



IAEA

60 Years

Atoms for Peace and Development

IAEA activities in Radiotherapy Medical Physics Education and Training

**Joint ICTP-IAEA International Workshop on the Implementation of IGRT
Trieste 8 - 12 May 2017**

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IAEA - International Atomic Energy Agency

Department of Nuclear Sciences and Applications

Division of Human Health

Dosimetry and Medical Radiation Physics Section

The IAEA is an independent intergovernmental, science and technology-based organization established in 1957 and part of the United Nations family.

The IAEA and its DG (ElBaradei) received the Nobel Peace Price in 2005.

The Nobel Peace Prize for 2005

The Norwegian Nobel Committee has decided that the Nobel Peace Prize for 2005 is to be shared, in two equal parts, between the

International Atomic Energy Agency (IAEA) and its

Director General, Dr. Mohamed ElBaradei,

for their efforts to prevent nuclear energy from being used for military purposes and to ensure that nuclear energy for peaceful purposes is used in the safest possible way.

At a time when the threat of nuclear arms is again increasing, the Norwegian Nobel Committee wishes to underline that this threat must be met through the broadest possible international cooperation. This principle finds its clearest expression today in the work of the IAEA and its Director General. In the nuclear non-proliferation regime, it is the IAEA which controls that nuclear energy is not misused for military purposes, and the Director General has stood out as an unafraid advocate of new measures to strengthen that regime. At a time when disarmament efforts appear deadlocked, when there is a danger that nuclear arms will spread both to states and to terrorist groups, and when nuclear power again appears to be playing an increasingly significant role, the IAEA's work is of incalculable importance.



Joint ICTP-IAEA International Workshop on the
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IAEA

International Atomic Energy Agency

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The IAEA Mission Statement

- Is an independent intergovernmental, science and technology-based organization, in the United Nations family, that serves as the global focal point for nuclear cooperation;
- Assists its Member States, in the context of social and economic goals, in planning for and using nuclear science and technology for various peaceful purposes, including the generation of electricity, and facilitates the transfer of such technology and knowledge in a sustainable manner to developing Member States;
- Develops nuclear safety standards and, based on these standards, promotes the achievement and maintenance of high levels of safety in applications of nuclear energy, as well as the protection of human health and the environment against ionizing radiation;
- Verifies through its inspection system that States comply with their commitments, under the Non-Proliferation Treaty and other non-proliferation agreements, to use nuclear material and facilities only for peaceful purposes

168 Member States

February 2016

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IAEA

International Atomic Energy Agency

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IAEA and Medical Physics

Why and how the IAEA is linked to medical physics?



IAEA and Human Health

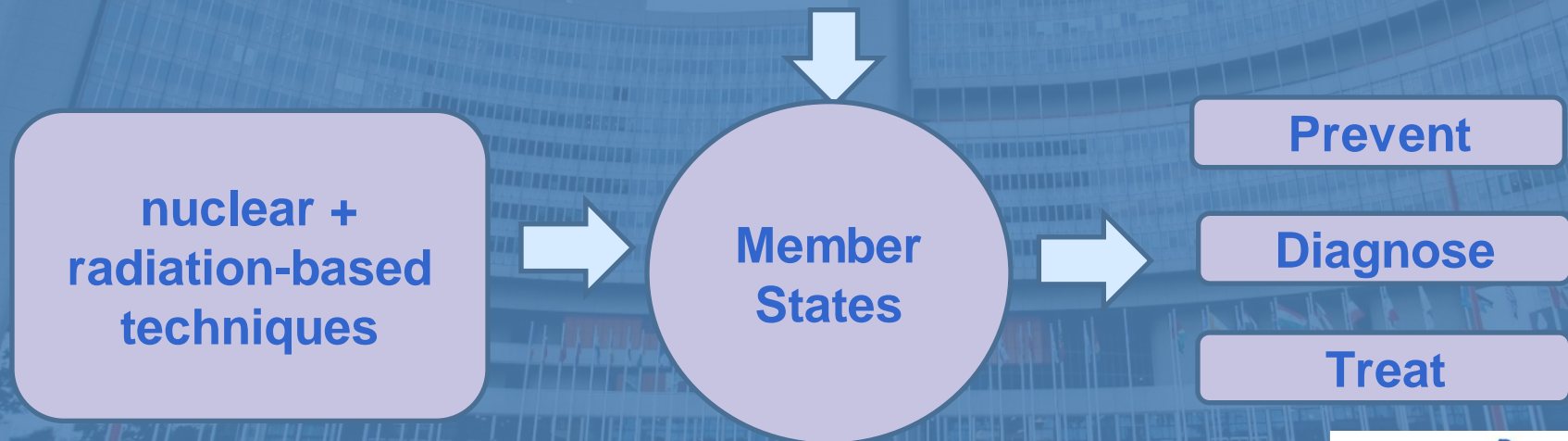
The mandate for human health derives from the Article of the IAEA Statute:

“The Agency shall seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world.”

STATUTE



INTERNATIONAL ATOMIC ENERGY AGENCY



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IAEA activities in Medical Physics

Harmonization of Medical Physicists' Education and Training

Development of Educational and Training Resources

Medical Physics educational resources on the Human Health Campus

Clinical Medical Physics Publications and Guidelines

The Dosimetry Laboratory in Seibersdorf

Competency Building and Training through Technical Cooperation

Research Activities in Medical Physics

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Harmonization of Academic Education and Clinical Training

Challenges in Medical Physics

The lack of recognition and professionalism of medical physics as a profession is a challenge internationally:

Lack of understanding of R&R of MP working in clinics

MP activities changes and have different areas of application

MP has evolved mainly with technologies

Definition of a Clinically Qualified Medical Physicist

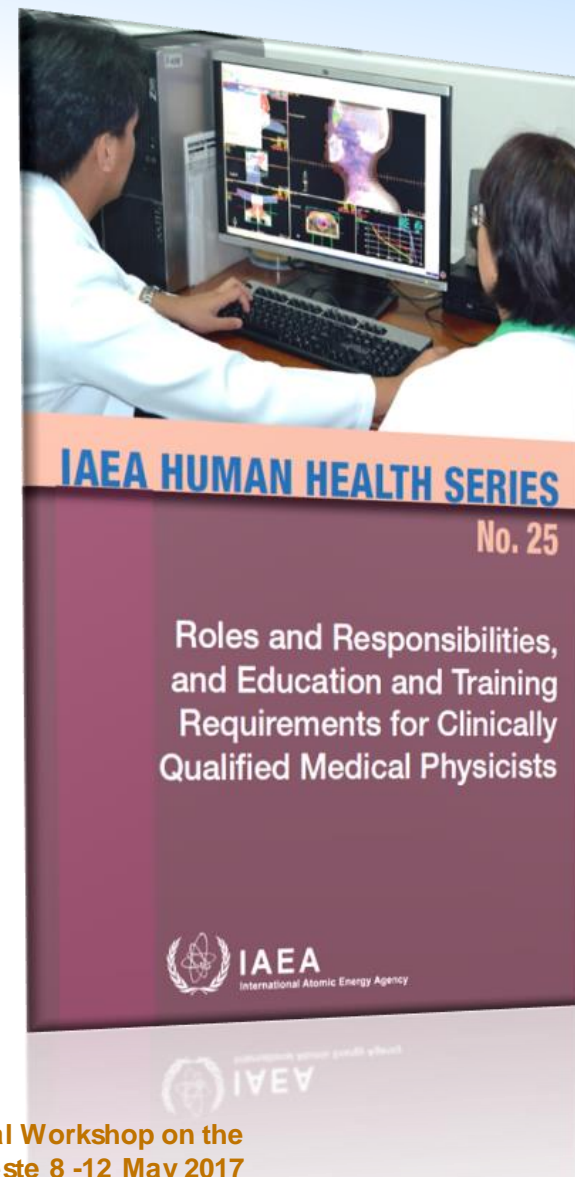
Define roles and responsibilities of a Clinically Qualified Medical Physics in the 3 sub-specialties (radiotherapy, diagnostic and interventional radiology, nuclear medicine)

