



Optimization of the Patient CT Dose in Europe

Dr Virginia Tsapaki

50th AAPM 2016
International Symposium:
Patient Dose Reduction in Diagnostic Radiology
Washington 31 July to 4 August 2016

Conflict of interest

- There is no conflict of interest

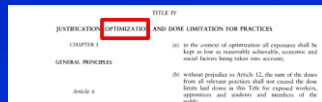
Topics that will be discussed:

How dose optimization is being implemented in Europe

- European legislation
- Industry initiatives
- European projects
- Various organizations initiatives
- Conclusions

EUROPEAN LEGISLATION

Eur Directive 29 1996



The history of optimization in Europe goes back 20 years!

European Directive 43 1997



- **Article 4:** Optimization
- **Article 8:** Dose measurement is mandatory
- **Article 9:** Special attention to high dose exams such as **CT**

European Directive 59 2013



• Article 60

Equipment used for interventional radiology and **computed tomography** has the capacity to transfer the dose information to the record of the examination.

INDUSTRY INITIATIVES



- COCIR is the European Trade Association representing the medical imaging, radiotherapy, health ICT and electromedical industries.
- It is the "voice" of industry towards EU
- <http://www.cocir.org/>

CT Manufacturer's Voluntary Commitment Regarding CT Dose



• COCIR represents:

- ✓ General Electric
- ✓ Philips
- ✓ Siemens
- ✓ Toshiba

Preamble

This document defines the CT manufacturers' voluntary commitment to HERCA as a result of the meeting held in Bern on 14 June 2010.

The CT manufacturers agree to work under the umbrella of their European Trade Association, COCIR, to ensure a joint approach. The aim of this commitment is to further the initiatives of improving dose reporting, promoting transparency in dose efficacy, continuing reduction of medical exposure, and provision of specific training curricula. The manufacturers agree to complete the voluntary commitments outlined within and provide yearly updates with regard to their status and developments. Additionally, if significant delays or advancements in the timelines are expected these are agreed to be communicated in a timely manner.

General statement from CT manufacturers

As the developers of sophisticated equipment, CT manufacturers acknowledge their unique role in the process to help optimize patient CT dose in the health care setting; this can be accomplished through 4 major items:

4 main commitments:

1. Characterization of CT Systems Standardized Benchmarking
2. Implementation of dose reduction measures in CT
3. Dose management and reporting
4. Provision of specific training curricula

2013 update



CT Manufacturer's Voluntary Commitment Regarding CT Dose

Updated list of dose management features

The CT manufacturers have worked through META to provide an updated list of available techniques implemented for dose reduction on CT systems, in line with Commitment 2 of the CT Manufacturer's Voluntary Commitment Regarding CT Dose.

This following list has been updated and is still based on the META list, but contains only the COCIR CT manufacturers: General Electric Healthcare, Philips Healthcare, Siemens Healthcare and Toshiba Medical Systems. This list describes generic categories of features and is not intended to reflect marketing names or be updated to show the evolution of each of these specific features with respect to improvement in performance that all manufacturers continue to develop on an ongoing basis.

1. General Electric Healthcare

- Patient Protocol Selection Guidance

- Color coded pediatric weight age-based protocols, pediatric Featherlight (procedure based) protocols, and low-dose pediatric CT protocols, to minimize technological errors
- Prescribed protocols for adults and for pediatric imaging organized by clinical indication to serve as a starting point for optimizing an institution's dose vs. IQ preferences

- Advanced Collimator Design

- Real time beam tracking during all scanning to minimize beam collimation
- Dynamic beam size collimation to reduce unwanted patient exposure at ends of helical scanning

CT manufacturers have worked to provide an updated list of available technologies implemented for dose reduction on CT scanners, in line with Commitment 2 (Implementation of dose reduction measures in CT)


EUROPEAN PROJECTS

EUR 16262 EN, 1999

<http://www.drs.dk/guidelines/ct/quality/>



- Provides Reference doses for 6 types of exams
- Good imaging techniques



CT Safety & Efficacy A Broad Perspective

A 6th Framework Research Project of the European Commission

2004 CT Quality Criteria

[Download the 2004 CT Quality Criteria](#)

Introduction

Multislice computed tomography (MSCT) has been the major advance in the practice of computed tomography (CT) since this modality began. It has made existing applications easier and has extended the applications of CT into new areas, with significant impact on the clinical management of disease. This change has created educational and practice challenges that are on-going because the technological advance continues. The last six years have seen the successive introduction of systems capable of acquiring simultaneously 4, 5 or 16, 32 slices, and systems with 64 or more detector arrays are on the point of introduction. So rapid has been the development that changes in examination technique have had difficulty keeping pace with technological advance. The new technology also has significant implications to the radiation dose administered to the population from medical uses. For more than ten years it has been recognised that CT represents a progressively enlarging contribution to the dose to the population and that in some departments the modality may represent the largest single source of patient radiation in diagnostic radiology. The wider applications of MSCT contribute to this trend, increasing the scope of examinations and increasing the number of patients in whom CT becomes the investigation of choice.

