INTERNATIONAL WORKSHOP ON OPTIMIZATION OF RADIATION PROTECTION MEDICAL STAFF. ORAMED 2011

International Basic Safety Standards for Protection against Ionizing Radiation and its relevance for occupational radiation protection in medical applications. Current IAEA activities

Rodolfo Cruz Suarez

Radiation Safety and Monitoring Section

Division for Radiation, Waste and Transport Safety
Department of Nuclear Safety and Security
International Atomic Energy Agency

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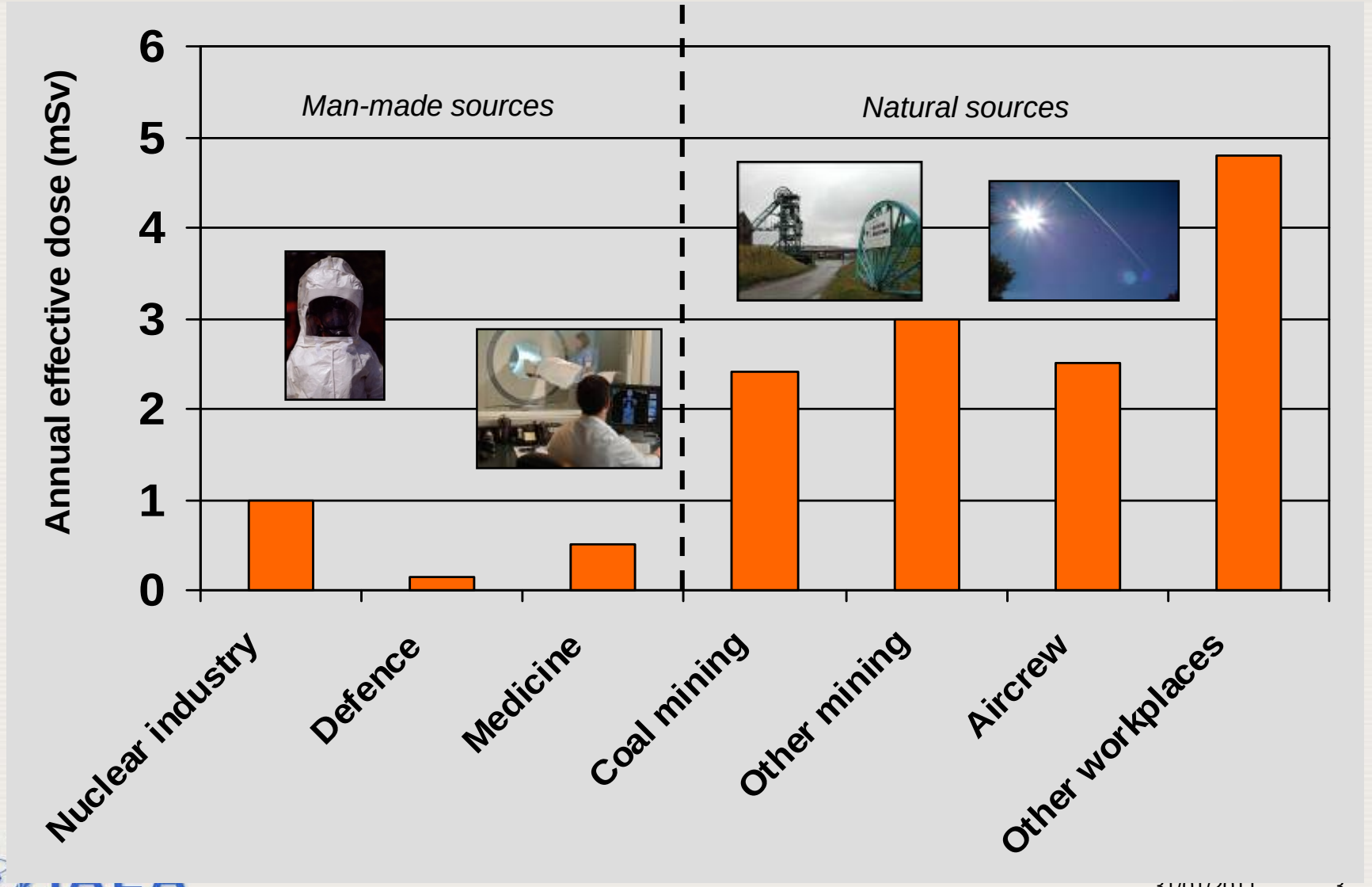
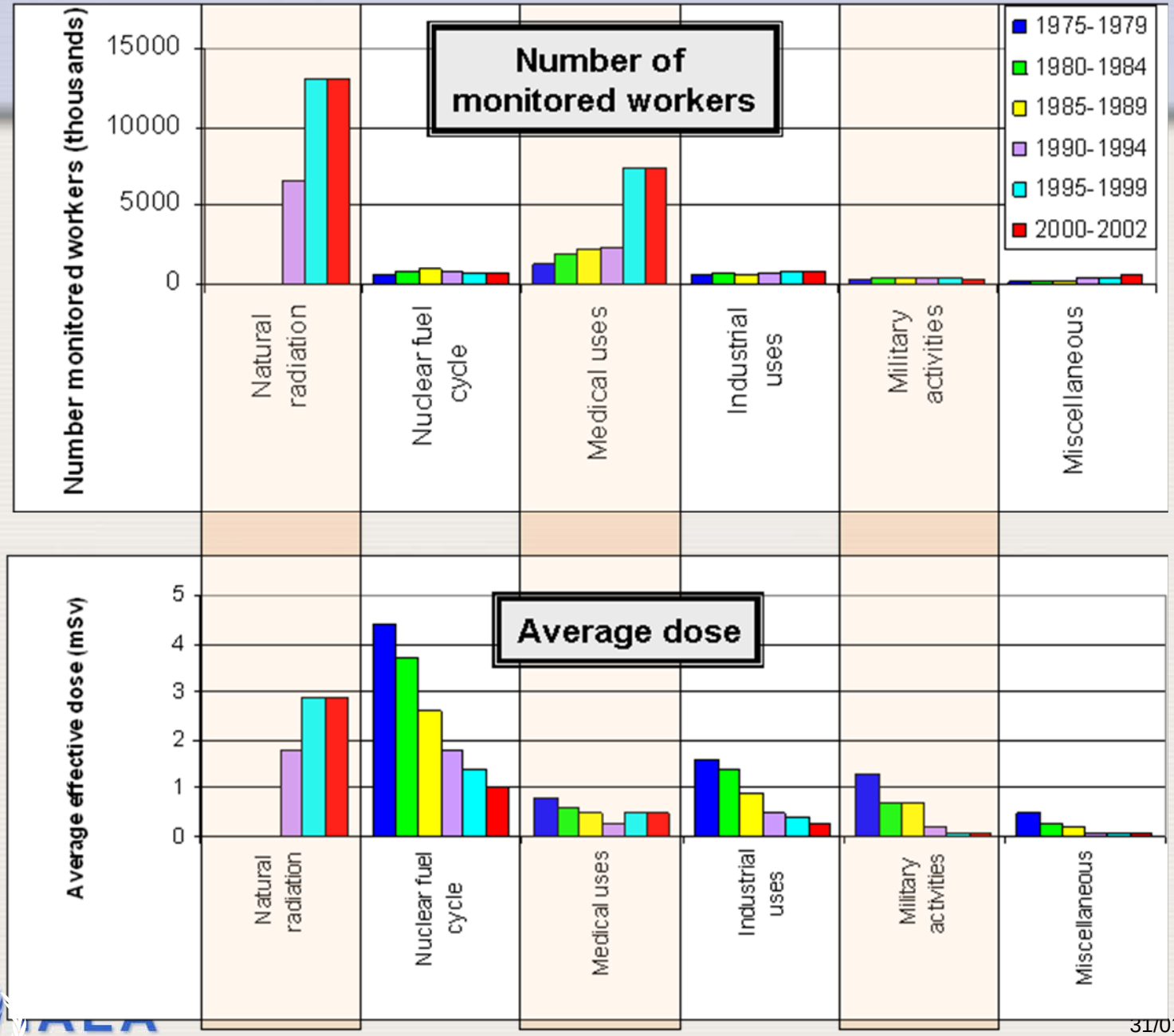
Outline

