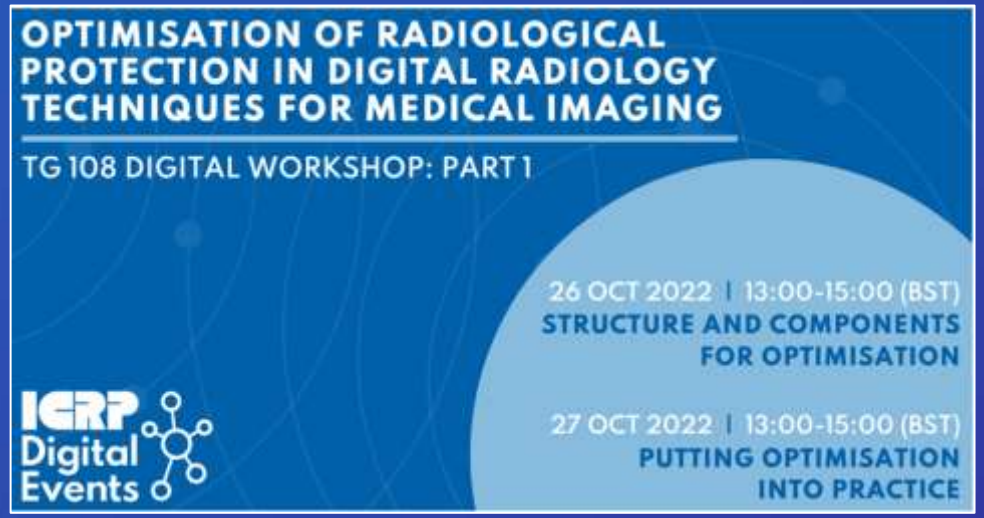
IAEA
International Atomic Energy Agency

CURRENT ISSUES WITH OPTIMISATION AROUND THE WORLD AND SUPPORT FROM THE IAEA



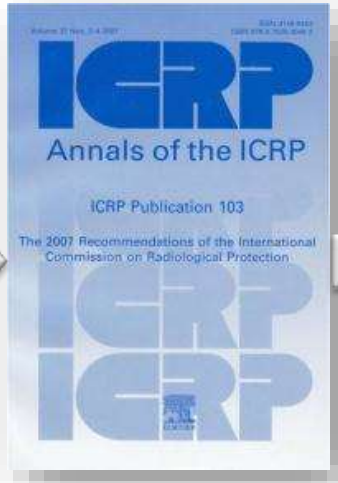
Jenia Vassileva
Radiation Protection of Patients Unit,
International Atomic Energy Agency
Member of the ICRP TG108

Olivera Ciraj-Bjelac
Dosimetry and Medical Radiation
Physics Section, IAEA

International system for radiation protection

UNSCEAR studies the sources and effects of radiation

ICRP provides recommendations for protection



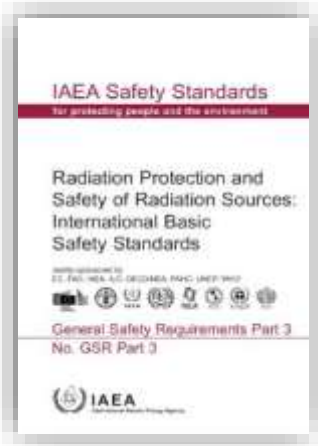
IAEA establishes safety standards and provides for the application of these standards

International system for radiation protection

- All Safety Standards go through a formal process of Member State comments
- Involve relevant professional bodies
- Reflect the international consensus

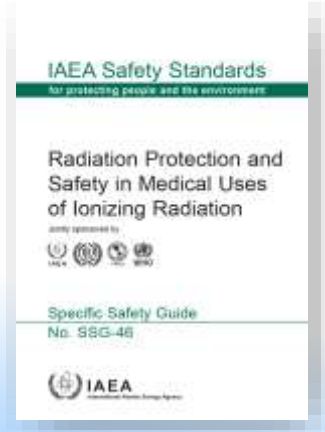
IAEA establishes safety standards and provides for the application of these standards

Radiation protection in medical uses



International Basic Safety Standards (GSR Part 3)

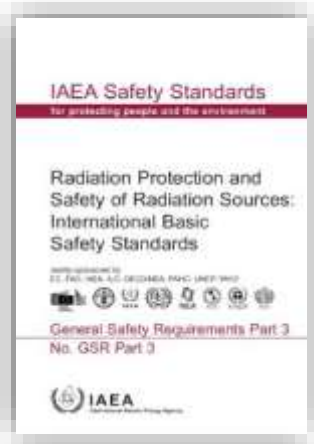
- Published 2014
- Set basic requirements for protection and safety
- Co-sponsored by 8 international organizations

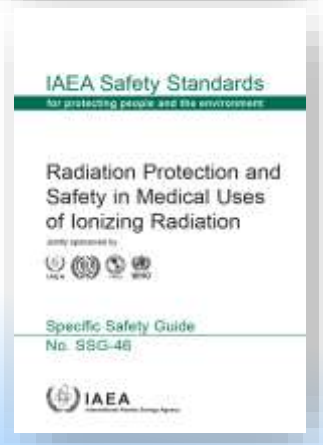


Safety Guide SSG-46: Medical uses of IR

- Published October 2018
- Jointly sponsored by IAEA, WHO, PAHO, ILO
- Cooperation in developing from international/regional professional organizations: IOMP, ISR, ISRRT, WFNMB, ESTRO

Optimization of protection (GSR Part 3, SSG-46)





- For medical exposure: The management of the radiation dose to the patient commensurate with the medical purpose.
- In diagnostic and interventional medical exposure: keeping the exposure of patients to the minimum necessary to achieve the required diagnostic or interventional objective.