For these reasons MSCT represents a powerful challenge to existing practice standards. Medical personnel using MSCT must be conscientious in practicing to the highest possible standards and adapting these standards as developments progress. It is mandatory that practice concurs with national and international legislation and guidelines in passing examinations and optimising practice. However MSCT continues to develop and it is essential that practice also takes account of evidence continually emerging from clinical experience and research studies.

http://www.msct.eu/CT_Quality_Criteria.htm

MDCT dosimetry: Guidelines on radiation dose to the patient

Table 1. Normalised effective dose per dose-length product (DLP) for adults (standard physique) over various body regions. Conversion factor for head and neck apply to the CT dose head phantom, all other conversion factors, including legs apply to the CT dose body phantom.

Region of body	Normalised effective dose, E/DLP (mSv mGy ⁻¹ cm-1)
Head	0.0023
Neck	0.0054 *)
Chest	0.019
Abdomen	0.017
Pelvis	0.017
Legs	0.0008 **)

*) Conversion factor from previous document on CT Quality Criteria (CT study group 2000).

**) Calculated with CT Dose (version 0.6.7) National Board of Health, National Institute of Radiation Hygiene, Denmark).

European ALARA Network

Project started in 2009 and finished in 2012



<http://www.eman-network.eu/>

EMAN partners:

- Strålsäkerhetsmyndigheten (Swedish Radiation Safety Authority, SSM, Sweden), Coordinator
- European Federation of Medical Physicist (EFOMP)
- European Society of Radiology (ESR)
- European Federation of Radiographer Societies (EFRS)
- European Radiation Dosimetry Group (EURADOS)
- Bundesamt für Strahlenschutz (Federal Office of Radiation Protection, BfS, Germany)
- Centre d'étude sur l'Evaluation de la Protection dans le domaine Nucléaire (Nuclear Protection Evaluation Center, CEPN, France)

Work package (WP 1) on Optimisation of Patient Exposures in CT-Procedures

- Mercè Ginjaume, EURADOS
- Jürgen Griebel, BfS
- Hans-Dieter Nagel, SASCRAD
- Elke Nekolla, BfS
- Dean Pekarovic, EFRS
- Mathias Prokop, ESR
- Viginia Tsapaki, EFOMP

WP 1 CT Optimisation

	Working Package (WP1)	Responsible
1	CT medical exposures	J. Griebel (Lead), E. Nekolla
2	CT risk / benefit estimation	J. Griebel (Lead), E. Nekolla
3	CT dose reduction techniques: equipment	M. Prokop
4	CT dose reduction techniques: protocols	M. Prokop
5	CT dose efficiency parameters	H. D. Nagel
6	CT dose reporting	M. Ginjaume
7	CT diagnostic reference levels	V. Tsapaki
8	Training & education	D. Pekarovic (Lead), V. Tsapaki, M. Prokop

Key suggestions

- **Standard protocols** by manufacturers
 - at various image quality levels, well below current DRLs
- **Common database format** for dose data
 - with standardized protocol names to collect and compare dose
- **Core team**
 - to focus training and provide clear responsibilities
- **Web-based forum and knowledge repository**
 - to disseminate knowledge
 - to share best practices and provide feedback

<http://www.eman-network.eu/>

2012



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EUTEMPE-RX

The EUTEMPE-RX project partners have established the EUTEMPE-Land to ensure the future reputation of the course modules.

[Read more](#)

http://www.eutempe-rx.eu/

Apply Now!

MPEOS: Mathematical model observers developed and implemented for patient dose optimization in CT

12-16 March 2016
Lausanne, Switzerland

10 Upcoming Modules

10 MPEOS: Leadership in Medical Physics: Development of the profession and the challenges for the MPE (LMP)

Leaders: C. Caruso & V. Tappin

6-10 February 2017, Prague, Czech Republic

10 MPEOS: Radiation biology for medical physicists in radiology

Leader: A. Ottolenghi, C. Baloni

15-19 January 2017, Paris, Italy

10 MPEOS: Monte Carlo Simulations of X-ray imaging and dosimetry

Leader: C. Sempin

20-24 June 2017 (Provisional), Barcelona, Spain

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Partners

EFOMP & its professional & educational matters

Teaching hospitals

Universities

- Med. physics
- Radiobiology
- Physics

Screening organisations

(Industry) (Authorities)


