS D, BRINK J, HOLMBERG O, KAWOYIA M, MENDELSON R, NAIDOO A, REED M, BETTMANN M. Members of the IAEA Technical Meetings on Radiation Protection of Patients Through the Development of Appropriateness Criteria in Diagnostic Imaging. Clinical imaging guidelines part 1: a proposal for uniform methodology. J Am Coll Radiol. 12 1 (Jan 2015) 45-50. doi: 10.1016/j.jacr.2014.07.023. Epub 2014 Oct 13. Abstract >

VASSILEVA J, REHANI. Diagnostic reference levels: AJR Am J Roentgenol. 204 1 (Jan 2015). W1-3. doi: 10.2214/AJR.14.12794. Physics Minireview. Full text >

BETTMANN MA, HOLMBERG O, DEL ROSARIO PEREZ M, REMEDIOS D, MALONE J. International collaboration on clinical imaging guidelines: many hands make light work. J Am Coll Radiol. 12 1 (Jan 2015) 43-4. doi: 10.1016/j.jacr.2014.09.033. Abstract >

Did You Know That...

66. You do NOT become radioactive after external beam radiotherapy and thus do not pose radiation risk to others in your surroundings.

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RPOP on Twitter

Latest News

The European Commission's publication on Medical Radiation Exposure
A new publication has been issued in the Radiation protection series

World Cancer Day
The worldwide campaign World Cancer Day took place on 4 February 2015

Occupational radiation protection posters
New posters are now available for download

NCRP Statement on fluoroscopically-guided interventions subset of potentially high-dose procedures
The NCRP Statement has been published

Upcoming Events

Technical Meeting on Justification of Medical Exposure
9-11 March 2015, Vienna, Austria

World Congress of Medical Physics & Biomedical Engineering
7-12 June 2015, Toronto, Canada

All Events >

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Referring Medical Practitioners

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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.

Related Links

Poster for this group

- What is justification and what is the framework?
- Is the referring medical practitioner responsible for justification of radiological procedures?
- How should justification be practiced and what knowledge is required for proper justification of a radiological procedure?
- Is the acquisition of patients' consent important?
- When is an investigation useful and what are the reasons that cause unnecessary use of radiation?
- What are the reasons for over-investigating?
- Is there any guidance available?
- What is the role of radiation protection experts?
- Which procedures are responsible for the highest doses to the patient?
- What if the patient whom I refer for a radiological procedure is pregnant?
- Should pregnant patients undergo radiological procedures?
- Do radiological procedures cause acute radiation injury?

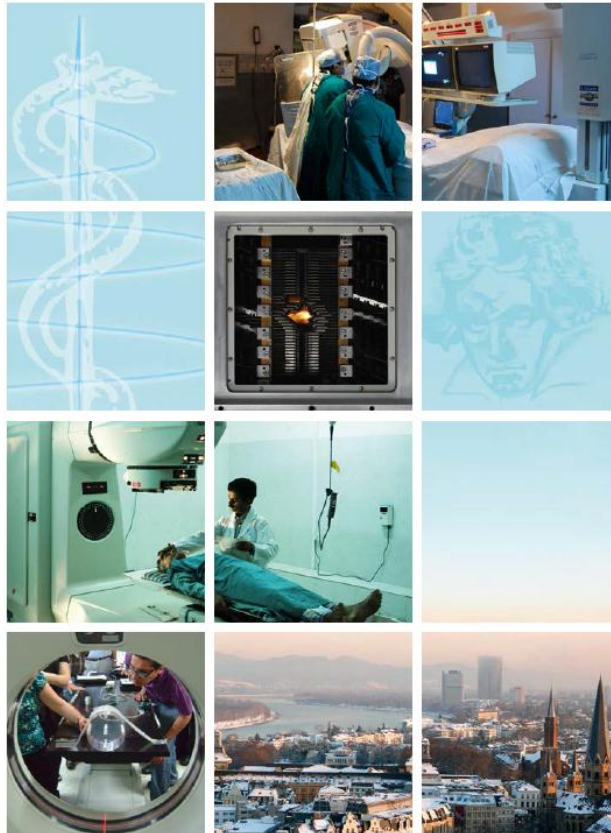
Regularly updated, reaching a broad audience, with >800,000 page views per year on rpop.iaea.org + Switch between English and Spanish

1. What is justification and what is the framework?

Justification requires that the expected net benefit be positive. According to principles established by the International Commission on Radiological Protection (ICRP) [ICRP, 1983] and accepted by major international organizations, the principle of justification applies at three levels in the use of radiation in medicine.