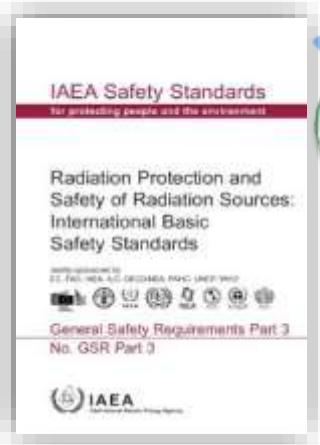
Components of optimization:

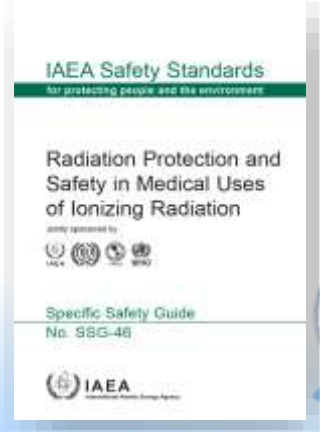
- Equipment design and software
- Calibration
- Quality assurance and quality control
- Dosimetry of patients and DRLs
- Operational aspects () protocols, technique and parameters
- Radiological review

Responsibilities:

- Radiological med. professionals
- Medical physicists
- Medical rad. technologists
- Vendors and service engineers
- Licensee
- Regulatory and health authorities
- Professional bodies

Application of safety standards into practice





- Guidance
- Trainings
- Technical assistance
- Knowledge exchange
- Building awareness

Issues with optimization around the world

IAEA coordinated studies

- Large variations in patient doses for the same imaging exam

Radiation Protection Dosimetry (2009), Vol. 136, No. 2, pp. 118–126
Advance Access publication 17 August 2009
doi:10.1093/rpd/ncp144

SCIENTIFIC NOTE

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

W. E. Muhogora[1], N. A. Ahmed[2], A. Beganovic[3], A. Benider[4], O. Ciraj-Bjelac[5], V. Gershan[6], E. Gershkevitsh[7], E. Grupetta[8], M. H. Kharita[9], N. Manatrakul[10], M. Milakovic[11], K. Ohno[12], L. Ben Omrane[13], J. Ptacek[14], C. Schandorf[15], M. S. Shabaan[16], D. Stoyanov[17], N. Toutaoui[18], J. S. Wambani[19] and M. M. Rehani[20,*]

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

Radiation Protection Dosimetry (2011), pp. 1–6

STATUS OF RADIATION PROTECTION IN INTERVENTION CARDIOLOGY IN FOUR EAST EUROPEAN COUNTRIES

O. Ciraj-Bjelac[1,*], A. Beganovic[2], D. Faj[3], S. Ivanovic[4], I. Videnovic[5] and M. Rehani[5]
[1]Radiation and Environmental Protection Department, Vinca Institute of Nuclear Sciences, M. 12–14, Vinca, PO Box 522, 11001 Belgrade, Serbia
[2]University of Sarajevo, Sarajevo, Bosnia and Herzegovina
[3]University Hospital of Osijek, Osijek, Croatia
[4]Clinical Centre of Montenegro, Podgorica, Montenegro
[5]International Atomic Energy Agency, Vienna, Austria

Virginia Tsapaki[1]
Nada A. Ahmed[2]
Jamila Salem AlSuwaidi[3]
Adnan Beganovic[4]
Abdelkader Benider[5]
Latifa BenOmrane[6]
Rada Borisova[7]
Sotirios Economides[8]

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

Radiation Protection Dosimetry (2010), Vol. 140, No. 1, pp. 49–58
Advance Access publication 11 February 2010
doi:10.1093/rpd/ncq015

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

W. E. Muhogora[1], N. A. Ahmed[2], J. S. AlSuwaidi[3], A. Beganovic[4], O. Ciraj-Bjelac[5], V. Gershan[6], E. Gershkevitsh[7], E. Grupetta[8], M. H. Kharita[9], N. Manatrakul[10], B. Maroufi[11], M. Milakovic[12], K. Ohno[13], L. Ben Omrane[14], J. Ptacek[15], C. Schandorf[16], M. S. Shaaban[17], N. Toutaoui[18], D. Sakkas[19], J. S. Wambani[20] and M. M. Rehani[21,*]

IAEA coordinated studies

IAEA study of practice in paediatric radiology:
40 countries, 126 hospitals, 146 CT facilities

- 22-fold variation between average dose indexes for the same age group and the same type of CT exam
- Adult protocols often used for children


IAEA Survey of Pediatric CT Practice in 40 Countries in Asia, Europe, Latin Amer Africa: Part I, Frequ Appropriateness

AJR

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

COMPUTED TOMOGRAPHY

IAEA survey of paediatric computed tomo countries in Asia, Europe, Latin America procedures and protocols

