International Perspective on Recording and Reporting Dose

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International Sources

• International Commission on Radiation Units & Measurements (ICRU)- Development of dose quantities

• International Commission on Radiological Protection (ICRP): Development and application of dose quantities for radiation protection e.g. Effective dose

• International Atomic Energy Agency (IAEA): Wider role
Reports

Radiation Dosimetry and Image Quality Assessment in Computed Tomography (ICRU 87)

Coming Soon

This Report will be published as ICRU Report No. 87 Vol. 12 No. 1.

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Dosimetry in Diagnostic Radiology: An International Code of Practice
Implementation of the International Code of Practice on Dosimetry in Diagnostic Radiology (TRS 457): Review of Test Results
Monitoring and Recording

• IAEA: Through International Basic safety Standards (International BSS, called as BSS)
• European Commission through its Eurotom Directive and then Basic Safety Standard (European BSS)

• European Directive through BSS is mandatory for member states whereas international BSS, even though not mandatory, it becomes the source upon which national regulations are set up by most developing countries.
European BSS*

- Dosimetric **information in all diagnostic systems and transfer** to the patient report.
- Dosimetric information mandatory for all **interventional and CT procedures** (also for old units).
- Population dose evaluation need to be made taking into **account the age distribution and the gender**.
European BSS*

• Any system used for **interventional radiology and CT** shall have a device informing the practitioner of the quantity of radiation produced by the equipment during the medical radiological procedure.

Draft BSS
European BSS*

• Any other radiodiagnostic equipment brought into use after the publication of the Directive, shall also have this information.

• The radiation dose shall form part of the report on the examination.

Draft BSS
IAEA Safety Standards

for protecting people and the environment

Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards

INTERIM EDITION

General Safety Requirements Part 3
No. GSR Part 3 (Interim)
Proposal for a

COUNCIL DIRECTIVE

laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation

{SWD(2012) 137 final}
{SWD(2012) 138 final}
Dose DataMed II

At the end of 2004 DG TREN launched a project to provide information and develop guidance on the implementation of Article 12 of the Medical Exposure Directive in Member States with regard to medical imaging. This "DOSE DATAMED" study (in the following referred as DOSE DATAMED1 or DDM1) covered ten European countries with national experiences in conducting surveys of dose distributions from medical radiodiagnostic procedures. The guidance developed under the DOSE DATAMED1 project, together with best available survey data from these ten counties around the year 2002, is published by the European Commission as Radiation Protection 154. European Guidance on Estimating Population Dose from Medical X-ray Procedures1 (RP154).

http://ddmed.eu
DDM2 (33 countries)

- Austria, Belgium, Bulgaria, Czech Republic, Croatia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Iceland, Italy, Lithuania, Luxembourg, Macedonia, Malta, Moldova, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Sweden, Switzerland, Ukraine and United Kingdom.
COLLECTIVE DOSE per caput

- **UNSCAR, 2008**

<table>
<thead>
<tr>
<th>Region</th>
<th>Dose (mSv)</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>1.91</td>
</tr>
<tr>
<td>Australia</td>
<td>2.2</td>
</tr>
<tr>
<td>USA</td>
<td>3.3</td>
</tr>
</tbody>
</table>

- **Europe, 2013**

<table>
<thead>
<tr>
<th>Dose (mSv)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
</tr>
</tbody>
</table>
Percentage of countries using measurement, calculation or literature dose determination
Percentage of countries using measurement, calculation or literature dose determination
Calculation of effective dose for each nuclear medicine examination
DDM2

Percent of countries having system for coding of examination
% of countries where population dose estimates were performed
Fig. 5.5. Mean effective doses from the European countries of this study compared with the earlier data from 10 European countries (RP 154) and UNSCEAR Health Care Level 1 (HCL1; UNSCEAR 2010) countries; (a) plain radiography, (b) other TOP 20 groups.

(a)
Recommended dose quantities for monitoring and recording are reference dose quantities

- $\text{CTDI}_{\text{vol}}$ and DLP
- Fluoroscopy: Dose area product (DAP)/kerma area product (KAP), cumulative air kerma (CAK) and entrance surface dose (ESD).
- Radiography: ESD, DAP/KAP
- Mammo: MGD
Diagnostic Reference Levels (DRLs)

- Both International and European BSS require establishment and use of DRLs
  - To detect outliers above 75 percentile distribution
  - NCRP 172, 2012: 50 percentile (median)
  - Investigate and optimize
This is pursued through periodic surveys rather than regular registries
Fig. 2.2. Diagnostic reference levels for paediatric x-ray examinations.
Fig. 2.1. Diagnostic reference levels for adult x-ray examinations.
Fig. 2.15. Comparison of DRLs for CT head in terms of DLP, mGy cm.

Fig. 2.16 Comparison of DRLs for CT chest in terms of DLP, mGy cm.
Ongoing Actions in Europe

• Exploitation of the full individual patient dose distributions in addition to DRLs, to help with optimization

• Standardization and consensus on the levels of complexity for some common procedures and the impact on DRLs.

