International Perspectives on Radiation Protection

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Learning Objectives

1. To understand the system of radiation protection in international and national context
2. To become familiar with international action plan on radiation protection of patients
3. To become familiar with international organizations in the area of medical radiation protection
4. To understand the potential role you can play in international activities

Why International System?

Good & bad example of international action
Examples in Radiation Protection

- Global acceptance of concepts and principles of radiation protection as developed by the International Commission on Radiological Protection (ICRP) such as justification, optimization and dose limitation.
- Conversely
  - dose limits for workers and members of the public, and
  - acceptance of SI units e.g. Sv and Gy against rem and rad.

Radiation Protection of Patients

Universal agreement
- No dose limits and
- Concept of diagnostic reference levels (DRLs) to be used with flexibility.

International Actions are needed

Besides harmonization, to
- Give impetus to some areas (mammography screening, exposure tracking…)
- Raise awareness about emerging issues (breast radio-sensitivity, cataract..)
- Forewarn about upcoming dangers if actions are not initiated well in time.

International Actions

- For example, the growing use of computed tomography (CT) and over-exposures in developed country has alerted other countries that they may face the same situation in future years.
Basic Scientific Studies
Scientific Evaluations (UNSCEAR, BEIR etc.)
ICRP Recommendations
Regional (PAHO, EC, NEA) & Topical (ILO, WHO, FAO) Stand’s
International Safety Standards: BSS (IAEA) Industry Stand’s (ISO, IIP)
National Regulations
Demonstration of Compliance

ICRP (**)
PRINCIPLES AND RECOMMENDATIONS
STANDARDS (IAEA)

UNSCEAR (*)
RADIATION EFFECTS

ICRP (**)
PRINCIPLES AND RECOMMENDATIONS
STANDARDS (IAEA)

(*) United Nations Scientific Committee on the Effects of Atomic Radiation
(**) International Commission on Radiological Protection

A matter of interpretation

What people know MOST

ICRP--- Dose limits
IAEA--- Iran, Iraq actions
UNSCEAR---??
### What you think that they do?

**ICRP**
- Establishes principles of radiation protection
- Provides protection philosophy

**IAEA**
- Has programs for promoting
  - Nuclear medicine, radiotherapy and medical physics
  - Radiation protection of patients

### Probably what you wish to know is

- How International organizations work?
- What are their individual mandates?
- How they cooperate to prepare International system?
- Is international system mandatory for Member States?
- Application of Standards.

### UNSCEAR

- UNSCEAR was established by the General Assembly of the United Nations in 1955.
- Its mandate in the United Nations system is to assess and report levels and effects of exposure to ionizing radiation.
- Governments and organizations throughout the world rely on the Committee's estimates as the scientific basis for evaluating radiation risk and for establishing protective measures.

- The original committee was composed of senior scientists from 15 designated UN Member States, namely Argentina, Australia, Belgium, Brazil, Canada, Czechoslovakia, Egypt, France, India, Japan, Mexico, Sweden, the UK, the USA and the USSR.
- Currently 21 countries
- Last report 2008
- HQ in Vienna
- Meeting once every year
### ICRP vs IAEA

<table>
<thead>
<tr>
<th>ICRP</th>
<th>IAEA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Independent Charity</strong></td>
<td><strong>Independent international organisation under UN family</strong></td>
</tr>
<tr>
<td><strong>Established to advance for the public benefit the science of Radiological Protection, in particular by providing recommendations and guidance on all aspects of protection against ionising radiation</strong></td>
<td><strong>Pillars: Safety and Security; Science and Technology; and Safeguards and Verification.</strong></td>
</tr>
</tbody>
</table>

### ICRP Commission on Radiological Protection

**Main Commission**

- C1
- C2
- C3
- C4
- C5

**Task Groups (TG)**

- Working Parties (WP)

**Budget:** $300,000

### Current Membership

**ICRP Committee 3 (as in 2011)**

- **Eliseo Vañó** (Chair)
- **Madan Rehani** (Secretary)
- **Katrine Åhlström Riklund**
- **Jean-Marc Cosset**
- **Lawrence T. Dauer**
- **Mario Baeza**
- **Igor Gusev**
- **John Hopewell**

**ICRP Committee 4 (as in 2011)**

- **Pek-Lankhong**
- **Pedro Ortiz Lopez**
- **Sören Mattsson**
- **Donald L. Miller**
- **Hans Ringertz**
- **Marvin Rosenstein**
- **Yoshiharu Yonekura**
- **Baorong Yue**
Changes in occupational Dose Limit (ICRP)

<table>
<thead>
<tr>
<th>Year</th>
<th>1931</th>
<th>1947</th>
<th>1977</th>
<th>1990</th>
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<tbody>
<tr>
<td>mSv/yr</td>
<td>500</td>
<td>250</td>
<td>125</td>
<td>60</td>
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</tbody>
</table>