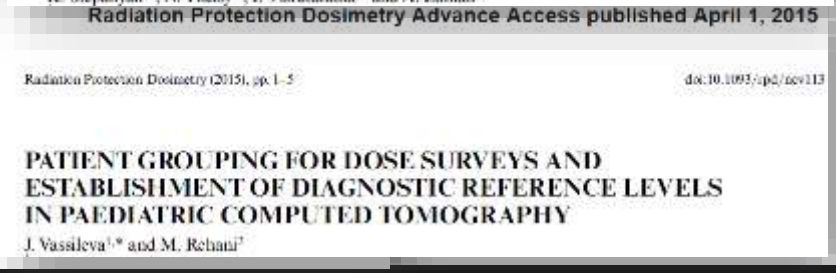
Jenia Vassileva · Madan M. Rehani · Kimberly Applegate · Nada A. Ahmed · Humoud Al-Dhuhli · Huda M. Al-Naemi


Radiation Protection Dosimetry Advance Access published April 1, 2015

Radiation Protection Dosimetry (2015), pp. 1–11 doi:10.1093/rpd/ncv116

A STUDY TO ESTABLISH INTERNATIONAL DIAGNOSTIC REFERENCE LEVELS FOR PAEDIATRIC COMPUTED TOMOGRAPHY

J. Vassileva[1,*], M. Rehani[2], D. Kostova-Lefterova[3], H. M. Al-Naemi[4], J. S. Al Suwaidi[5], D. Arandjic[6], F. H. O. Bashier[7], S. Kodliulovich Renha[8], L. El-Nachef[9], J. G. Aguilar[10], V. Gershan[11], E. Gershkevitsh[12], E. Gruppetta[13], A. Hustac[14], A. Jauhari[15], Mohammad Hassan Kharita[16], N. Khelassi-Toutaoui[17], H. R. Khosravi[18], H. Khoury[19], I. Kralik[20], S. Mahere[21], J. Mazuoliene[22], P. Mora[23], W. Muhogora[24], P. Muthavelu[25], D. Nikodemova[26], L. Novak[27], A. Pallewatte[28], D. Pekarovic[29], M. Shaaban[30], E. Shelly[31], K. Stepanyan[32], N. Thelsy[33], P. Visrutaratna[34] and A. Zaman[35]


Radiation Protection Dosimetry Advance Access published April 1, 2015

Radiation Protection Dosimetry (2015), pp. 1–5 doi:10.1093/rpd/ncv113

PATIENT GROUPING FOR DOSE SURVEYS AND ESTABLISHMENT OF DIAGNOSTIC REFERENCE LEVELS IN PAEDIATRIC COMPUTED TOMOGRAPHY

J. Vassileva[1,*] and M. Rehani[2]

IAEA coordinated studies

IAEA study of CT protocols and doses for hematuria and urinary stones

20 countries

- Up to 12-fold variations in urinary stone CT examinations (median DLP values of 219−2664 mGy.cm) with use of reduced dose CT in only 4/20 participating countries.
- 80% use 3–6 phase CT urography protocols associated with 2.4–4.9-fold higher dose compared to 2-phase protocol


European Journal of Radiology 126 (2020) 108923

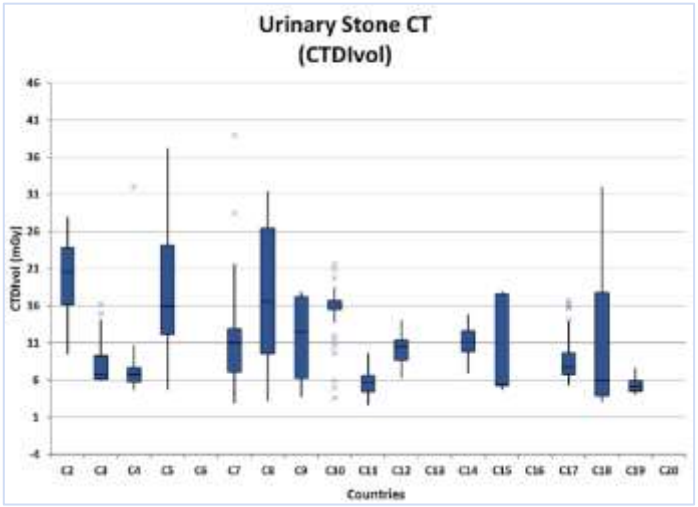
Contents lists available at ScienceDirect

European Journal of Radiology

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

CT protocols and radiation doses for hematuria and urinary stones: Comparing practices in 20 countries

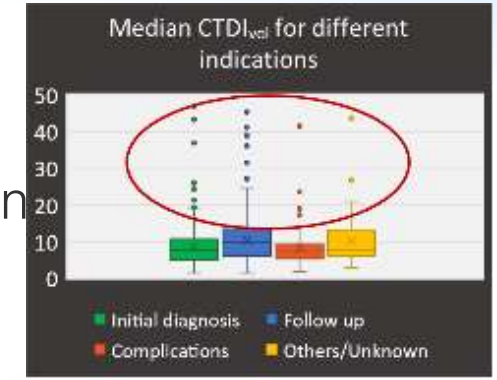
Vesna Gershan[a], Fatemeh Homayounieh[b,*], Ramandeep Singh[b], Simona Avramova-Cholakova[c], Dario Faj[d], Emil Georgiev[e], Olga Girjoaba[f], Birute Griciene[g], Edward Gruppetta[h], Darka Hadnadjev Šimonji[i], Siarhei Kharuzhyk[j], Andrej Klepanec[k], Desisslava Kostova-Lefterova[l], Anna Kulikova[m], Ivan Lasic[n], Aleksandra Milatovic[o], Graciano Paulo[p], Jenia Vassileva[q], Mannudeep K. Kalra[b]