1. Trends of Occupational Exposure.
2. Current situation of the BSS.
3. International Action Plan on Occupational Radiation Protection.
4. ISEMIR project.
5. Outreach approaches.
6. IRPA Regional in LA conclusions.
7. IDOS conclusions.
8. Future activities.

UNSCEAR Global Occupational Exposure




Number of monitored workers
Number monitored workers (thousands)
15000
10000
5000
0
1975-1979
1980-1984
1985-1989
1990-1994
1995-1999
2000-2002
Natural radiation
Nuclear fuel cycle
Medical uses
Industrial uses
Military activities
Miscellaneous
Average dose
Average effective dose (mSv)
5
4
3
2
1
0
Natural radiation
Nuclear fuel cycle
Medical uses
Industrial uses
Military activities
Miscellaneous

Medical exposures

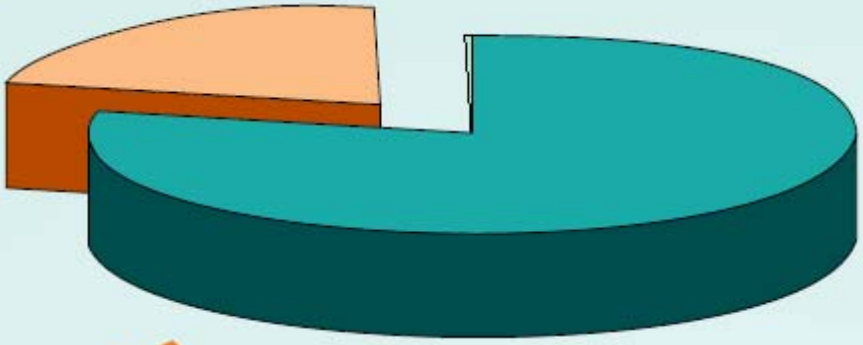
Relative Contributions to Global Radiation Doses

Medical uses of radiation per year :
About 4 billion X ray examinations
About 35 million nuclear medicine examinations
About 8 million radiation therapy treatment courses

An increasing slice of the pie

1980s

2008



- Natural background radiation
- Medical uses of radiation
- All other (global fallout, Chernobyl accident, nuclear power production)

Up to 50% of X ray examinations lack proper justification or optimization

Skin injuries occur in interventional procedures

The future:
Medical uses of radiation
- Will increase significantly
- Will become more complex

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Mandate IAEA

IAEA Safety Functions (Article III.A.6)

Facilitate and service international conventions and other undertakings

"To establish or adopt… [in consultation …] standards of safety for protection of health & minimization of danger to life and property"

"…and to provide for the application of these standards…"

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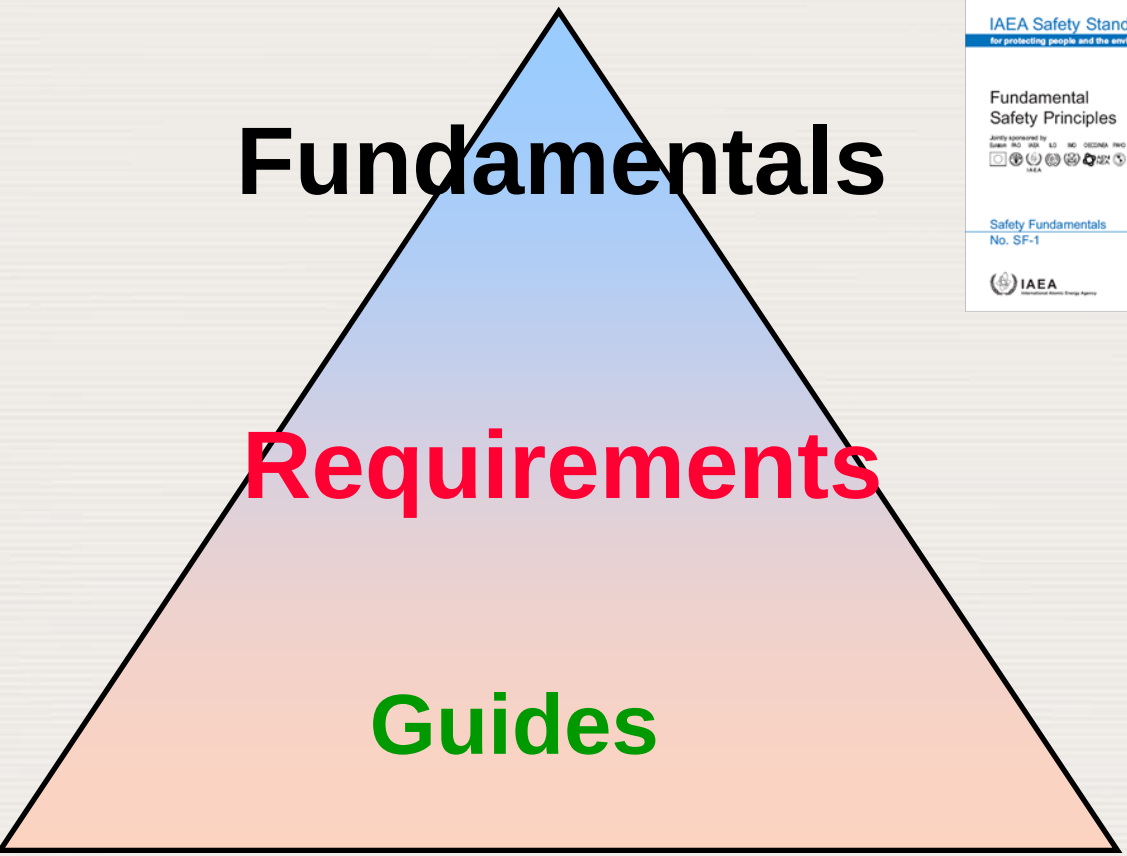
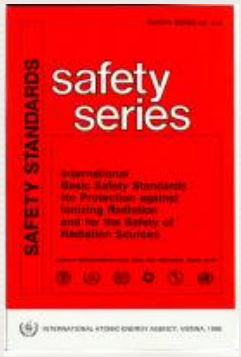
Hierarchy of Safety Standards