Number	Title	Lead
7	Advanced measurements of the performance of X-ray imaging systems	Prof. K. Young & A. McKenzie
8	CT imaging and dose optimized with objective means	Prof. F. Verdun
9	Achieving quality in the medical physics aspect of breast cancer screening	R. van Engen, W. Veltkamp
10	High dose X-ray procedures in Interventional radiology and cardiology	Dr. R. Padovani & Prof. E. Vano
11	Radiation dose management of pregnant patients, pregnant staff and paediatric patients in diagnostic and interventional radiology (focus on CT)	Prof. J. Damlakis
12	Personnel dosimetry, including techniques to communicate practical results to the users (RPE)	Dr. M. Borowski, prof. Fiebach
Finished in July 2016		

8



www.pidrl.eu

European Society of Radiology (ESR), Coordinator
 European Society of Paediatric Radiology (ESPR)
 European Federation of Radiographer Societies (EFRS)
 European Federation of Organisations for Medical Physics (EFOMP)
 Finnish Radiation and Nuclear Safety Authority (STUK) –
 Subcontractor: Public Research Centre Henri Tudor (CRP-HT)



The project provided European DRLs for children and promoted their use so as to advance optimisation of radiation protection of paediatric patients, with a focus on CT, interventional procedures using fluoroscopy and digital radiographic imaging.

This 27-month project aimed at:

- Agreeing on a methodology for establishing and using DRLs for paediatric imaging
- Updating and extending the European DRLs to cover more procedures and a wider patient age/weight range based on current knowledge.



WORKSHOP
 October 15–17, 2015
 Lisbon School of Health Technology /
 Escola Superior de Tecnologia da
 Saúde de Lisboa
 Lisbon, Portugal

SAVE THE DATE!
 Pre-register for free:
www.eurosafeimaging.org

FREE registration

The aims of the Workshop were to:

- present and discuss the project's results,
- submit the draft European Guidelines for comments and critical review by a larger audience and
- identify the needs for further action on DRLs and optimisation of radiation protection of paediatric patients.

The workshop aimed at key stakeholders in paediatric imaging

<http://www.eurosafeimaging.org/pidrl/workshop>

BSS Transposition European Project

Evaluation of national actions regarding the transposition of Council Directive 2013/59/Euratom's requirements in the medical sector

<http://www.eurosafeimaging.org/bss-transposition>



OTHER EUROPEAN INITIATIVES FOR CT OPTIMIZATION

http://www.efomp.org/images/docs/ESMPE_2016_Flyer.pdf





<http://www.herca.org/activities.asp?p=3&s=5>



Medical Physicists together with the CT technologists are responsible for the:

- Quality assurance of the CT scanners;
- Dose optimisation of the CT protocols;
- Patient dose measurements;
- Establishment of Diagnostic Reference Levels (DRLs);
- Investigation of events where a patient receives a dose which is higher than a defined level.



The European Alliance for Medical Radiation Protection Research (EURAMED) represents a consortium of associations involved in the application of ionising radiation in medicine:

- European Association of Nuclear Medicine (EANM)
- European Federation of Organisations for Medical Physics (EFOMP)
- European Federation of Radiographer Societies (EFRS)
- European Society of Radiology (ESR)
- European Society for Radiotherapy and Oncology (ESTRO)

with the goal of jointly improving medical care and its radiation protection issues through sustainable research efforts.

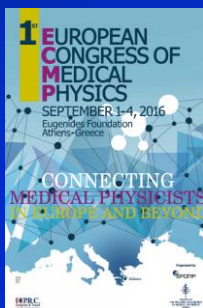


Strategic Research Agenda (SRA)

http://www.eibir.org/wp_live_eibir12_km21s/wp-content/uploads/2016/07/EURAMED-SRA-2016.pdf

Optimization is one of the 5 top priority research topics

- 3.3. Optimisation of radiation exposure and harmonisation of practices
- 3.3.1. Patient-tailored diagnosis and treatment including an expert system for optimisation
 - 3.3.2. Full exploitation and improvement of technology and techniques
 - 3.3.3. Clinical and dose structured reporting
 - 3.3.4. Protection of staff, patients, carers and general public



<https://www.ecmp2016.org/site/page/program>

73 invited speakers

2 talks per day related to CT optimization

Conclusions

- CT Optimization has a long tradition in Europe
- It is specifically mentioned in European legislations the last 20 years
- Millions of euros have been invested by EC on addressing the issue of optimization and radiation protection in CT. This will increase in the future within the Horizon 2020 research program.
- Collaboration and team work is strongly encouraged by various European organizations.
- European alliances are currently built up between various professionals for more efficient CT dose reduction.