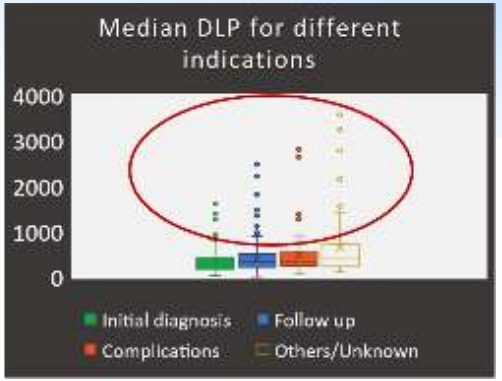


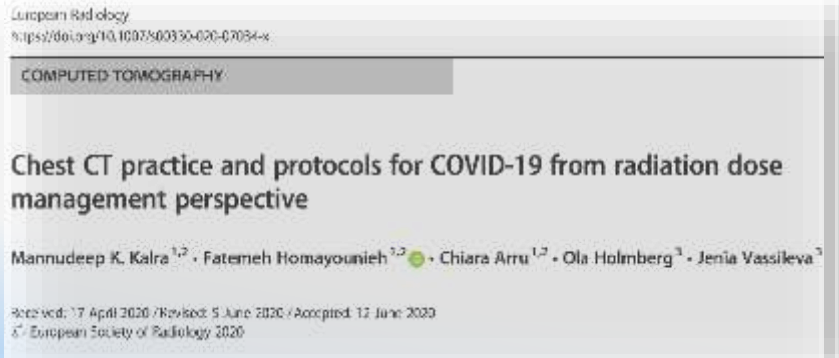
IAEA coordinated studies

IAEA study on COVID-19

- 62 CT facilities from 34 countries
- 10-fold variations in median DLP
- CT use, scan protocols, and radiation doses showed wide variation across health care sites within the same and between different countries.






European Radiology
https://doi.org/10.1007/s00330-020-07034-x

COMPUTED TOMOGRAPHY

Chest CT practice and protocols for COVID-19 from radiation dose management perspective

Mannudeep K. Kalra[1,2] · Fatemeh Homayounieh[1,2] · Chiara Arru[1,2] · Ola Holmberg[3] · Jenia Vassileva[3]

Received: 17 April 2020 / Revised: 5 June 2020 / Accepted: 12 June 2020
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Radiology

ORIGINAL RESEARCH · THORA

Variations in CT Utilization, Protocols, and Radiation Doses in COVID-19 Pneumonia: Results from 28 Countries in the IAEA Study

Fatemeh Homayounieh, MD • Ola Holmberg, PhD • Rashid Al Umairi, MD • Sallam Aly, MD • Algidas Basevičius, MD • Paulo Roberto Costa, PhD • Adham Darweesh, MD • Vesna Gershan, PhD • Pilvi Ilves, MD, PhD • Desislava Kostova-Lefterova, PhD • Simone Kodlulovich Renda, PhD • Iman Mohseni, MD • Osvaldo Rampado, DMP • Natalia Rotaru, MD • Isahaku Shirazu, PhD • Valentin Sinitsyn, MD • Tajana Turk, MD • Claire Van Ngoc Ty, PhD • Mannudeep K. Kalra, MD • Jenia Vassileva, PhD**

Challenges with optimization

- Access to dose reduction technology in different parts of the world
- Access to dose data in a digital format
- Knowledge and skills of health professionals, often linked to lack of good professional qualification or lack of training on practical RP aspects
- Access to qualified medical physicists in medical imaging
- Safety culture and team work
- Enforcement through national legislation
- Collaboration between regulatory bodies, health authorities and professional bodies
- National DRLs and patient dose monitoring programs
- Proper QM/QA/QC program, often limited to technical QC
- Operational procedures and optimized protocols

Enforcement through regulation

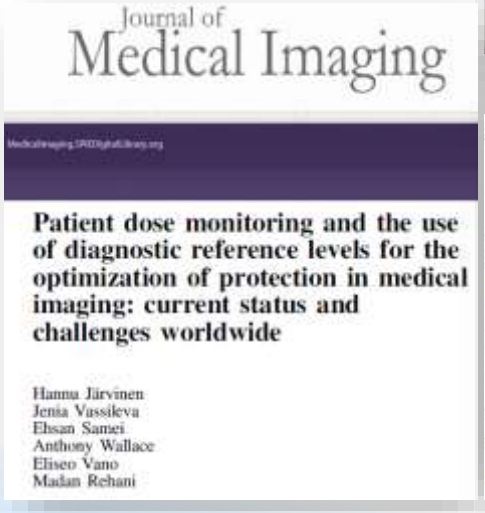
Main issues with the optimization, based on the analyses of the legislation of 24 countries from Europe and Central Asia (TC region Europe) made in 2021:

- Access to medical physicists in diagnostic and interventional radiology is required in only 10/24 (42%) countries.
- Establishment of a QA program for medical exposure is required in 10/24 (42%) countries and partly (limited to technical QC) in 10/24 countries
- Establishment of DRLs in diagnostic and interventional radiology and local assessment of typical doses for patients in DRL quantities considering image quality is required in 11/24 (46%) and partly in 10/24 countries
- Formal education of medical radiation technologists exists in only 40% of countries
- Requirements on radiation protection training and competence are in many cases general, not specific for medical exposures
- Much better enforcement in EU-member states due to the binding EU Directive