• Establishment of European DRLs for pediatric
IAEA Survey of Pediatric CT Practice in 40 Countries in Asia, Europe, Latin America, and Africa: Part I, Frequency and Appropriateness

OBJECTIVE. The purpose of this study was to assess the frequency of pediatric CT in 40 less-resourced countries and to determine the level of appropriateness in CT use.

MATERIALS AND METHODS. Data on the increase in the number of CT examinations during 2007 and 2009 and appropriate use of CT examinations were collected, using standard forms, from 146 CT facilities at 126 hospitals.

First ever study of this kind
Findings from these papers

- $\text{CTDI}_{\text{vol}}$ for head, chest in some facilities 2-5 times adults
- Up to 100 times variation in radiation dose
Results: Typical exposure parameters

Protocols for **chest examination** of infant (<1 y) in 8 CT facilities with the same 64-detector scanner model (Light Speed VCT, GE)

<table>
<thead>
<tr>
<th>Scanner number</th>
<th>mode</th>
<th>Tube voltage, kV</th>
<th>Tube current, mA</th>
<th>t rot, s</th>
<th>Pitch value</th>
<th>CTDI_{vol}, mGy</th>
</tr>
</thead>
<tbody>
<tr>
<td>39</td>
<td>helical</td>
<td>80</td>
<td>129</td>
<td>0.5</td>
<td>1.3</td>
<td>1.89</td>
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<tr>
<td>40</td>
<td>helical</td>
<td>120</td>
<td>120</td>
<td>0.5</td>
<td>0.984</td>
<td>10.21</td>
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<td>0.5</td>
<td>0.984</td>
<td>2.64</td>
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<td>26</td>
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<td>80</td>
<td>100-250</td>
<td>0.5</td>
<td>0.96</td>
<td>4.2</td>
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<tr>
<td>29</td>
<td>helical</td>
<td>100</td>
<td>180</td>
<td>0.4</td>
<td>0.98</td>
<td>3.2</td>
</tr>
<tr>
<td>8</td>
<td>helical</td>
<td>120</td>
<td>80</td>
<td>0.4</td>
<td>1.375</td>
<td>4.5</td>
</tr>
<tr>
<td>124</td>
<td>helical</td>
<td>80</td>
<td>25</td>
<td>0.5</td>
<td>0.9</td>
<td>0.71</td>
</tr>
<tr>
<td>119</td>
<td>helical</td>
<td>120</td>
<td>80</td>
<td>0.6</td>
<td>0.9</td>
<td>10</td>
</tr>
</tbody>
</table>

14.5-fold variation
Head CT

- CTDI$_w$ values were higher than the latest UK DRL values for children by:
  - 62% for age group <1y,
  - 27% for (1-5) y,
  - 22% for (5-10) y.

- The third quartile CTDI$_{vol}$ values are lower by 3 to 16% than the DRLs in UK, Germany and France, depending on the age group, but they are higher than corresponding values in Switzerland by up to 45%.

- Gantry tilt or patient head repositioning was applied by more than 75% of operators.
Impact of Optimization
Impact of optimization

Median CTDIvol (mGy)

- Head CT Age 1-5 (Czech Rep., 6)
- Head CT Age 5-10 (Serbia, 20)
- Head CT Age 5-10 (Thailand, 131)
- Head CT Age 10-15 (UAE, 29)
- Head CT Age 10-15 (Slovenia, 22)
- Chest CT Age 1-5 (Czech Rep., 22)
- Abd. CT Age 1-5 (Czech Rep., 5)
- Abd. CT Age 1-5 (Slovenia, 22)

Before (Phase I) vs After (Phase II)
How many have experience in documenting impact of optimization with time???
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 IN 18 COUNTRIES: INITIAL RESULTS FROM INTERNATIONAL ATOMIC ENERGY AGENCY PROJECTS

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PAEDIATRIC CT EXAMINATIONS IN 19 DEVELOPING COUNTRIES: FREQUENCY AND RADIATION DOSE


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Image quality and dose in mammography in 17 countries in Africa, Asia and Eastern Europe: Results from IAEA projects

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Radiation protection of patients in diagnostic radiology: Status of practice in five Eastern-European countries, based on IAEA project

Olivera Ciraj-Bjelac\textsuperscript{a,1}, Adnan Beganovic\textsuperscript{b,2}, Dario Faj\textsuperscript{c,3}, Vesna Gershan\textsuperscript{d,4}, Sonja Ivanovic\textsuperscript{e,5}, Ivan R. Videnovic\textsuperscript{f,6} and Madan M. Rehani\textsuperscript{g,7,8,*}
Free download http://rpop.iaea.org

Optimization of the radiological protection of patients: Image quality and dose in mammography (coordinated research in Europe)

Optimization of the radiological protection of patients undergoing radiography, fluoroscopy and computed tomography

Results of the Coordinated Research Project on Optimization of Protection in Mammography in some eastern European States

Final report of a coordinated research project in Africa, Asia and eastern Europe

IAEA
International Atomic Energy Agency

May 2005

IAEA
International Atomic Energy Agency

December 2004
2001 Situation of optimization in radiological imaging
Recap

- International sources: monitoring, recording and reporting of dose
- Mandatory provisions under European BSS
- International BSS
- Glimpse of data from DDM2, IAEA projects
- Publications
Thank You

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