underlying principles - aimed at politicians and regulatory authorities



specify obligations and responsibilities ("shall" statements)

recommendations to support requirements ("should" statements)

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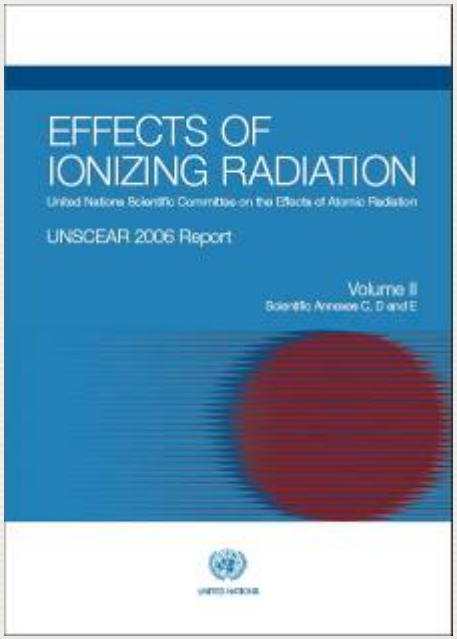
Radiation Protection Paradigm to be maintained



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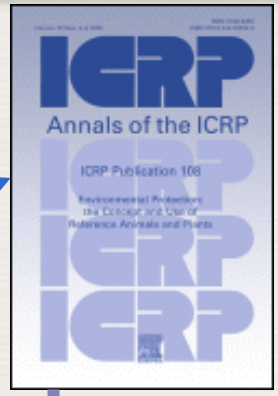
Scientific basis

effects
risks



recommendations

levels
trends

ILO convention 115:
occupational
radiation protection

FAO/WHO
Codex Alimentarius Commission
(food contamination guides)

UN transport regulations for
radioactive material

IAEA, WHO, ILO, FAO etc.
-Safety standards
-Protection programmes

implemented by
Member States

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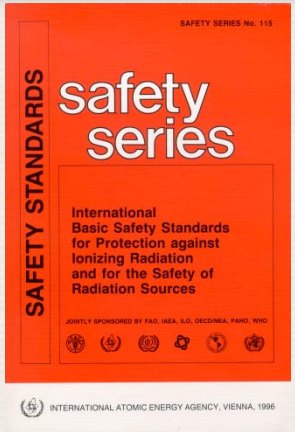
International Standards for Radiation, Transport & Waste Safety



→ **review**
2005/6

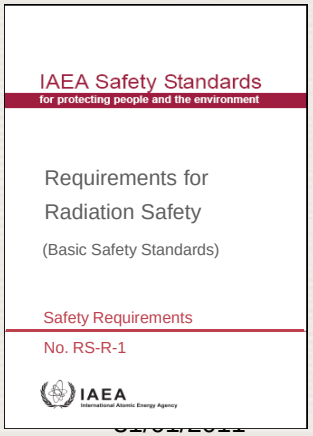
→ **plan for revision**
Nov 2006

→ **revision**
2007-09

→ **approval**
2010/
2011?

MEMBER STATES

Committees &
the Commission
on Safety Standards
+
BSS Secretariat*



*participants include:
FAO, IAEA, ILO, OECD/NEA, PAHO, WHO
EC, UNEP, ICRP, IRPA

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BSS Secretariat

Resolution GC(49)/RES/9A 2005 ➡ Review BSS

Resolution GC(50)/RES/(10) 2006 ➡ Revision BSS

coordinated by a secretariat

Objectives:

- To support and facilitate the revision by ensuring that the interests, views and responsibilities of each cosponsoring organisation are fully taken into account
- To provide a forum for cosponsor organisations to inform each other of developments that may need to be taken into account
- To coordinate the approval process of the cosponsoring organisations for the revised BSS

The IAEA secretariat has the overall responsibility for the revision of the BSS. The IAEA will chair meetings of cosponsoring organisations, which will generally be held in Vienna.

Revision of International BSS – draft 4.0

New structure

The structure of the revised BSS follows from the new recommendations of ICRP

- ***three exposure situations***
  - Planned
  - Emergency
  - Existing
- ***three categories of exposure***
  - Occupational
  - Public
  - Medical

Revision of International BSS – draft 4.0

New format *(CSS - 2008)*

- Overarching discrete requirements expressed as "shall" statement, allocated a discrete number, written in plain language, with clear and short sentences.
- Associated with overarching requirements are so-called associated requirements which are considered as an integral part of the safety requirements.
- Draft 4.0 contains 52 overarching requirements currently

Principles of Radiation Protection

Planned exposure situations

- justification
- optimization
- dose limitation (+dose constraints & risk constraints)

Emergency exposure situations

- optimization
- dose limitation (reference levels)

Existing exposure situations

- optimization
- dose limitation (reference levels)

Revision of International BSS – draft 4.0

Responsibility tree

To establish and maintain a legal, regulatory and organizational framework

GOVERNMENT

To establish or adopt regulations and guides

REGULATORY BODY

PRIME responsibility

- Person or organization responsible for facilities and activities
- Principal parties

Specified responsibility

- Other parties

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Revision of International BSS – draft 4.0