Status and challenges of the use of DRLs

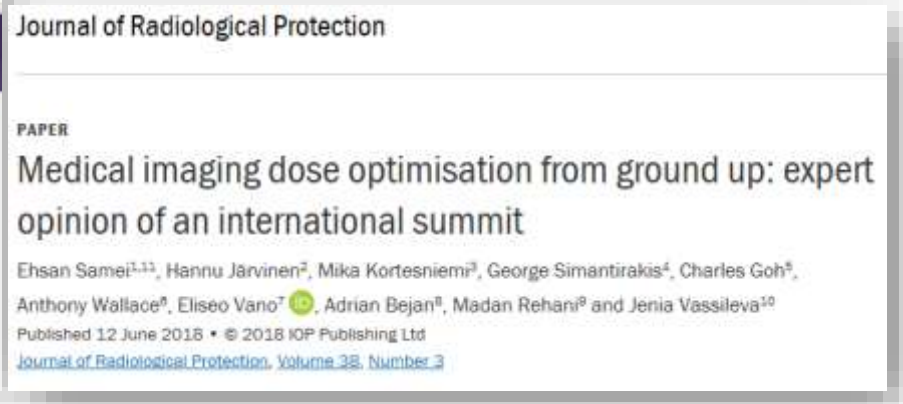
IAEA Technical meeting in 2016
“Patient dose monitoring and the use of DRLs for the optimization of protection in medical imaging”

60 professionals representing
35 countries and
8 international organizations and professional bodies


Journal of Medical Imaging

Patient dose monitoring and the use of diagnostic reference levels for the optimization of protection in medical imaging: current status and challenges worldwide

Hannu Järvinen
Jenia Vassileva
Ehsan Samei
Anthony Wallace
Eliseo Vano
Madan Rehani


Journal of Radiological Protection

PAPER

Medical imaging dose optimisation from ground up: expert opinion of an international summit

Ehsan Samei[1,11], Hannu Järvinen[2], Mika Kortesniemi[3], George Simantirakis[4], Charles Goh[5], Anthony Wallace[6], Eliseo Vano[7], Adrian Bejan[8], Madan Rehani[9] and Jenia Vassileva[10]

Published 12 June 2018 • © 2018 IOP Publishing Ltd

Journal of Radiological Protection, Volume 38, Number 3

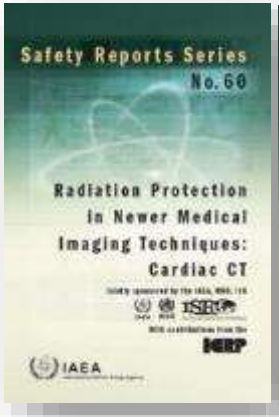
Main system components requiring development

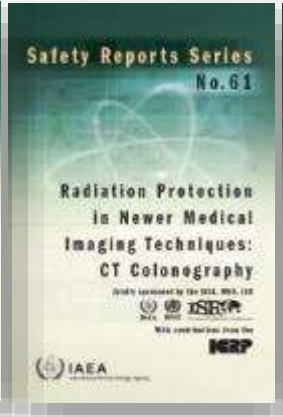
Main point	Possible solutions
①Human resources and responsibilities	Increase the number and recognition of medical physicists. Raise awareness and responsibilities of the principle professionals.
②Training	Improve basic and continuous training in radiation protection. Ensure proper mentoring and oversight.
③Safety and quality culture	Enhance accountability, awareness, motivation, both at leadership level and among professionals. Emphasize team work.
④Regulations	DRLs, QA and medical physicists access should be required by legislation wherever lacking. Advocacy to authorities.
⑤Funding	Funding can facilitate quality of data collection. Motivate governments for funding.

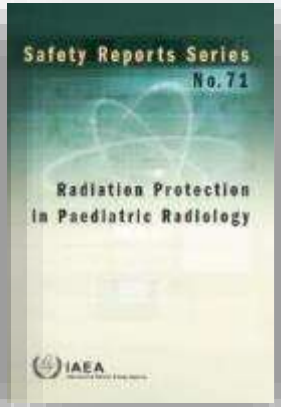
IAEA support for improving optimisation

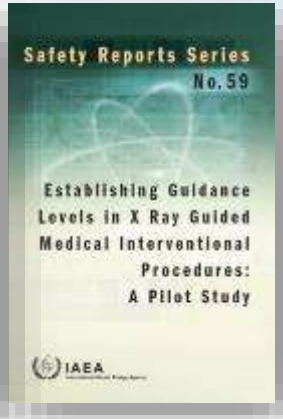
- Radiation protection of patients (RPOP)
- Dosimetry and medical radiation physics (RDMP)