Contribution to harmonization of education and clinical training

Promote the recognition of medical physics as a profession internationally

Recommendations for accreditation, certification and registration

Promoting and supporting Continuing Professional Development (CPD)



Role of medical physicist

The role of the Medical Physicist in all specialities:

Calibration and verification of measurement instruments;

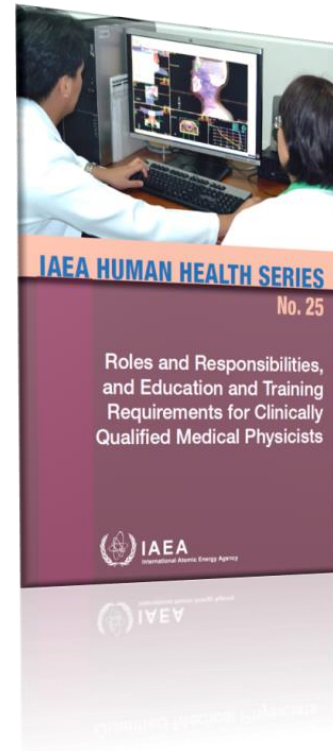
Technical supervision of equipment operation and maintenance;

Records and documentation;

Clinical computing and networking;

Research and development;

Education and training.

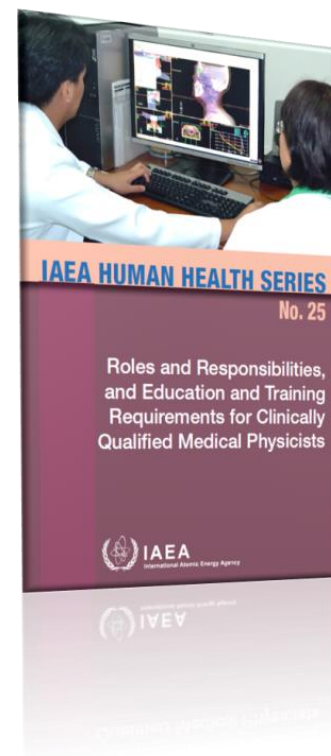


Role of medical physicist


The role of the Medical Physicist in all sub-specialities:

TABLE 2. SUMMARY OF THE ROLES AND RESPONSIBILITIES OF CLINICALLY QUALIFIED MEDICAL PHYSICISTS SPECIFIC TO THE SPECIALTIES OF RADIATION THERAPY, NUCLEAR MEDICINE, AND DIAGNOSTIC AND INTERVENTIONAL RADIOLOGY (cont.)

Area of responsibility	Radiation therapy	Nuclear medicine	Diagnostic and interventional radiology
(b) <i>Radiation safety and protection of patients, staff and the general public</i>	<ul style="list-style-type: none"> (i) Develop the clinical radiation safety programme for radiation protection of patients, staff and the public; (ii) Participate in the investigation of radiation incidents and accidents; (iii) Develop procedures for verifying the integrity, safe operation and use of radiation therapy equipment and accessories. 	<ul style="list-style-type: none"> (i) Develop the clinical radiation safety programme for radiation protection of patients, staff and the public; (ii) Participate in the investigation of radiation incidents and accidents; (iii) Develop procedures for verifying the integrity, safe operation and use of nuclear medicine equipment and radioactive sources. 	<ul style="list-style-type: none"> (i) Develop the clinical radiation safety programme for radiation protection of patients, staff and the public; (ii) Participate in the investigation of radiation incidents and accidents; (iii) Develop procedures for verifying the integrity, safe operation and use of diagnostic and interventional radiology equipment and accessories.



The Clinically Qualified Medical Physics



The formal process by which an independent recognized body (professional and/or governmental) evaluates and recognizes that a programme or a clinical site meets pre-determined requirements or criteria is called **accreditation**.

Certification is the formal process by which an authorized body (governmental or non-governmental) evaluates and recognizes the knowledge and proficiency of an individual, which must satisfy pre-determined requirements or criteria.

Certification of CQMPs should be mandatory, as it is with most other health professionals.

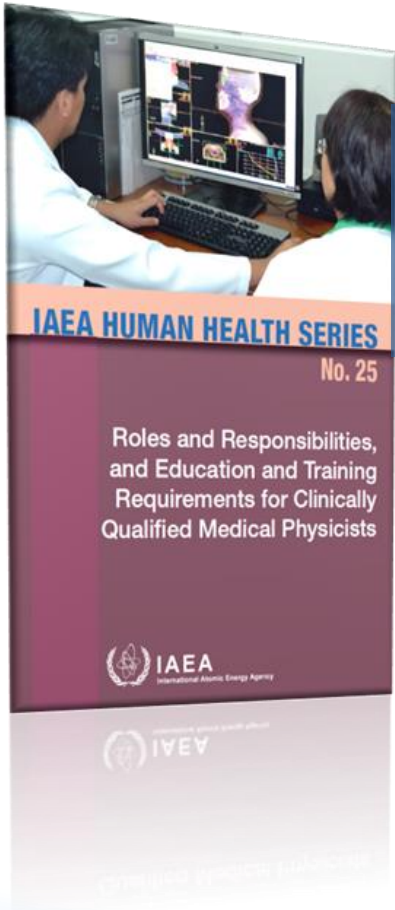
IAEA HUMAN HEALTH SERIES

No. 25

Roles and Responsibilities,
and Education and Training
Requirements for Clinically
Qualified Medical Physicists