- **Specific requirements** on responsibilities of regulatory bodies have been **included** (eg Req. 19, 20)
- The requirements on licensees, registrants, workers, are **essentially unchanged**
  - *Some rearrangement, consolidation and editing of text*
  - *Some detailed requirements on monitoring have been removed – more appropriate in a Safety Guide*
  - *Requirements for "special circumstances" (relaxation of dose limit) have been removed – complicated, and no longer needed*

Occupational exposure

- ✓ Responsibilities assigned (incl. government and regulatory body)
- ✓ Requirements for special circumstances (relaxation of dose limit) deleted

Medical exposure

- ✓ Responsibilities assigned for Government and Reg. Body as well as referrers, medical radiological practitioners, medical physicists, radiographers
- ✓ Requirements for key personnel on training, education and competence
- ✓ Emphasis is placed on key players (in RP) having the appropriate competence to fulfill their role
- ✓ Justification is expanded to follow ICRP 73, 103
- ✓ Introduction of the radiological review (audit)
- ✓ The patient is introduced into the picture

Medical exposures in 2010 versus 1996

Since the early 1990s:

- Increasing use of radiation in medical applications worldwide
  - More machines, etc
  - New technologies and techniques

    Single slice CT → Multi-Detector CT
    Film → Computed & Digital Radiography
    Hybrid imaging, PET-CT

    Image-guided interventional procedures
    Virtual procedures

  - New roles

    E.g. Changes in the role of imaging:
    First "port of call"
    A move towards "screening", in all its guises

- Increasing complexity in the planning & delivery of the radiation

  E.g. IMRT, IGRT, etc.

Plus:

- 10+ years experience of Member States in trying to implement the BSS

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The revised BSS must address all of these

New terms

- Distinguishing the roles of the “referrer” and the “doer”, namely:
  - *Referring medical practitioner*
  - *Radiological medical practitioner*

    (Note: these can be the same person, e.g. a dentist, a radiation oncologist)
- Medical physicist (based on IOMP definition)
- Medical radiation technologist
  - Radiographer,…

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Education, training and competence

- Crucial to radiation protection
  - Radiological medical practitioner
  - Medical physicist
  - Medical radiation technologist
  - Radiopharmacist
- All definitions have a similar format:
  - A health professional, with education and specialist training in ……., competent to …… .
- Explanatory note to each definition:
  - Competence of persons is normally assessed by the Member State by having a formal mechanism for registration, accreditation or certification of ….
  - Member States that have yet to develop such a mechanism need to assess …. based either on international accreditation standards or standards from another country ….

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Short history to get draft 4.0 revised BSS

- DPP approved end 2006
- January 2007 – Revision process startet
- July 2007 – “Technical Meeting”

- Draft 1.0 - July 2008 - 1200 comments
- Draft 2.0 – May 2009 - 500 comments
- Draft 2.5 – Sep. 2009 – 1000 comments
- Draft 3.0 – Jan. 2010 – 1500 MS comments

- Draft 3.5 – Aug. 2010 BSS Secretariat meeting

- Draft 4.0 – Sept. 2010 sent to committees

- December 2010 approved to be sent to CSS (March 2011)

Action Plan for Occupational Radiation Protection

Fourteen proposed actions under headings:

CLOSED ACTIONS

- ILO Convention 115 (Actions 1-3)
- The ILO code of practice (Action 4)
- Co-operation IAEA – ILO (Action 5)
- Information exchange and Networking (Actions 6, 7)
- Exposure to natural radiation (Action 11)
- Protection of pregnant workers (Action 13)
- Probability of causation (Action 14)

- *Education and Awareness (Actions 6, 8, 10)*
- *Holistic approach to workplace safety (Action 12)*

ONGOING ACTIONS

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Action 6- *to develop publicity materials that target groups of workers*

Follow up actions to be made:

- finalising the posters;
- providing them in a leaflet or brochure form ;
- asking for endorsement by stakeholders such as trade unions;
- making the material available as pdf in the six official languages.

FINALIZATION OF POSTERS

DIAGNOSTIC RADIOLOGY

EQUIPMENT

X-ray equipment will be fitted with various features that will keep doses ALARA.

- A collimator will determine the size of the beam. If the collimator can be adjusted, a light beam diaphragm will be fitted so that the size of the beam can be seen before the exposure.
- A filter in the beam takes out low energy x-rays, which would otherwise add to patient and worker dose, but would not contribute to the image.
- Lights at the control panel will indicate:
  - When the x-ray set is connected to the electricity supply
  - When x-rays are being produced.
- Lights outside the room will warn others when the x-ray set is switched on, and when they should not enter.
- For fluoroscopy, the control panel will also indicate the exposure time and the peak kV and mA. The patient dose will be monitored for every exposure.

QUALITY ASSURANCE

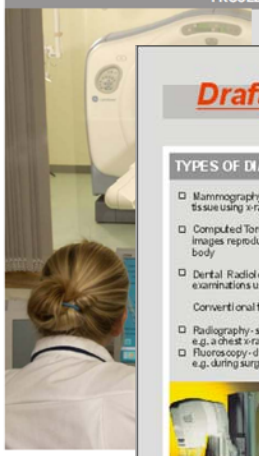
QA will ensure that doses are always ALARA and that good images are produced every time.

QA means many things, including:

- Regular checks on equipment output and related safety features
- Procedures for setting up and taking radiographs, and audits to check that procedures are being followed.
- Recording the exposure settings used.
- Analysing individual images, and investigating reasons for rejected images.

Each hospital or clinic will have its own QA programme. Always follow your local procedures to play your part in maintaining good QA.

PROCEDURES



IMAGING

REMEMBER

- Rejected radiographs mean repeat exposures.

Radiation Protection of workers:

Draft

DIAGNOSTIC RADIOLOGY

Agency's Logo

TYPES OF DIAGNOSTIC EXAMINATIONS

- Mammography: screening for lesions in breast tissue using x-rays
- Computed Tomography (CT): provides high quality images reproducing transverse cross sections of the body
- Dental Radiology: one of the most common x-ray examinations using specific types of equipment

Conventional techniques:

- Radiography - static (radiographic images) e.g., a chest x-ray
- Fluoroscopy - dynamic (real time) imaging e.g., during surgery when fitting a pacemaker

QUALITY ASSURANCE

QA will ensure that doses are always ALARA and that good images are produced every time.

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Each hospital or clinic will have its own QA programme. Always follow your local procedures to play your part in maintaining good QA.