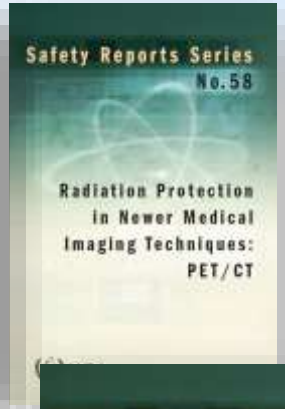
IAEA guidance

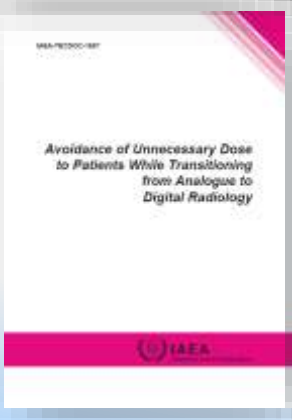


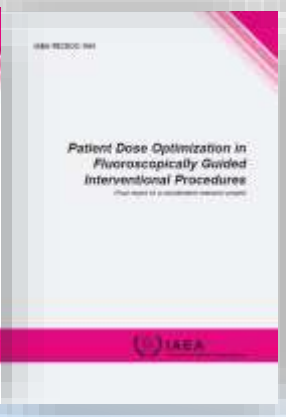


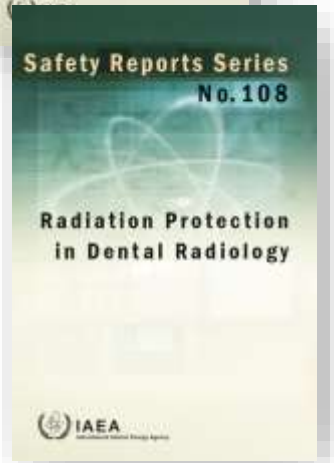












IAEA guidance

SAFETY REPORT SERIES No. XX

PATIENT RADIATION EXPOSURE MONITORING IN MEDICAL IMAGING

IAEA
International Atomic Energy Agency

https://preprint.iaea.org/search.aspx?orig_q=patient+radiation+exposure+monitoring&src=ics

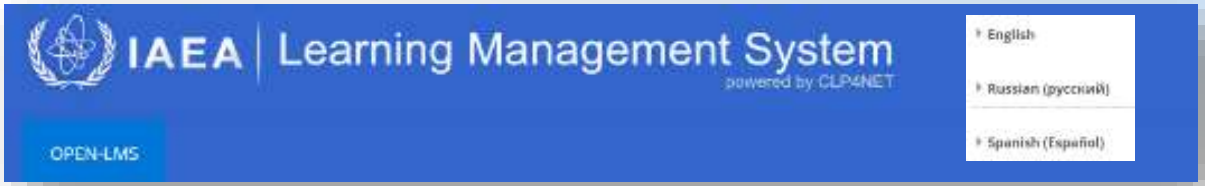
Free training material for trainers

Training material

- Diagnostic and interventional radiology →
- Digital radiology →
- Paediatric radiology →
- Radiation dose management in computed tomography (CT) →
- Radiotherapy →
- Radiotherapy: Prevention of accidental exposure →
- Safety and quality in radiotherapy →
- Nuclear medicine →
- Cardiology →
- PET/CT →
- Doctors using fluoroscopy outside radiology (Urologists, Gastroenterologists, Orthopaedic surgeons etc.) →
- Dental radiology →
- Radiation Safety Culture Trait Talks Handbook →
- Radiation Protection in Interventional Procedures: Practical Tutorials →

https://www.iaea.org/resources/rpop/resources/training-material

E-learning material



https://elearning.iaea.org/m2/course/index.php?categoryid=75

Free webinars

- Online lectures on topics in radiation protection of patients and staff
- In English, Spanish, Portuguese, Russian
- Held in cooperation with Image Gently, ESR (EuroSafe Imaging), LatinSafe, EFRS, IOMP, CIRSE, IADMFR, etc.
- Free registration and attendance
- Recording available for viewing

Since February 2016 → **75** webinars covering various topics → over **25,000** participants attended from **100** Member States

https://www.iaea.org/resources/rpop/resources/webinars

Technical cooperation

- Regional and national meetings, workshops and trainings
- Participation in medical conferences and congresses
- Group scientific visits for teams of professionals
- Expert support
- Trainings of regulators on inspecting optimization



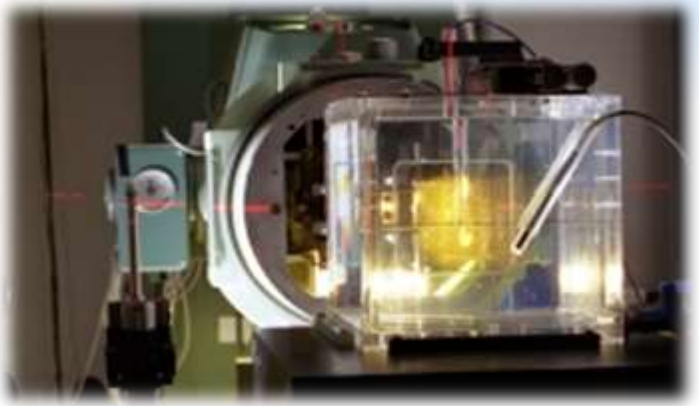



Public website http://rpop.iaea.org

Annually: 1 million pageviews

- Contains useful information and FAQs for health professionals, patients and public
- Links to resources: training material, posters, webinars, videos, etc.