- At the first level, the use of radiation in medicine is accepted as doing more good than harm to the patient. This level of justification is now taken for granted. According to the revised International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (BSS), generic justification of a radiological procedure shall be carried out by the health authority in conjunction with appropriate professional bodies, and shall be reviewed from time to time, with account taken of advances in knowledge and technological developments [IAEA BSS, Interim edition].

Bonn Call-for-Action, with WHO



BONN CALL FOR ACTION

10 Actions to Improve Radiation Protection
in Medicine in the Next Decade

01

Enhance the implementation of the principle of justification

- Introduce and apply the 3A's (awareness, appropriateness and audit), which are seen as tools that are likely to facilitate and enhance justification in practice;
- Develop harmonized evidence-based criteria to strengthen the appropriateness of clinical imaging, including diagnostic nuclear medicine and non-ionizing radiation procedures, and involve all stakeholders in this development;
- Implement clinical imaging referral guidelines globally, keeping local and regional variations in mind, and ensure regular updating, sustainability and availability of these guidelines;
- Strengthen the application of clinical audit in relation to justification, ensuring that justification becomes an effective, transparent and accountable part of normal radiological practice;
- Introduce information technology solutions, such as decision support tools in clinical imaging, and ensure that these are available and freely accessible at the point-of-care;
- Further develop criteria for justification of health screening programmes for asymptomatic populations (e.g. mammography screening) and for medical imaging of asymptomatic individuals who are not participating in approved health screening programmes (e.g. use of CT for individual health surveillance).

Proceedings from Bonn

- Including a number of papers on justification
- Free to download (rpop.iaea.org)

JUSTIFICATION AND THE ROLE OF TECHNOLOGY AND ALGORITHMS

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Abstract

Justification of the use of ionizing radiation is one of the pillars of radiation protection in medical practice. While there are often clear justifications for performing diagnostic imaging examinations, there are many situations in which justification is arguable. Determining what is justified is an extremely complicated aspect of medical practice as it potentially involves multiple health care providers, with varying levels of experience, anecdotal based decision making and a broad variety of other forces. It is beyond the scope of this paper to fully dissect this aspect of justification in medical imaging. However, the tools that are becoming available for improving evidence based medicine, including decision rules, practice guidelines and appropriateness criteria, and point-of-care decision support systems. Many of these advancements are becoming embedded in electronic health care systems following material will present background information, define some of the terms involved in "algorithms" for improving justification, address the current status, provide the challenges in implementing models for improved justification of medical imaging and present some of the current needs.

1. BACKGROUND

Globally, and certainly within the United States of America, the use of diagnostic imaging which employs ionizing radiation is certainly increasing. For example, the use of computed tomography (CT) in the USA over the last 30 years or so has increased nearly 600% [1]. This increased use of medical imaging has some associated potential health risks, but costs also have significant financial implications for health care delivery as well as utilization of limited resources, such as equipment and medical personnel. With increased scrutiny on delivery of radiation, as well as some of these health care considerations, increased attention, particularly in more developed countries,