OCCUPATIONAL EXPOSURE

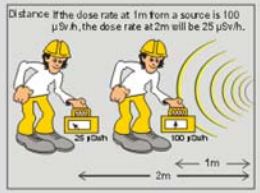
Exposure to gamma and x-radiation can be controlled by consideration of time, distance and shielding:

Time

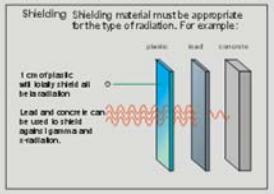
To reduce radiation doses, the time spent in radiation areas must be kept as short as possible. The longer the time spent in an area, the higher the dose received.

In an area where the dose rate is 100 µSv/h, the dose received will be:

Distance: If the dose rate at 1m from a source is 100 µSv/h, the dose rate at 2m will be 25 µSv/h.



Shielding: Shielding material must be appropriate for the type of radiation. For example:



HEALTH SURVEILLANCE

Occupational exposure to ionising radiation can be assessed through the wearing of personal dosimeters and by keeping records of work patterns.

Several types of dosimeters might be recommended. They have to be strictly worn according to the dispositions and information provided by the responsible for the radiation protection.

Dosimeters do not provide protection from exposure to ionising radiation, they are a means of assessing the dose that the wearer has received.

Radiation doses to staff and patients must be As Low As Reasonably Achievable: ALARA

Sometimes, people have to stand near the patient during the exposure. In these cases, lead aprons, lead glass eye wear and thyroid shields can help to keep doses ALARA.

Interventional radiology

Doses to the patient should be kept ALARA without compromising the required diagnostic objective (optimised).

This can be achieved by careful planning of the work and the use of appropriate equipment and exposure parameters.

Operator training is essential.

Lead aprons and dosimeters, worn under the lead aprons, must always be worn by all those involved.

PROTECTIVE EQUIPMENT

Protective clothing

Personal protective equipment can be worn to provide protection against exposure to gamma or x-radiation, e.g. gown, aprons and thyroid protectors made of a material (such as vinyl) which contains lead

A lead apron for the body

A thyroid protector

Protective devices

Protective devices might be available in fluoroscopy and interventional radiology rooms which include:

- ☑ Ceiling suspended protective screens.
- ☑ Protective lead curtains mounted on the patient table.
- ☑ Protective lead curtains for the operator if the X Ray tube is placed in an over couch geometry and if the radiologist must stand near the patient

Protective lead curtain mounted on the patient table

REMEMBER

- A poor quality image may necessitate a repeat exposure and unnecessary dose
- A perfect image is not required. A good image is one that provides the clinical information, without delivering unnecessary dose
- If the image is not what you had expected, e.g. it is significantly over or under exposed, investigate and fix the problem before taking any more radiographs
- Plan all radiology carefully
- Follow procedures and use PPE, e.g. a lead apron, if instructed
- A female worker should, on becoming aware that she is pregnant, notify the employer in order that her working conditions may be modified if necessary

DEFINITIONS

Units of dose

The unit used to quantify measured dose is the Sievert

One millisievert (mSv) is 1/1000 of a Sievert.
- Annual doses from safe background radiation vary on average between 1 mSv and 5 mSv worldwide

One microsievert (µSv) is 1/1000th of a millisievert.
- The typical dose from a chest x-ray is 20 µSv

Dose rate

Dose rate is the dose that can be received in a given time; the unit used is Microsievert per hour (µSv/h).

- If a person spends two hours in an area where the dose rate is 10 µSv/h, then they will receive a dose of 20 µSv.

Here the effects of radiation exposure

If radiation doses are very high, the effects to the body will appear relatively soon after the exposure. These acute injuries will occur if the absorbed dose is higher than a threshold value; the equipment used in diagnostic radiology is capable of delivering such doses. It is therefore essential that procedures to work are followed

Radiation burns to the hands after being exposed to a high dose of radiation

Five years later

Even if the dose is not high enough to cause serious injury, there is still the possibility of other health effects. These effects, e.g. radiation induced cancer, are risk based, i.e. the higher the dose received, the greater the chance of developing the effect. To reduce the possibility of developing late effects, radiation doses must be kept

AS LOW AS REASONABLY ACHIEVABLE

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TOPICS

- Industrial Irradiators
- Industrial Radiography
- Radioactive Tracers
- Nuclear Gauges

- Diagnostic Radiology
- Nuclear Medicine
- Radiotherapy

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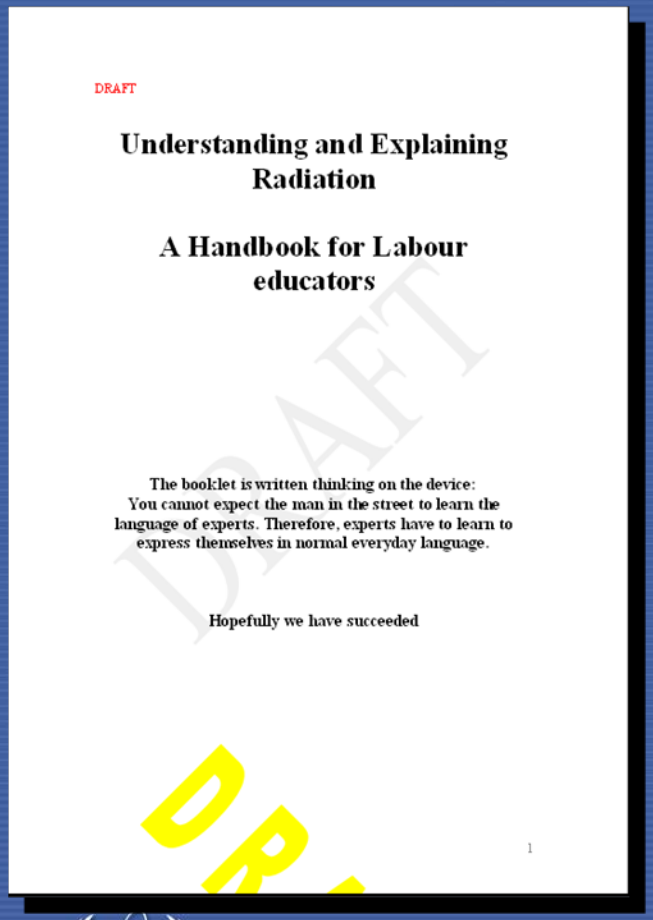
Action 8: To *prepare and disseminate suitable information materials to workers'* representatives *and labour educators*


DRAFT

Understanding and Explaining Radiation

A Handbook for Labour educators

The booklet is written thinking on the device:
You cannot expect the man in the street to learn the language of experts. Therefore, experts have to learn to express themselves in normal everyday language.