Dosimetry and Medical Radiation Physics Section (under the Human Health Division of the IAEA)



Medical physics

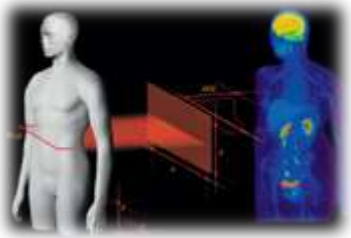
Development and harmonization of guidance on physical & technical aspects of QA to support safe & effective use of radiation in medicine

Dosimetry

Calibration & audit services
Dosimetry Laboratory and Dosimetry Audit Networks

Education & Training

Dosimetry and Medical Radiation Physics



Harmonization of radiation dosimetry through the development of dosimetry codes of practice (e.g. TRS-457);

Publication of **guidelines on quality assurance and quality control** in therapy and imaging physics;

Publication of **guidelines for harmonization of education, training and professional development** of medical physicists in radiotherapy and imaging;

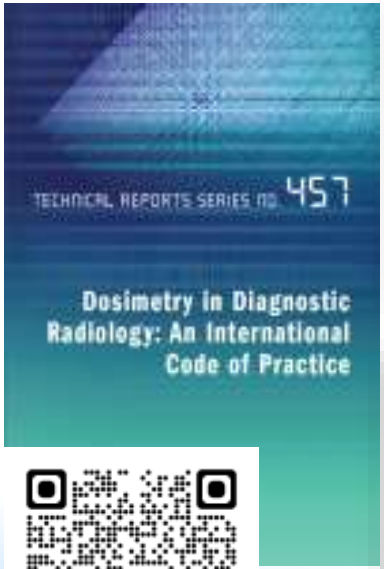
Provision of **dosimetry services** (comparisons and calibration of radiotherapy, X-ray diagnostic radiology and radiation protection standards) and **postal dosimetry audits** for radiotherapy centres.

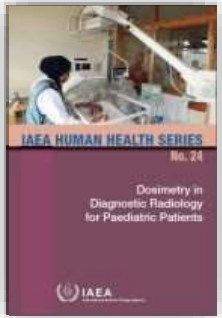
Supporting the **development of clinical medical physics services** in LMICs (in the framework of the IAEA ‘s Technical Cooperation Programme)

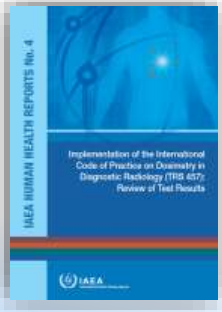
Supporting the establishment and **strengthening of national education programmes** in medical physics, including audit and certification aspects.

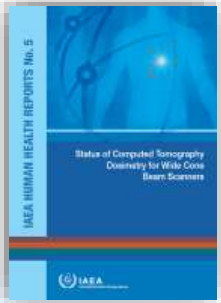
Radiation Dosimetry

International harmonization and consistency in radiation dosimetry









Calibration service for national dosimetry standards

IAEA/WHO SSDL Network is an association of national SSDLs Members

- 88 laboratories in 75 countries
- The IAEA laboratory acts as a central laboratory for the network

Clinical Medical Radiation Physics & Quality assurance

To achieve **international harmonization in quality assurance** in radiation medicine by enhancing quality in the practice of diagnosis and treatment in Member States.

Comprehensive clinical audits

Key elements for the development of effective systems for managing quality in health care.

5. TECHNICAL PROCEDURES

5.1. PRINCIPLES AND CRITERIA FOR GOOD PRACTICE

The principles and criteria for good practice of the technical aspects of radiology involve the available facility infrastructure, radiation protection and safety, imaging equipment QA processes, optimization in clinical practice, dosimetry, and instrumentation and calibration. All policies and procedures should be documented and regularly updated, and be available to staff at all times.

The imaging mod
include the following:

—Plain radiography
—Fluoroscopy;
—Image guided inte
—Mammography;
—Computed tomogr
—Dental radiograph
—Ultrasonography;
—Magnetic resonan

5.1.4. Optimization in clinical practice

Optimization of image quality and patient dose is a dynamic process that aims to give sufficient diagnostic image quality with minimum doses to patients. Optimization involves inputs from the radiological medical practitioner, radiographer and medical physicist. The procedure used for examination optimization should be documented.

While all imaging examinations should be optimized, the following require special attention:

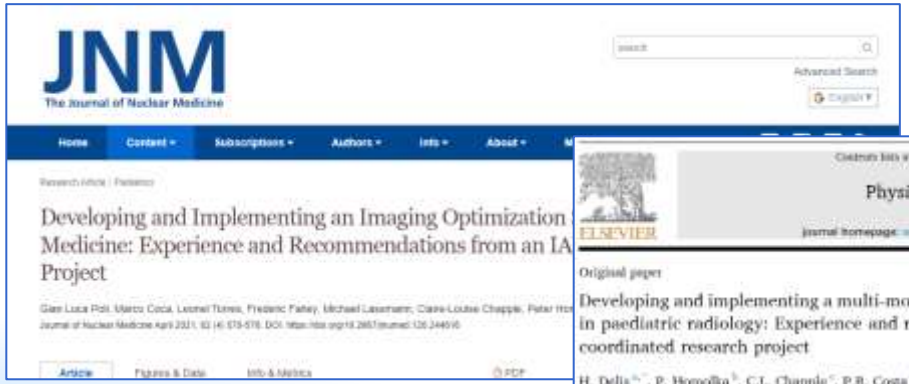
—Computed tomography examinations;
—Screening programmes (e.g. mammography);
—Interventional or procedural examinations;
—Examinations involving infants or children;
—Examinations involving pregnant patients;
—Volunteers for research (if applicable).