Tissue weighting factors

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Brain</td>
<td>0.01</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>Breast</td>
<td>0.12</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>(Liver)</td>
<td>0.05</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>(Stomach)</td>
<td>0.12</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>(Remaining)</td>
<td>0.30*</td>
<td>0.05**</td>
<td>0.12</td>
</tr>
</tbody>
</table>

Remainder in tissue weighting factors

<table>
<thead>
<tr>
<th>Unspecified organs</th>
<th>Stomach, lower large intestine, salivary glands, liver</th>
</tr>
</thead>
</table>

**When the gastrointestinal tract is irradiated, the stomach, small intestine, lower large intestine and upper large intestine are treated as four separate organs and are included in the remainder tissues. With WT = 0.06 each |

| Adrenals, brain, upper large intestine, small intestine, kidneys, muscle, pancreas, spleen, thymus, uterus | Adrenals, extrathoracic (ET) region, gall bladder, heart, kidneys, lymphatic nodes, muscle, oral mucosa, pancreas, prostate (♂), small intestine, spleen, thymus, uterus (♀) |

Gonad shielding wherever practicable in order to keep doses ALARA!
Upcoming Publications of ICRP C3

1. Patient and Staff Radiological Protection in Cardiology
2. Radiological Protection in Fluoroscopically Guided Procedures Performed outside the Imaging Department
3. Radiological protection in paediatric diagnostic and interventional radiology

- Radiation protection in charged particle radiotherapy

Topics under discussion ICRP C3

- Occupational protection in Brachytherapy
- Justification: Framework on justification on the use of ionizing radiation in medical imaging
- Occupational protection issue in relatively higher exposure situations in interventional procedures
- Radiation protection in cone-beam CT (medical and dental)
- Extending the use of reference levels to interventional radiology
- Protection in PET (PET/CT) and cyclotrons
- Screening with ionising radiation in asymptomatic individual
- Follow up of persons accidentally exposed
IAEA

- Headquarter in Vienna
- 2400 staff from > 90 countries
- Director General, 6 Deputy DG, Directors, SH, UH
- €320 million

IAEA- Development of Standards

- The IAEA is the world’s center of cooperation in the nuclear field.
- It was set up as the world’s "Atoms for Peace" organization in 1957 within the United Nations family.

http://rpop.iaea.org
Are International Standards Binding?

• No
• But in practice, they tend to for countries seeking IAEA assistance
• National Standards and Regulations are based on BSS

National regulations-developing countries

All member states of the IAEA are given full opportunity to participate in process of development and revision of BSS

DIRECTION of Work

• Specific aspects of patient protection and then key elements of revision of International systems (IAEA BSS and European BSS). The revised BSS is expected to be agreed this year.

1. Assessing how safe are patients in radiological examinations
2. Comparing with Standards
3. Taking actions where necessary
4. Make patients safer
2001 Radiation doses to Patients in Radiological Imaging

AJR June 2008

Patient Doses in Radiographic Examinations in 12 Countries in Asia, Africa, and Eastern Europe: Initial Results from IAEA Projects

OBJECTIVE: The purpose of this study was to survey image quality and the estimated radiation dose for patients in radiographic examinations and to perform comparative risk assessments between different regions.

SUBJECTS AND METHODS: In this international prospective study, image quality and estimated radiation doses to patients were assessed using standardized protocols. The study included 12 countries in Africa, Asia, and Eastern Europe, covering 17 hospitals. The objective was to evaluate image quality and radiation doses for various types of examinations including chest, abdomen, and head scans.

RESULTS: The results indicate that image quality was poor in up to 50% of the examinations, and radiation doses were higher than recommended limits. The study also highlighted the need for improved quality control (QC) programs and implementation of QC protocols to improve image quality and radiation safety.

Plus 9 countries in Latin American region
Radiography

- In all countries radiation doses (ESAK) within Reference Levels and thus not higher than those in developed countries
- Poor image quality (4 to 53%)
- Improvements achieved (QC)
  - 1.4 to 85% reduction in dose (ESAK)
  - 2 to 16 percent points reduction in poor quality images

DIRECTION of Work - Radiography

1. Assessing how safe are patients in radiological examinations ✓
2. Comparing with Standards ✓ ✓
3. Taking actions where necessary ✓
4. Make patients safer ✓

X-rays Often Repeated for Patients in Developing Countries

IAEA Mission to Help Improve Quality of Medical Radiography

The IAEA mission to help improve the quality of medical radiography in developing countries resulted in a survey of sterilisation methods and radiographic practice taken by officials in 45 out of 47 countries of Africa, Asia and Eastern Europe.