Hopefully we have succeeded

1

- to submit the redrafted training handbook with a clear indication of the objectives and target audience;
- to make the new draft available within
- to request members of the Steering Committee to send written comments on the draft document within three months;
- to make the final draft available within 18 months.

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Action 10- Manuals on Radiation Protection

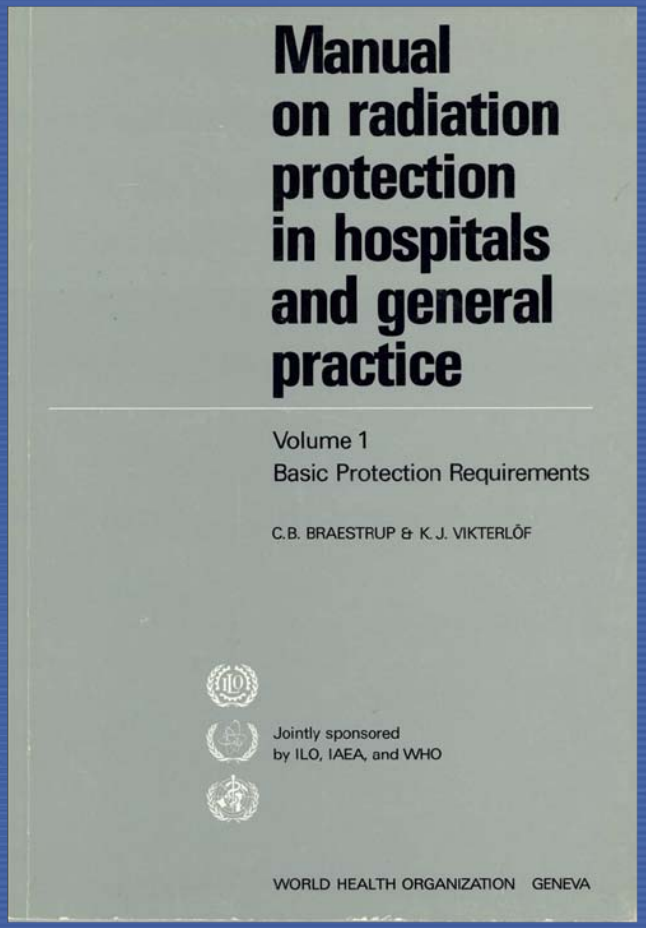
Vol. 1: General

Vol. 2: Radiology

Vol. 3: Dentistry

Vol. 4: Nuclear Medicine

Vol. 5: Radiotherapy



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ACTION 12- DEVELOPING COHERENT APPROACH TO RADIATION AND OTHER RISKS FACTORS AT WORK PLACE

- Chapter 1 Philosophy, principles and system
- Chapter 2 Technical tools for risk assessment, management, communication
- Chapter 3 Examples of managing risks in different activity sectors
- Chapter 4 Examples of regulating and controlling occupational risks in different countries
- Chapter 5 Findings and conclusions
- Glossary
- Annexe

The ISEMIR project

- Information System on Occupational Exposure in Medicine, Industry and Research
  - Based on the experience of a network of Nuclear Power Plant operators
  - A database containing operational occupational doses at a detailed level is very helpful for:
    - Comparing doses for specific occupations and functions
    - Assessing the impact of specific radiation protection actions
    - Following dose trends

A tool for the implementation of ALARA

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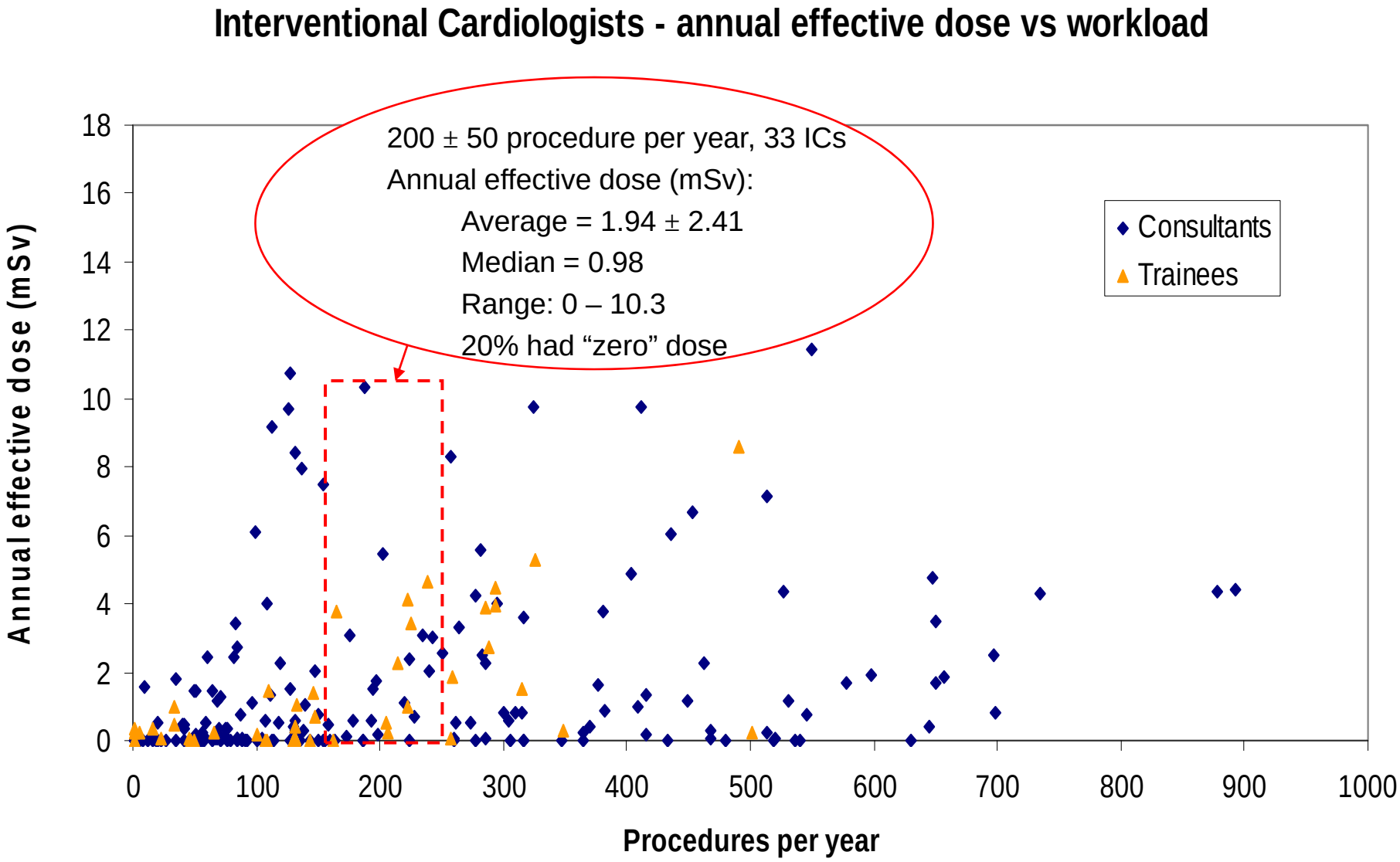
ISEMIR
Information System on Occupational Exposure in Medicine, Industry and Research