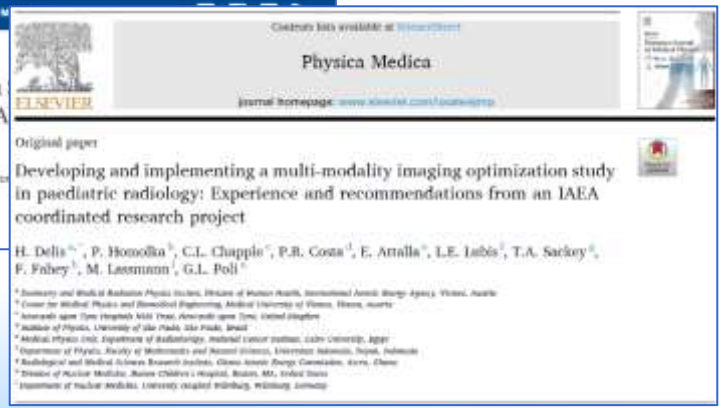
Relevant Coordinated Research Activities

Evaluation and Optimization of Paediatric Imaging

CRP E24020 (2015-2019)

To enhance the capabilities of Member States to improve the efficiency of existing modalities for paediatric medical imaging, as well as to implement and enhance optimization techniques and methodologies for advanced paediatric medical imaging





New CRP: Evaluation of the Dosimetry Needs and Practices for the Update of the Code of Practice for Dosimetry in Diagnostic Radiology (TRS-457) (E24024)

CRP E24024 (2021-2025)

Standardization of radiology medical physics dosimetry instrumentation, equipment and procedures in laboratories and hospitals to support the update of the IAEA Technical Reports Series (TRS) No. 457 “Dosimetry in diagnostic radiology: an international code of practice”.

IAEA
International Atomic Energy Agency
Atoms for Peace and Development

Medical Physics

E&T

- Access
- Harmonization
- Resources

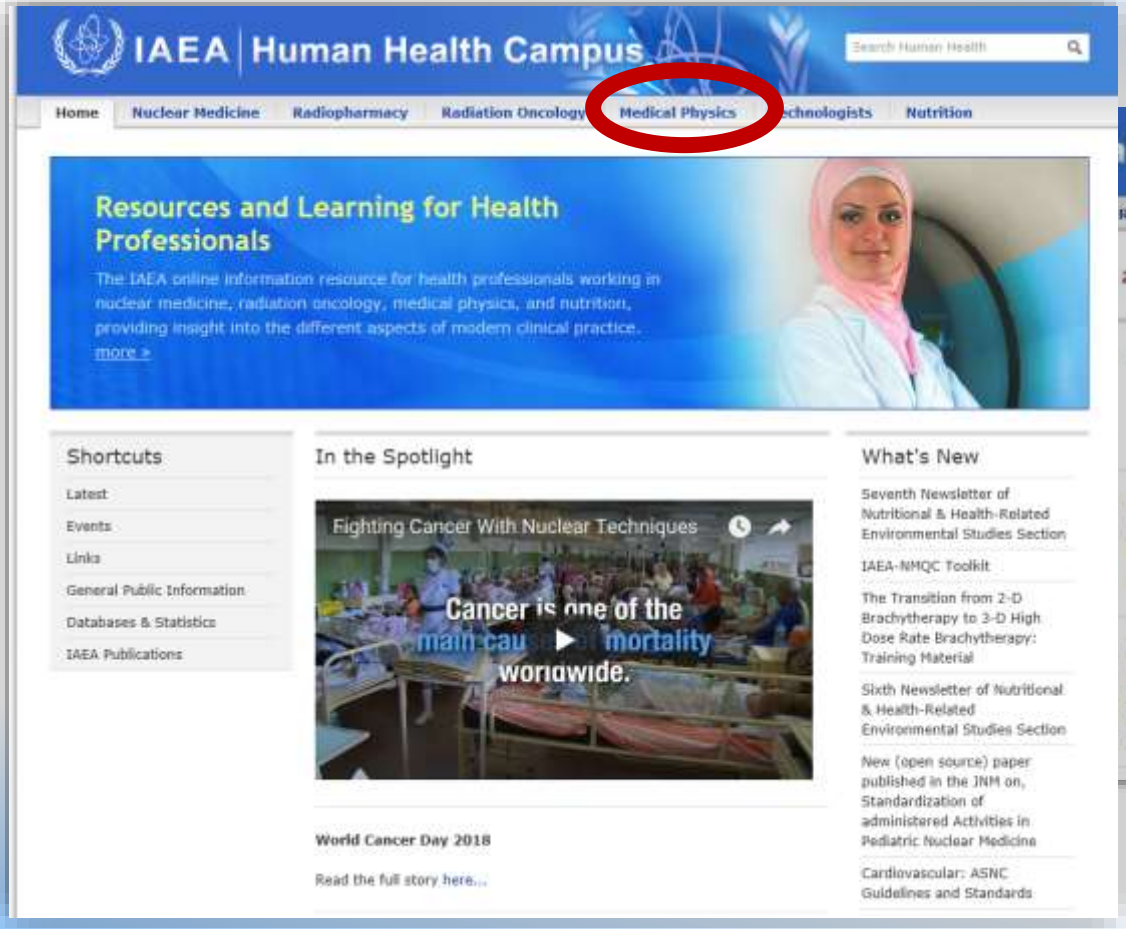
CPD

- Training Courses
- Online resources

Guidelines

- Dissemination
- TC
- e-learning

The Human Health Campus




IAEA
International Atomic Energy Agency
Thank YOU!