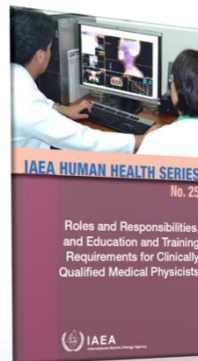
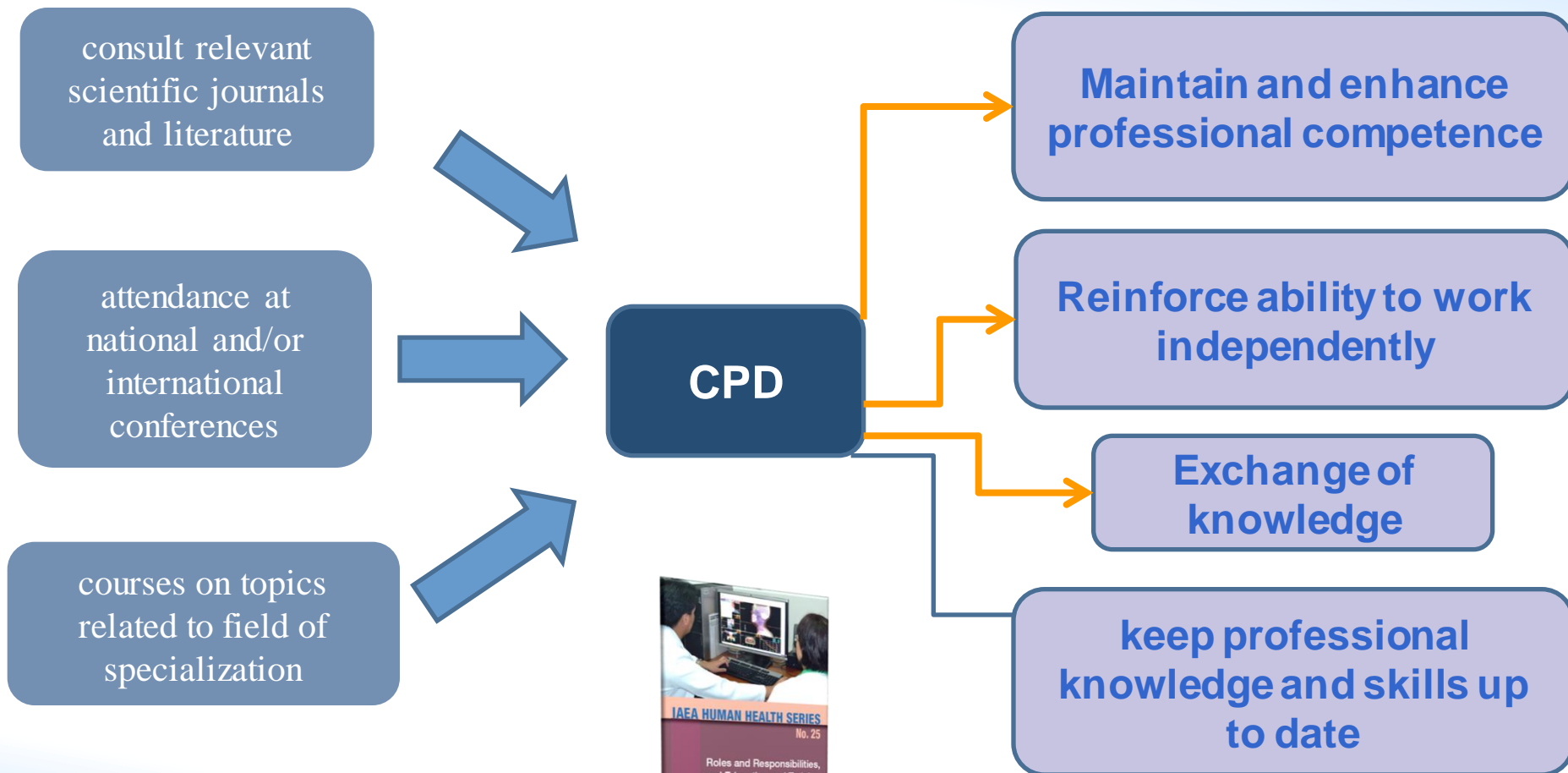
The Clinically Qualified Medical Physicist



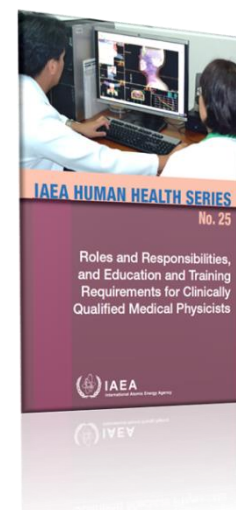
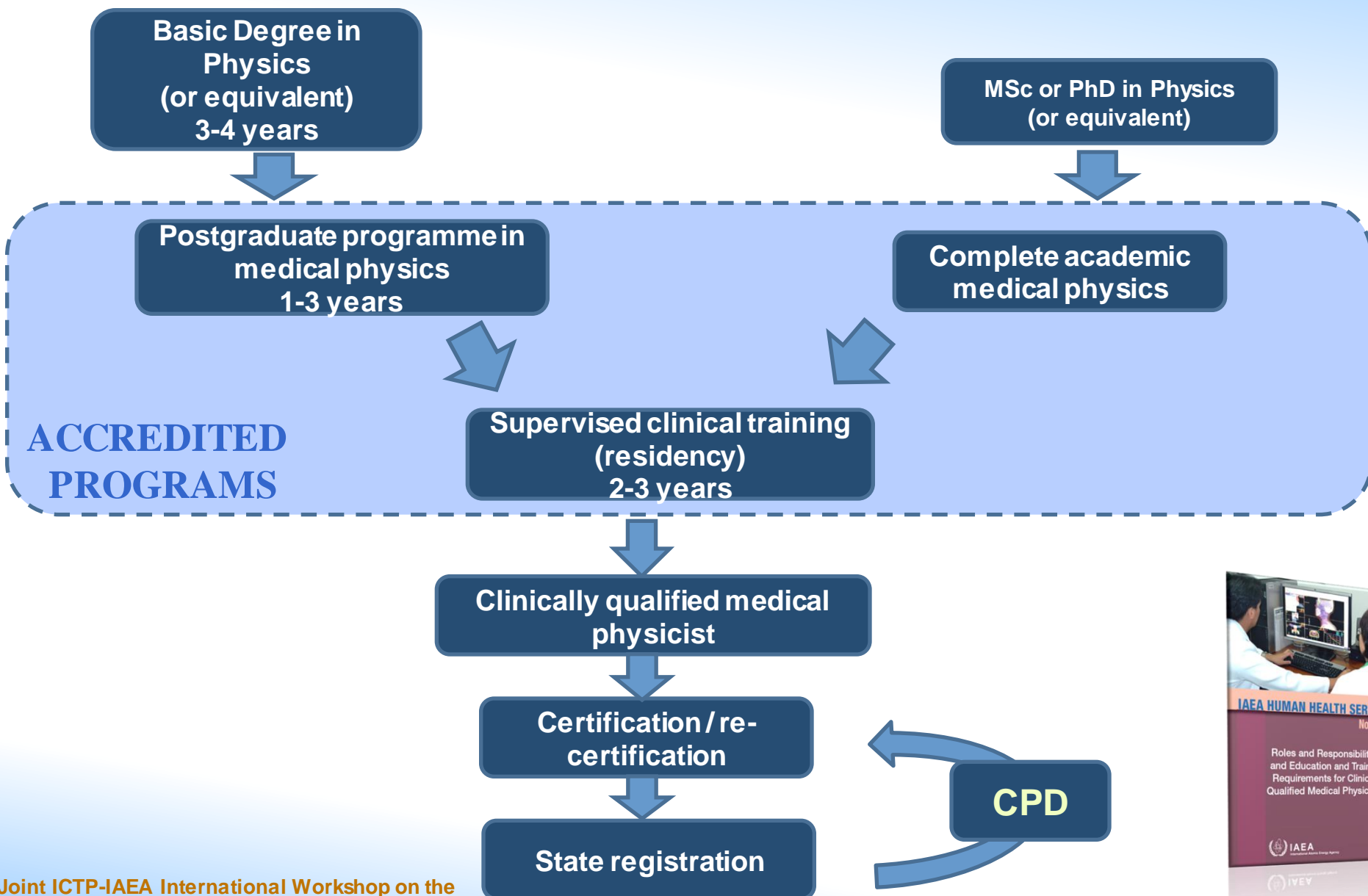
A **CPD** system should be implemented in order to demonstrate that the CQMP maintains current knowledge of modern technologies, methods and practice standards. This is usually achieved via a **CPD programme**