Occupational dose versus workload



Conclusions

- 2009 Survey of RBs showed
  - For a world-wide IC dose database
    - RBs are probably not the best source of dose data
    - Compliance with wearing dosimeters is an issue
- Interim results of 2010 Pilot Test show
  - Dose data can be obtained directly from IC facilities
    - Compliance with wearing dosimeters is still an issue
- You are invited to participate in this project:
  - Recruiting interventional cardiology facilities
  - Please visit ISEMIR web pages on IAEA ORPNET website, or
  - Email: John.Le.heron@iaea.org

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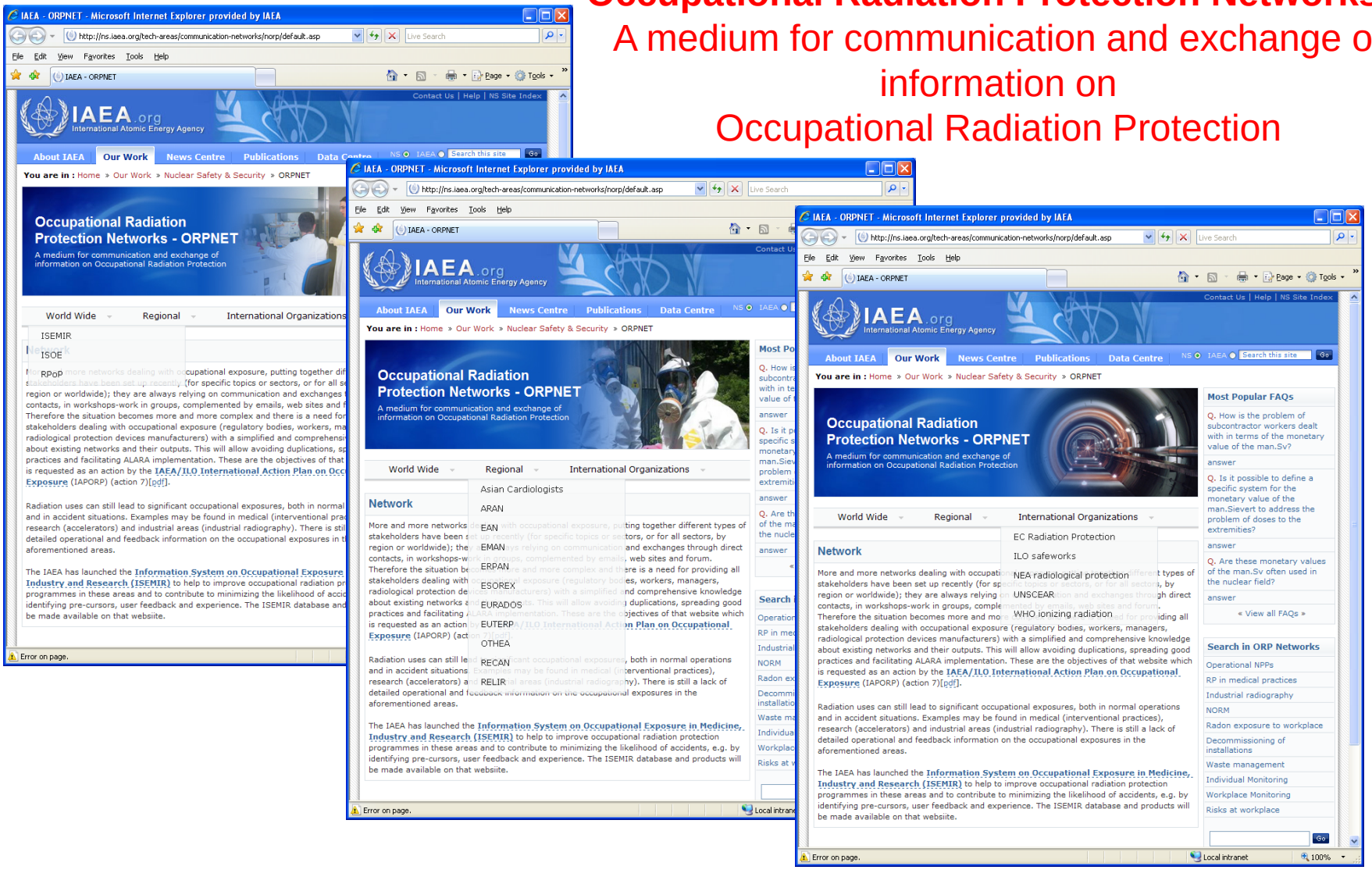
ISEMIR
Information System on Occupational Exposure in Medicine, Industry and Research

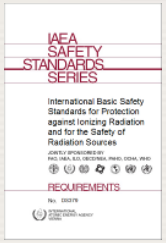
Occupational Radiation Protection Networks – A medium for communication and exchange of information on Occupational Radiation Protection

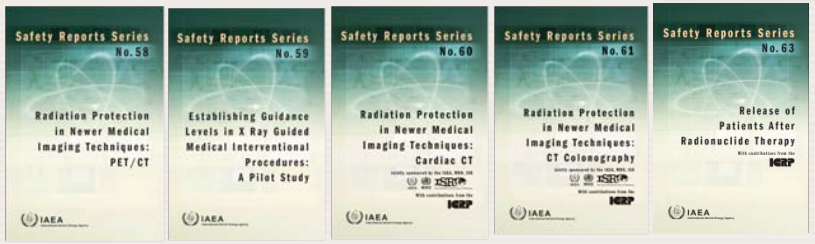


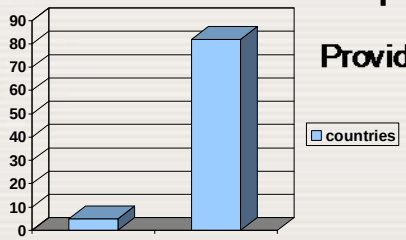
http://www-ns.iaea.org/tech-areas/communication-networks/norp/default.asp