- First multi-national scientifically planned study of this kind
- What are problems pertaining dose & image quality rather than equipment testing (QC)

AJR August 2009

Radiation Exposure to Patients During Interventional Procedures in 20 Countries: Initial IAEA Project Results

OBJECTIVE

The purpose of the project was to determine the level of radiation protection of patients and staff during interventional procedures in 20 countries of Africa, Asia, and Eastern Europe.

METHODS

A multinational prospective study, in which radiation protection data were collected from the operator, the patient, and the staff involved, was conducted in 20 countries of Africa, Asia, and Eastern Europe.

CONCLUSION

The results of this study provide a valuable source of information for healthcare professionals involved in radiation protection and radiation oncology. The findings of this study can be used to improve radiation safety practices and to develop guidelines for radiation protection in medical practice.
Radiation exposure to patients during interventional procedures: Information availability

Only 67% of facilities, however, were able to estimate patient radiation dose with a kerma-area product (KAP) meter, and none had experience in its use. A total of 62% of coronary angioplasties had dose levels above current dose reference levels.

This shows that radiation protection for patients "needs to be higher on the agenda," Rahbar said.

Clinical implications for all countries

This is a well-executed study with implications for practitioners in both the developed and developing world. Dr. Thomas O. Gerber (Mayo Clinic, Jacksonville, Fl), who was not involved with the study, lists barriers:

1. We generally see that we don’t emphasize radiation protection for personnel and patients sufficiently in our training of new physicians, at least in cardiology. More could be done. Many physicians perceive the medical physics training part as dry and boring, but I think it can be made interesting and engaging,” he said. Operators should have enough exposure to perform straightforward procedures with a radiation exposure that is “as low as reasonably achievable” and be able to perform complex procedures without an excessive increase in radiation exposure, Gerber noted.

Interventional Procedures

1. Assessing how safe are patients in radiological examinations ✓
2. Comparing with Standards ✓
3. Taking actions where necessary ✓
4. Make patients safer ✓
Are there enough of these specialised procedures performed in Developing countries or is this an advanced technique only in developed countries?

Children

<table>
<thead>
<tr>
<th>Country</th>
<th>Adults</th>
<th>Children</th>
<th>Total Adult/Child Dose (mSv)</th>
<th>Percentage of Adult Dose</th>
<th>Percentage of Child Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria</td>
<td>20.00</td>
<td>3.50</td>
<td>23.50</td>
<td>93.5%</td>
<td>6.5%</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>9.04</td>
<td>3.46</td>
<td>12.50</td>
<td>73.3%</td>
<td>26.7%</td>
</tr>
<tr>
<td>Botswana</td>
<td>22.00</td>
<td>4.00</td>
<td>26.00</td>
<td>92.3%</td>
<td>7.7%</td>
</tr>
<tr>
<td>Cameron</td>
<td>3.00</td>
<td>3.00</td>
<td>6.00</td>
<td>50.0%</td>
<td>50.0%</td>
</tr>
<tr>
<td>Egypt</td>
<td>4.50</td>
<td>2.00</td>
<td>6.50</td>
<td>83.3%</td>
<td>16.7%</td>
</tr>
<tr>
<td>Ghana</td>
<td>6.00</td>
<td>2.00</td>
<td>8.00</td>
<td>80.0%</td>
<td>20.0%</td>
</tr>
<tr>
<td>India</td>
<td>15.00</td>
<td>3.00</td>
<td>18.00</td>
<td>94.4%</td>
<td>5.6%</td>
</tr>
<tr>
<td>Indonesia</td>
<td>6.00</td>
<td>2.00</td>
<td>8.00</td>
<td>75.0%</td>
<td>25.0%</td>
</tr>
<tr>
<td>Malaysia</td>
<td>6.00</td>
<td>2.00</td>
<td>8.00</td>
<td>75.0%</td>
<td>25.0%</td>
</tr>
<tr>
<td>Philippines</td>
<td>5.00</td>
<td>2.00</td>
<td>7.00</td>
<td>71.4%</td>
<td>28.6%</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>4.50</td>
<td>2.00</td>
<td>6.50</td>
<td>83.3%</td>
<td>16.7%</td>
</tr>
<tr>
<td>South Africa</td>
<td>5.00</td>
<td>2.00</td>
<td>7.00</td>
<td>71.4%</td>
<td>28.6%</td>
</tr>
<tr>
<td>Turkey</td>
<td>6.50</td>
<td>2.00</td>
<td>8.50</td>
<td>77.1%</td>
<td>22.9%</td>
</tr>
<tr>
<td>United States</td>
<td>11.00</td>
<td>2.00</td>
<td>13.00</td>
<td>86.5%</td>
<td>13.5%</td>
</tr>
</tbody>
</table>

• 28 countries, but dose information from 19 countries of Africa, Asia and Eastern Europe
• The frequency of paediatric CT examinations was 20% (Africa), 16% (Asia) and 5% (Europe) of all CT examinations in participating centres
• Eleven CT facilities in six countries were found to use adult CT exposure parameters for paediatric patients
Brain CT- Adults, UAE (Dubai)

How CT Dose has changed over period

Dose management actions following awareness, review of DLP values and analysis of causes when values are high and management in following patients thus increasing awareness among staff on regular basis.