The process of certification should lead to that of **registration**, where **records of certified professionals are maintained** and organized in the form of databases or rosters.

Continuing Professional Development (CPD)



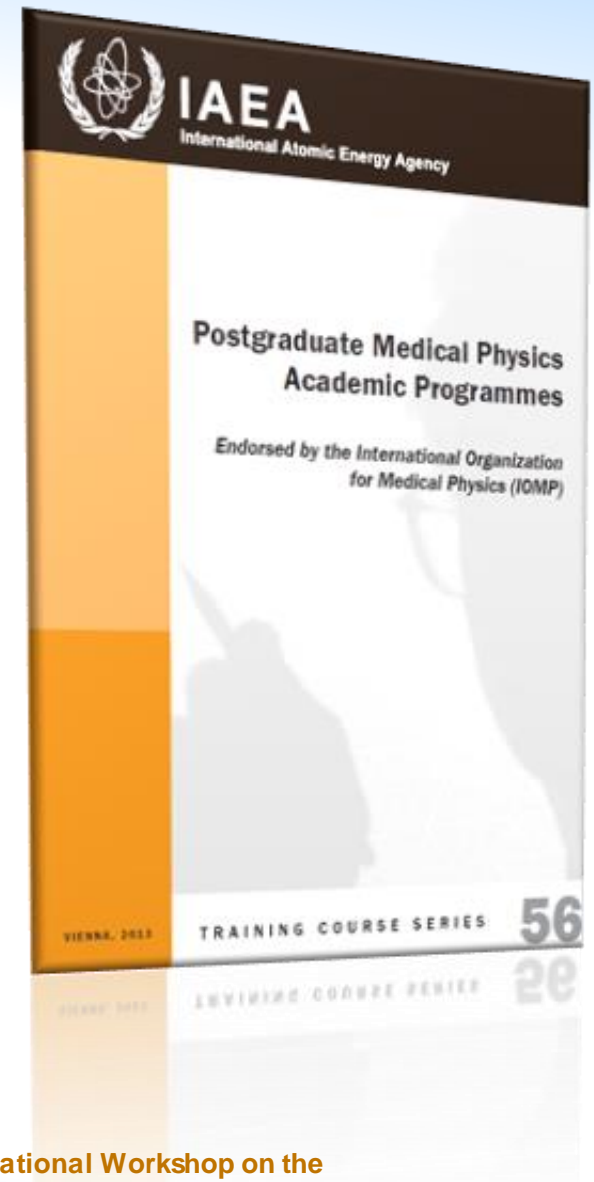
Recommendations for CQMP



Academic education

guidelines for the establishment of an internationally harmonized postgraduate academic education programme in medical physics

achieve harmonized standards of competence worldwide



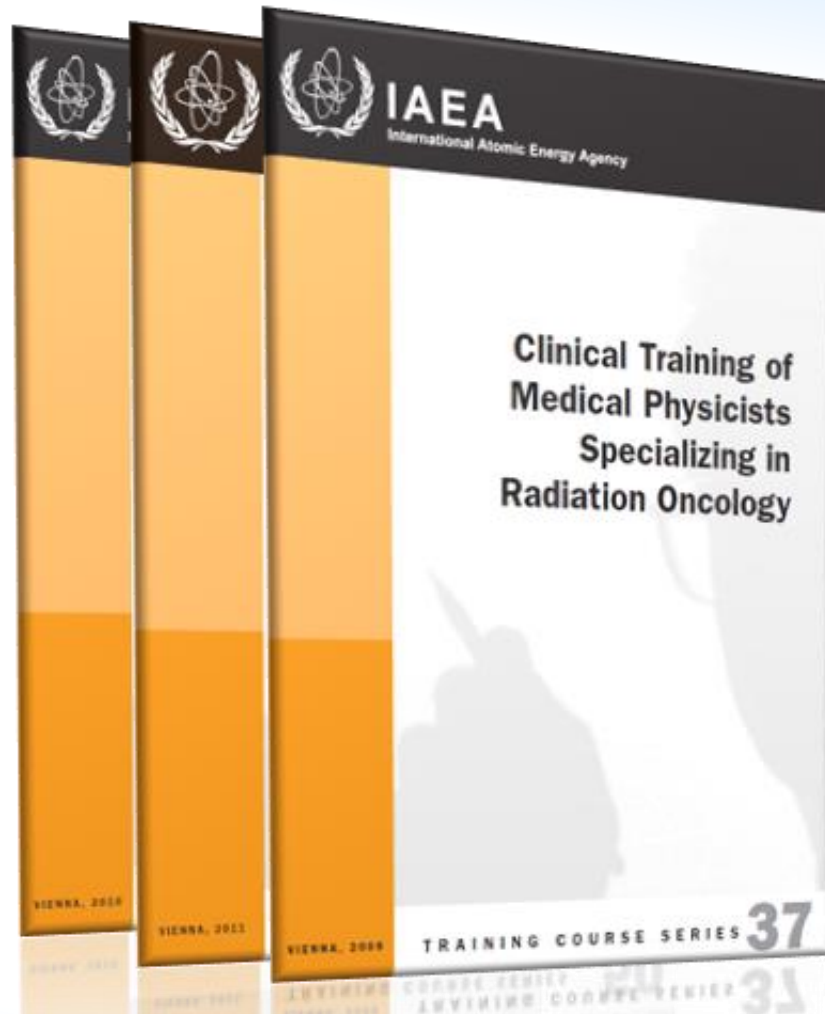
Clinical training

A **structured** clinical training programme provides a better preparation for medical physicists to ensure that they are capable of independent, safe and effective practice.