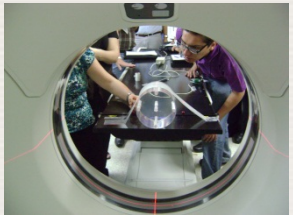
Radiation protection of patients-Recent activities

- Activities are related to the International Action Plan for Radiation Protection of Patients









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International campaign AAA

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

Information for
Health Professionals
Member States
Patients

Additional Resources
Publications
International Standards
Training

Special Groups
Pregnant Women
Children

Member Area
Member States Area
Drafts Management Area

Actions to Protect Patients in:

- Radiology →
- Radiotherapy →
- Nuclear Medicine →
- Interventional Radiology →
- Interventional Cardiology →
- Other Specialities & Imaging Modalities →

Latest Literature

Lemburg, S.P., Peters, S.A., Roggenland, D., Nicolas, V., Heyer, C.M.,
Cumulative effective dose associated with radiography and CT of adolescents with spinal injuries, AJR Am. J. Roentgenol. **195** 6 (Dec. 2010) 1411-1417.

Nikolic, B., Khosa, F., Lin, P.J., Khan, A.N., Sarwar, S., Yam, C.S., Court, L.E., Raptopoulos, V., Clouse, M.E.,
Absorbed radiation dose in radiosensitive organs during coronary CT angiography using 320-MDCT: effect of maximum tube voltage and heart rate variations, AJR Am. J. Roentgenol. **195** 6 (Dec. 2010) 1347-1354.

Ron, E., Brenner, A.,
Non-malignant Thyroid Diseases after a Wide Range of Radiation Exposures, Radiat. Res. **174** 6 (Dec. 2010) 877-888.

All Literature

Did You Know That...

32. If a patient needs to have a CT scan, diagnostic X ray examination or MRI scan on the same day as a PET/CT scan, it can be performed

« Prev Next »

Latest News

Report of the IAEA Smart Card/SmartRadTrack Project meeting
The brief report of the recent Technical Meeting held on 18-21 Oct.2010 is available

Report of meeting on justification of medical exposure
The brief report of the recent Technical Meeting held on 4-8 Oct.2010 is available

Radiation dose optimization in nuclear medicine
New North American consensus guidelines issued for administered activity

Increasing focus on radiation protection in CT is unabated
Much is happening almost every month

All News

Upcoming Events

International Workshop ORAMED 2011, Barcelona 20-22 January 2011
Optimization of Radiation Protection of Medical Staff

4th meeting of the Working Group on Interventional Cardiology (WGIC), IAEA, Vienna, 28 February - 2 March 2011
Information System for Occupational Exposure in Medicine, Industry and Research (ISEMIR) project

All Events

Summary of the Round Table on ORP in Medical Application in LA

- Poor implementation of the RPP .
- Lack of E & T of medical staff .
- Lack of National Dose Registry .
- Lack on Internal Dosimetry in Nuc. Medicine.
- Issue with “Itinerant” workers in medical applications
- Need of ORAMED results dissemination

IDOS Highlights- *Radiation Protection Dosimetry*

- Increased awareness of the management & medical staff on the risk of deterministic effects from the use of radiation in medical procedures;
- Radiation protection programs must be in place at medical facilities for both worker and patient protection. Individual monitoring of medical staff, specially for extremity dosimetry demonstrates improved protection.
- Diagnostic imaging procedures, in interventional radiology and nuclear medicine, should be optimized.
- International standards, guidance and assistance on capacity building in radiation protection remain abreast of the rapidly developing medical technology and are effectively disseminated, in particular for dosimetry.

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IDOS Highlights- *Radiation Protection Dosimetry*

- Proposal for double dosimetry and eye dosimetry.
- Upgrade and/or creation of National Dose Registry at the National/State level.
- Recommendation needed for the protection and monitoring of “itinerant” medical staff
- Collaboration with medical and scientific societies and organizations as well as manufacturers of medical equipment.
- Monitor the ORAMED and participation in ISEMIR projects for improving the staff monitoring and optimization of protection.
- Implementation of QMS for monitoring and Medical Physics services.

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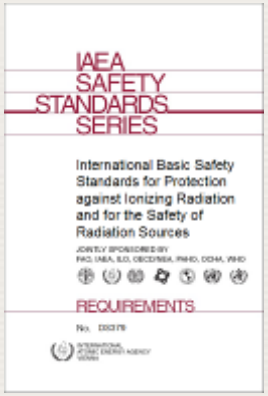
Future activities

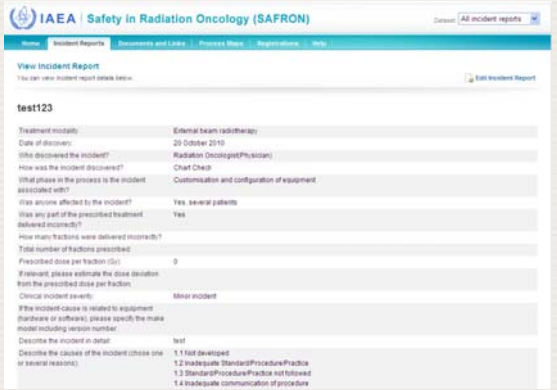
As BSS is approaching finalization:



- Development of a Safety Guide on the use of radiation in medical facilities
- Updating Safety Guides on Occupational Radiation Protection

Development of voluntary reporting systems:

- SAFRAD (Safety in Radiological Procedures)
  - Web-based voluntary educational reporting system
  - To identify circumstances around high dose events in interventional procedures
  - Currently undergoing pilot-studies
- SAFRON (Safety in Radiation Oncology)
  - Web-based voluntary safety reporting system for rt
  - Retrospective incident reporting and sharing
  - Complementing mandatory reporting; linking to other voluntary initiatives
  - Incorporating prospective safety analysis



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Future activities

Progressing outreach of balanced information:

- RPoP website to be further strengthened
  - Information for health professionals and patients to be updated – and translated to Spanish
  - The use of Social Media to reach more relevant individuals more effectively and timely
- ORPNET website to be further strengthened

A major conference is under preparation:

- International conference on radiation protection in medicine
  - To be held in Germany towards the end of 2012
  - Follow-up to Malaga Conference in 2001, which set the agenda for the following decade
  - Target: 1000 participants; health professionals; regulators; policy makers; patient organizations
  - To set the agenda for the coming years

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THANK YOU
http://www-ns.iaea.org/home/rtws.asp