AAPM 2013 The Management of Imaging Procedure Dose 4

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



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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Resources

The ICRU is pleased to announce that the 16th Gray Current Program »

Reports »

TECHNICAL REPORTS SERIES NO. 457

Dosimetry in Diagnostic Radiology: An International Code of Practice



IAEA HUMAN HEALTH REPORTS No. 4



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.

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.

IAEA Safety Standards

for protecting people and the environment

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

General Safety Requirements Part 3 No. GSR Part 3 (Interim)





EUROPEAN COMMISSION

Brussels, 30.5.2012 COM(2012) 242 final

2011/0254 (NLE)

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

• UNSCEAR, 2008

World Australia USA 1.91 mSv 2.2 mSv 3.3 mSv

• Europe, 2013

1.1 mSv



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



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.



Recommended dose quantities for monitoring and recording are reference dose quantities

- CTDI_{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.



ig.2.1. Diagnostic reference levels for adult x-ray examinations.

Ddmed.eu



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

Jenia Vassileva¹ Madan M. Rehani² See end of article for complete author list

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.

Eur Radiol DOI 10.1007/s00330-012-2639-3

COMPUTED TOMOGRAPHY

IAEA survey of paediatric computed tomography practice in 40 countries in Asia, Europe, Latin America and Africa: procedures and protocols

Jenia Vassileva • Madan M. Rehani • Kimberly Applegate • Nada A. Ahmed • Humoud Al-Dhuhli • Huda M. Al-Naemi

First ever study of this kind

Findings from these papers

- CTDI_{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)

Scanner	mode	Tube	Tube	t rot, s	Pitch value	CTDI _{vol} , mGy
number		voltage, kV	current, mA			
39	helical	80	129	0.5	1.3	1.89
40	helical	120	120	0.5	0.984	10.21
102	helical	80	240	0.5	0.984	2,54
26	helical	80	100-250	0.5	0.96	24.20 54.20
29	helical	100	180	0.4	0.98	* 3 .2
8	helical	120	80	0.4	1.375	4.5
124	helical	80	25	0.5	0.9	0.71
119	helical	120	80	0.6	0.9	10

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



How many have experience in documenting impact of optimization WITH TIME???



Rehani, Making X rays safer for patients & staff

Brain CT- Adults LIAF (Dubai) CT Head Examination DLP Values (Jan2008-April2010)- Dubai 1600 Max DLP 1400 Average DLP (mGy cm) 1200 JLP (mGy cm) 1000 800 600 400 200 0 Nat09 May08 Junos Jan09 13108 fen08 A9108 Decos FebOB AND WO JULO JULO GER OF LO LO DE O UND GERDO OCTO NOVO Months

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

Radiation Protection Dosimetry Advance Access published August 17, 2009

Radiation Protection Dosimetry (2009), pp. 1-9

doi:10.1093/rpd/ncp144

PATIENT DOSES IN CT EXAMINATIONS IN 18 COUNTRIES: INITIAL RESULTS FROM INTERNATIONAL ATOMIC ENERGY AGENCY PROJECTS

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Radiation Protection Dosimetry (2010), pp. 1-10

doi:10.1093/rpd/ncq015

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

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European Journal of Radiology

journal homepage: www.elsevier.com/locate/ejrad

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

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IAEA-TECDOC-1423

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

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

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

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



December 2004



May 2005

2001 Situation of optimization in radiological imaging





Developing Counties

Patient Doses in Radiographic Examinations in Asia, Africa, Latin America and Eastern Europe



Algeria	China	FYR Macedonia	Madagascar	Oman	Singapore	United Arab Emirates
Argentina	Costa Rica	Ghana	Malaysia	Pakistan	Slovakia	Uruguay
Armenia	Croatia	Indonesia	Malta	Paraguay	Slovenia	Zimbabwe
Belarus	Cuba	Iran	Mexico	Peru	Sri Lanka	
Bosnia and						
Herzegovina	Czech Republic	Israel	Moldova	Poland	Sudan	
Brazil	Dem. Rep. of Congo	Kuwait	Montenegro	Qatar	Syria	
Bulgaria	Ecuador	Lebanon	Myanmar	Saudi Arabia	Tanzania	
Chile	Estonia	Lithuania	Nicaragua	Serbia	Thailand	

Recap

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



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Rehani, Making X rays safer for patients & staff