Such a programme should reduce the total time needed for medical physicists to reach clinical competence and also prepare them to undertake more advanced methodologies.

Relatively few countries have developed **national standards of clinical training**, which is an essential part of ensuring high quality and consistent training throughout a country.

Clinical training



ALSO AVAILABLE IN
FRENCH AND SPANISH

- Modular in structure
- Competency-based



Now available on Moodle through CLP4net



 AMPLE - DR
















 AMPLE - NM

 AMPLE - RT

Standardized guidelines for implementation of clinical training in every medical physics subspecialty

Advanced Medical Physics Learning Environment

▼ Module 3: Radiation Dosimetry for External Beam Therapy

-  Module 3
-  Sub-module 3.1: Dosimetry operations using ionisation chambers
 -  Sub-module 3.1 submission
-  Sub-module 3.2: Dosimetry operations using other methods
 -  Sub-module 3.2 submission
-  Sub-module 3.3: Absolute absorbed dose measurements
 -  Sub-module 3.3 submission
-  Sub-module 3.4: Relative dose measurements
 -  Sub-module 3.4 submission
-  Sub-module 3.5: Patient dose verification
 -  Sub-module 3.5 submission
-  Sub-module 3.6: In-vivo dosimetry
 -  Sub-module 3.6 submission
-  Sub-module 3.7: QA in dosimetry
 -  Sub Module 3.7 submission

Pilot project to support a structured Clinical Training in Asia.

AMPLE - RT
Currently 188 participants
Of which 88 residents



Clinical Training of Medical Physicists specializing in Radiation Oncology



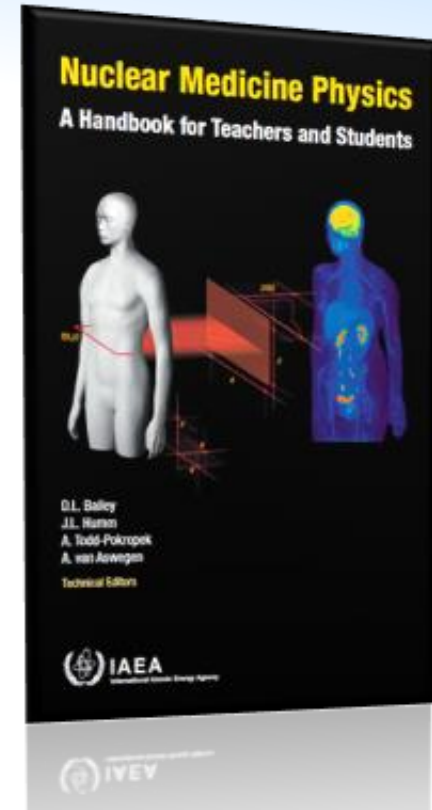
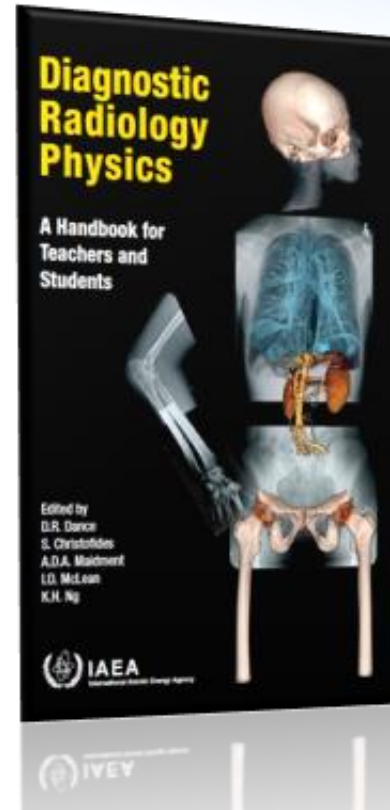
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Medical Physics Education and training resources: **Handbooks**

Education and training: handbooks

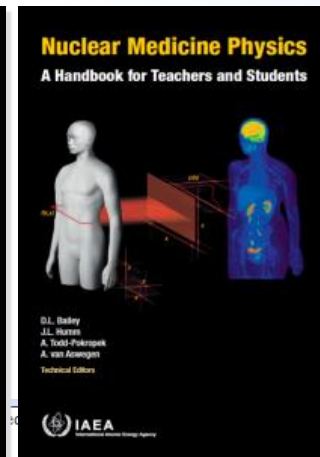
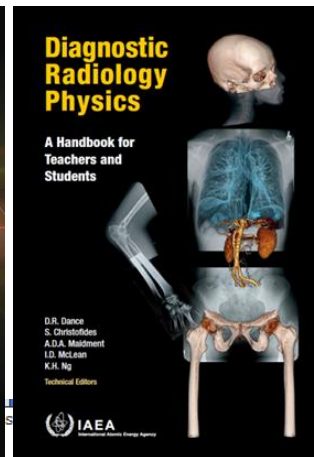
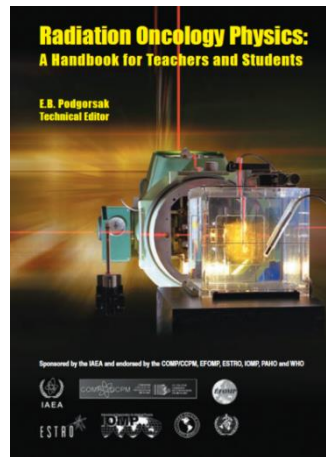


Comprehensive and freely downloadable handbooks, providing the basis for the education of medical physicists.
Endorsed by major medical physics societies.

Handbooks' slides

Since June 2016 the handbook slides are available for free download also in PowerPoint, after compilation of a form.

<http://www-naweb.iaea.org/NAHU/DMRP/handbooks/DMRPWebForm.asp>



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First name:	<input type="text"/>
Email:	<input type="text"/>
Country:	<input type="text"/>
Town:	<input type="text"/>
Profession:	<input type="text"/>
Institute:	<input type="text"/>

You are mainly interested in (please tick all that applies):

Diagnostic Radiology Physics: ☐

Nuclear Medicine Physics: ☐

Radiation Oncology Physics: ☐

You plan to use the slides mainly for (please tick all that applies):

Teaching purposes: ☐

Self study: ☐



After about 1 months > 750 downloads

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Medical Physics resources for professionals: Human Health Campus website

Human Health Campus

Educational resources for professionals

Video tutorials

Selected links to publications and scientific articles



Web based e-learning material

Concise explanations of scientific topics

Includes different disciplines related to human health

links to IAEA publications

Human Health Campus



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IAEA Human Health Campus



Home

Nuclear Medicine

Radiopharmacy

Radiation Oncology

Medical Physics

Technologists

Nutrition

Resources and Learning for Health Professionals

The IAEA online information resource for health professionals working in nuclear medicine, radiation oncology, medical physics, and nutrition, providing insight into the different aspects of modern clinical practice.