STRATEGIES FOR IMPROVING JUSTIFICATION

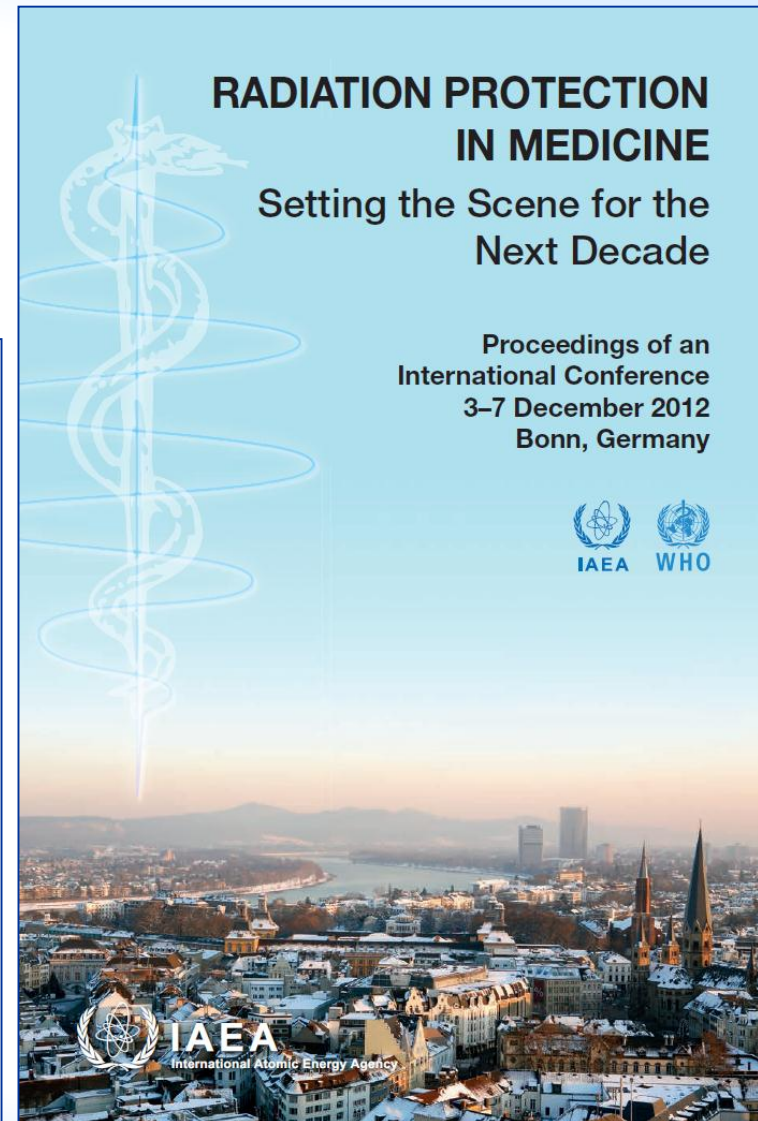
J. MALONE
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Abstract

Good practice in radiology relies on a core principle that each examination is justified for the patient involved. An international workshop organized by the IAEA and the European Commission concluded that: "There is a significant and systemic practice of inappropriate examination in radiology." Audit reveals that 20-50% of examinations are routinely not justified and the figure can be as high as 60-77% in particular cases (e.g. for lumbar spine examinations or cardiac angiography). Doctors/health professionals generally have poor awareness of the risks involved and consistently underestimate them. Knowledge of, and compliance with, guidelines for referral for common examinations is poor. The ethical background considerations to this situation are briefly reviewed and a strategy for improvement is proposed, i.e. the global "three As" campaign of improving awareness, appropriateness and audit adopted by the IAEA.

1. INTRODUCTION

A joint IAEA/European Commission workshop identified the fact that there is a systemic failure of justification in medical radiology [1]. It is easy to overlook justification and risk-benefit analysis in busy, technically excellent departments, in which the scale of practice verges on the industrial. Such assessments involve a potent mix of values (ethics), science and medicine. Other international bodies, the World Health Organization, International Radiation Protection Association (IRPA) and Nuclear Energy Agency, simultaneously expressed concern or have taken related actions. The IAEA/European Commission joint workshop identified the three As as a viable and mature way forward. These are: awareness, appropriateness and audit. The approach is fundamentally based on ethical considerations although financial and health technology assessment issues are also important [2-4]. The Nordic countries have endorsed the three As approach and the heads of the European Regulatory Competent Authorities have also expressed support for the approach.



Next: international conference



60 Years
Atoms for Peace and Development



Bonn:
536 participants from 77 countries
and 16 organizations



BONN CALL FOR ACTION

10 Actions to Improve Radiation Protection
in Medicine in the Next Decade

- International Conference on Radiation Protection in Medicine
- 11-15 December 2017 (5 years since Bonn)
- Following up on the Bonn Call-for-Action



IAEA

60 Years

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Thank you!