Patient doses in CT examinations based on IAEA projects

Information availability chart

CT

1. Assessing how safe are patients in radiological examinations ✓
2. Comparing with Standards ✓
3. Taking actions where necessary ✓
4. Make patients safer ✓
Mammography

- 54 mammography units in 17 countries of Asia, Africa and Europe
- >21000 mammography images evaluated
- Poor image quality in ≈25-30%
- Radiation dose mostly within reference level, but some cases unacceptably low
- Reduction in poor images by ≈10-50%

Mammography

1. Assessing how safe are patients in radiological examinations
2. Comparing with Standards
3. Taking actions where necessary
4. Make patients safer

IAEA survey of practice in pediatric CT in 40 countries in Asia, Europe, Latin America, and Africa

40 countries that participated

146 CT facilities (scanners) at 126 hospitals

Armenia (1), Belarus (1), Bosnia & Herzegovina (3), Brazil (5), Bulgaria (12), China (3), Costa Rica (1), Croatia (3), Czech Republic (6), Estonia (2), Indonesia (1), Iran (10), Israel (7), Kuwait (5), Lebanon (6), Lithuania (3), Malaysia (5), Malta (1), Mexico (2), Montenegro (1), Moldova (5), Myanmar (1), Oman (1), Pakistan (5), Paraguay (3), Peru (1), Poland (1), Qatar (1), Serbia (3), Singapore (1), Slovakia (4), Slovenia (1), Sri Lanka (2), Sudan (3), Syria (8), Tanzania (3), Thailand (2), The Former Yugoslavia Republic (FYR) of Macedonia (5), United Arab Emirates UAE (15).
Billions (patients)

3.6 billion ≈ 300 million children

International staff

Hundreds to thousands radiology professionals (national level)

~ Million (radiology professionals, worldwide)

Need to reach millions & more

Website http://rpop.iaea.org

10 million hits/year

Strength of CONTENTS

Similarly other areas

• Number 1 website in the World in this field
• Established in Sept. 2006
• 189 countries/territories

~ Million

(Hradiology
professionals, worldwide)
Is there information from the IAEA for PATIENTS?
Information for Public
Radiation is an essential part of our life. From birth, we are exposed to radiation from cosmic rays in our atmosphere and from food and water that also contain traces of radionuclides. In school, we use beakers containing small amounts of radioactive (in the form of radionuclides) in chemistry and biology lessons. The typical type is 100-500 gamma rays per second, a typical amount of radiation. There are many different types of radiation that can affect a source, depending on their nature and the type of shielding.

1. What is radiation dose and dose rate?
2. Who has the highest dose and how is it measured?
3. What is the relationship between the dose and the biological effects of radiation?
4. What are the risks of radiation exposure?
5. How do we protect against radiation hazards?
6. How can radiation be measured?
7. How do the safety procedures control the use of radiation?
8. What is the radiation risk?
9. How does radiation affect the human body?
10. How can radiation be avoided?
11. How can radiation be avoided in the workplace?

IAEA - Safety in Radiological Procedures (SARTRAD)

Safety in Radiological Procedures

The IAEA has a sub-programme on Radiation Protection that operates under the framework of the International Atomic Energy Agency. This programme is aimed at improving the safety of patients and the public by providing guidance and support for the development and implementation of radiological protection measures. The programme includes the provision of technical assistance and training to countries and organizations, as well as the development of guidelines and standards.

IAEA - Regional Training Courses

Regional Training Courses

The IAEA offers regional training courses to enhance the knowledge and skills of professionals in the field of radiological protection. These courses are designed to provide participants with the latest information and best practices, as well as the opportunity to network with other professionals in the field. The courses are typically held in various locations around the world, and participants come from a wide range of countries.

Free Material

- Diagnostic and Interventional Radiology
- Radiotherapy
- Nuclear Medicine
- Prevention of Accidental Exposure in Radiology
- Chemistry
- Physics
- Environmental Radiation
- Dental Radiology

40,000 downloads per year
**How you can be involved**

- Expert assignments in countries
- Lecturer in training course
- Expert in preparing new training material, new guidance documents
- Revision of material
- Translation

**Vision: World map of patient safety situation**

_Justification, Optimization_

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**Miles to go before I sleep-Robert Frost**

**“Whatever you do will be insignificant, but it is very important that you do it”**

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**IAEA**

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Working towards making medical exposure a Safer practice

Thank You