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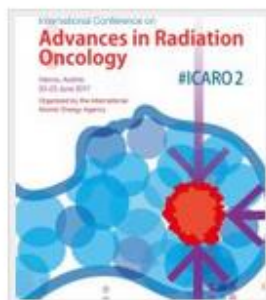
[Links](#)

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[IAEA Publications](#)

In the Spotlight



International Conference on Advances in Radiation Oncology #ICARO2; Vienna, Austria; 20-23 June 2017

The conference will give health care professionals an opportunity to review the current developments in clinical applications in the fields of radiation oncology, radiation biology and medical physics, with a view to addressing the challenge of cancer management in Member States. It will also critically examine the pivotal role of emerging radiotherapy techniques in tackling the health challenges common to many Member

What's New

New (open source) paper published in the JNM on, Standardization of administered Activities in Pediatric Nuclear Medicine

Fifth Newsletter of Nutritional & Health-Related Environmental Studies Section

Cardiovascular: ASNC Guidelines and Standards

Radiotherapy in Children

A Guide To FDG PET/CT In Clinical Oncology

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Human Health Campus website

Submenus for every subspecialty

Radiotherapy



The image displays the Human Health Campus website interface. On the left, a sidebar contains the IAEA logo, navigation links (Home, Nuclear Medicine, Medical Physics, Diagnostic Radiology, Nuclear Medicine, The Medical Physics Training Event, E-learning), and a 'Shortcut' section with a 'Latest' link. The main content area features a 'Radiotherapy' submenu with icons and labels for: Radiotherapy Program Implementation, Acceptance tests and commissioning of radiotherapy equipment, Topics of special interest, Treatment planning, Patient related Quality Assurance, and Radiation Protection. A central yellow-bordered box shows a hand holding a smartphone displaying the mobile version of the Radiotherapy submenu. At the bottom, a purple banner states 'Mobile phone version available'.

Radiotherapy

Radiotherapy Program Implementation

Acceptance tests and commissioning of radiotherapy equipment

Topics of special interest

Treatment planning

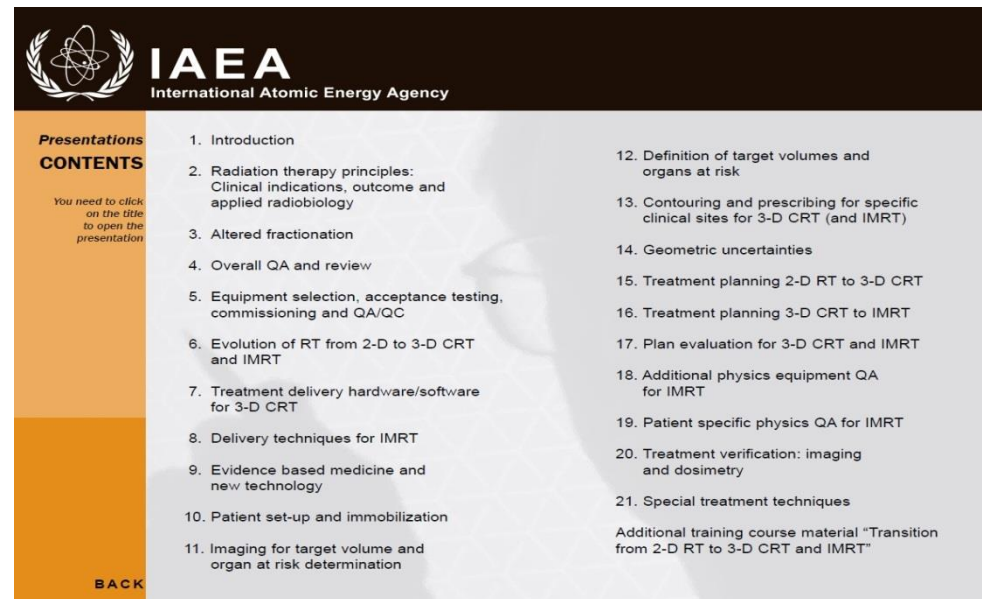
Patient related Quality Assurance

Radiation Protection

Mobile phone version available

Web-based e-learning material for medical physics

Transitioning from 2-D Radiation Therapy to 3-D Conformal Radiation Therapy and Intensity Modulated Radiation Therapy: Course Material



Web-based e-learning material for medical physics



Video training module to assist medical physicists in the implementation of IAEA Technical Report Series No. 398 for high energy linear accelerator photon beams



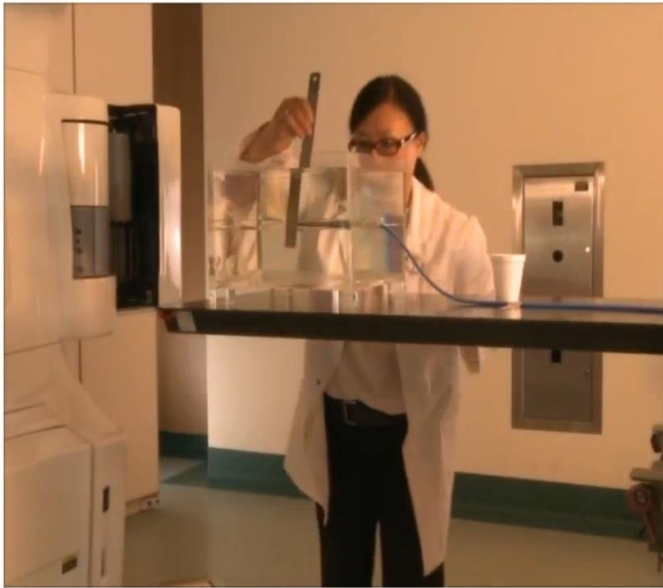
TRS 398 HE Photons v1.1 Jan 2014 (14:17 / 57:29)

IAEA Human Health Campus

IAEA TRS No. 398
High Energy Photon Beams

Outline Search

- 1. INTRODUCTION
 - 1.1 Why TRS 398 is important
 - 1.2 What you will learn
 - 1.3 Where to get help
 - 1.4 How to use this presentation
- 2. WHEN TO MEASURE
- 3. BEFORE YOU START
- 4. REFERENCE CONDITIONS
 - 4.1 Worksheet Section 1
 - 4.2 SSD and SAD explained
 - 4.3 SAD and SSD: which one to use?
 - 4.4 Video of setup
 - 4.5 Summary
- 5. CHAMBER AND ELECTROMETER
- 6. MEASUREMENTS
- 7. DOSE AT Zref
- 8. DOSE AT Zmax
- 9. QC BASELINE MEASUREMENTS
- 10. REFERENCES
- 11. DEFINITIONS
- APPENDIX 1. PDD, TPR and TMR
- APPENDIX 2. POLARITY AND RECOMBINATION



SLIDE 17 OF 57 PAUSED 02:52 / 04:05

Web-based e-learning material for medical physics

 **IAEA** | Human Health Campus

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Dosimetry and Medical Physics

 **Radiotherapy**

 **Diagnostic Radiology**

 **Nuclear Medicine**

 **The Medical Physicist**

 **Training Events**

 **E-learning**

 **International Medical Physics Certification Board**

 **IAEA references**



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Clinical medical physics: guidelines and technical documents

Scientific and technical guidelines

Comprehensive clinical audit guidelines

Quality Assurance

Guidance on how to safe transition to new technologies

**Professional Medical Physics publications
Endorsed by major medical physics professional societies**

Support for best practice

Clinical Dosimetry

How to plan and set up radiation facilities

**Free
download**

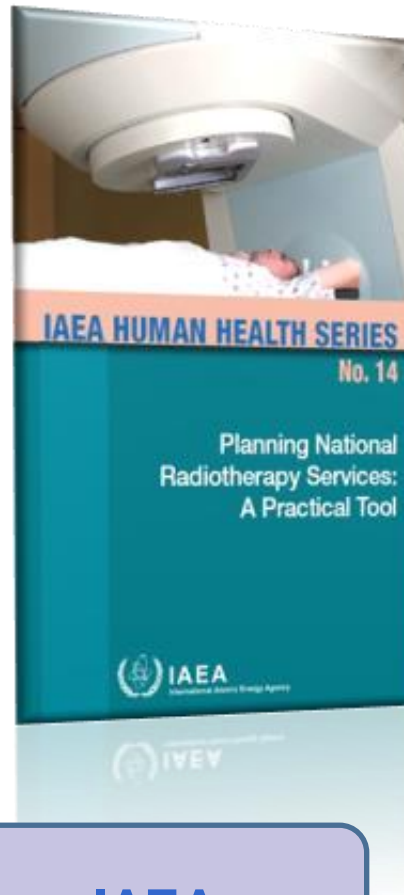
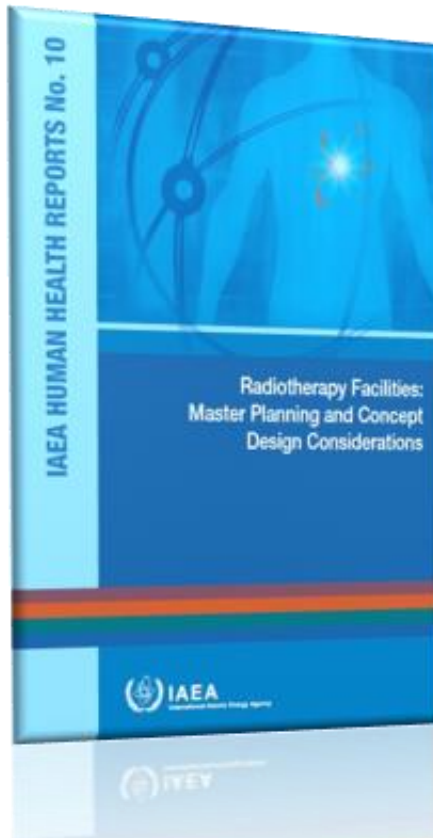
Radiotherapy publications



Freely downloadable from IAEA.org

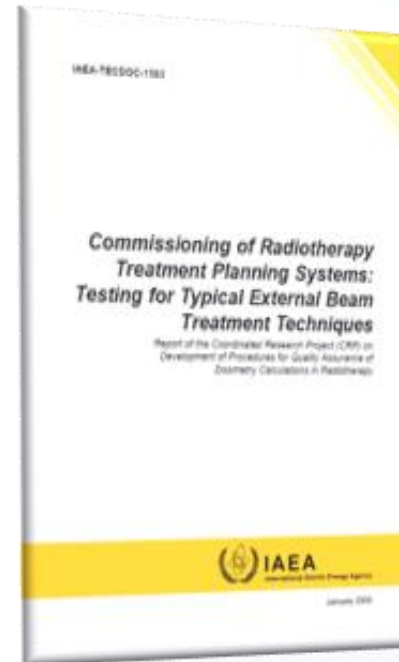
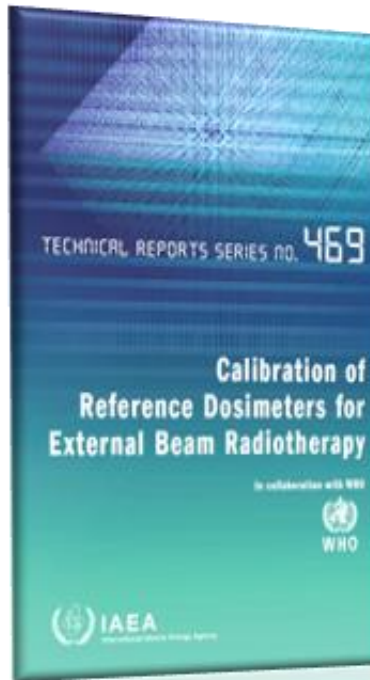
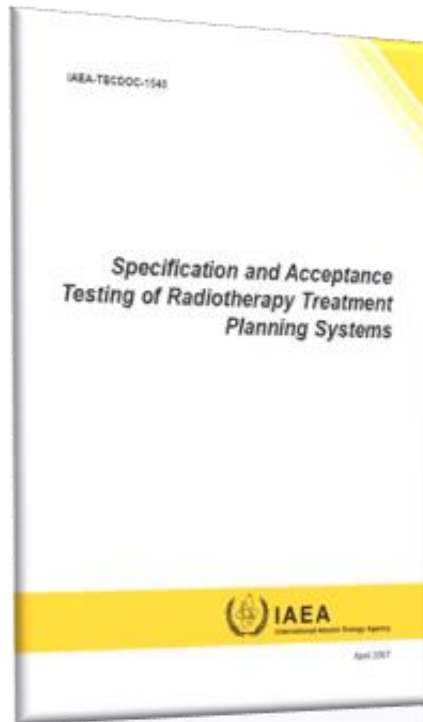
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Radiotherapy publications



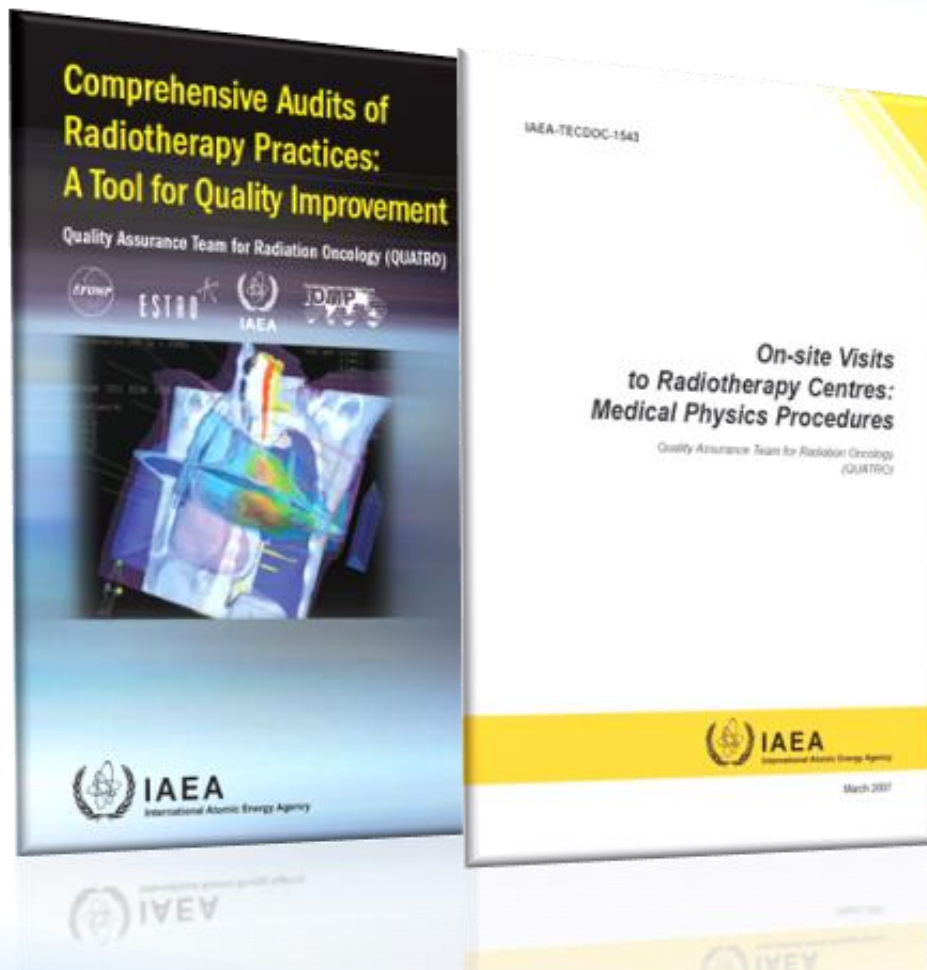
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Radiotherapy publications



Freely downloadable from IAEA.org

Comprehensive clinical audits in Radiotherapy



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

Freely downloadable from IAEA.org



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Support to clinical medical physics: The Dosimetry Laboratory

Dosimetry Laboratory in Seibersdorf

Central Laboratory of the IAEA/WHO SSDL Network

Dosimetry audits

> 11000 radiotherapy beams checked

Calibration services to Member States that have no national dosimetry capabilities

Education and research activities in dosimetry

Dissemination of best practices in dosimetry

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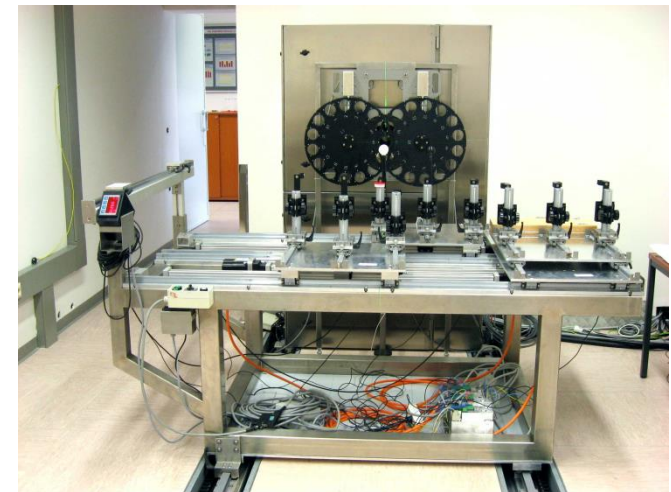
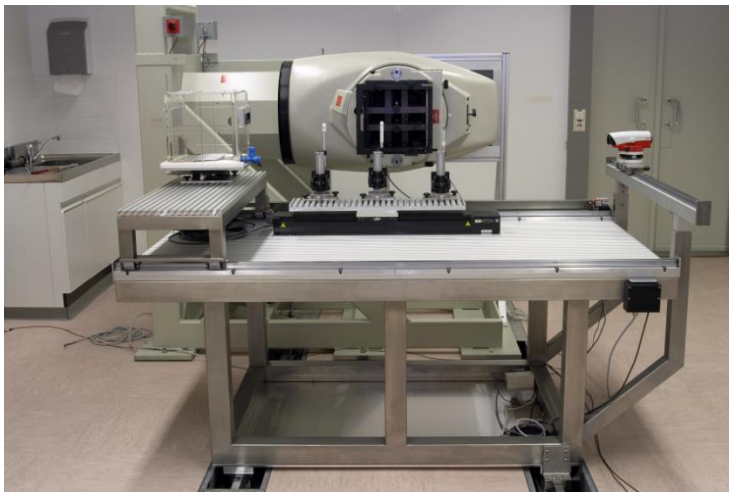
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International Atomic Energy Agency

Atoms for Peace

IAEA / WHO Network of SSDLs

Calibration facilities at the IAEA dosimetry laboratory, central laboratory for the IAEA/WHO Network of SSDL



support in the correct application of guidelines and dosimetric measurements for applications in RT, DR and radiation protection

Beams produced by radiotherapy machines need to be calibrated, since the quality and effectiveness of the medical radiation therapy relies on their accuracy.

The IAEA Dosimetry Lab helps participating Member States:

checking regularly their radiotherapy facilities

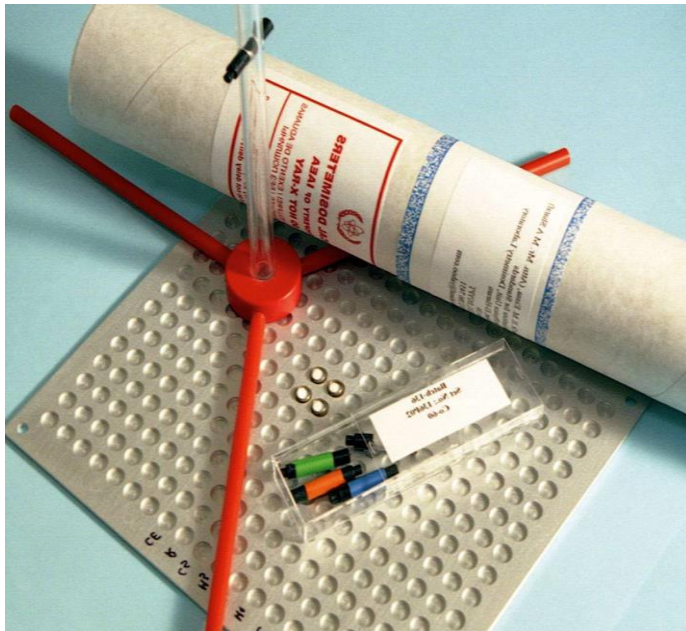
providing feedback on their quality procedures

alerting in case of a problem

offering a follow-up programme for quality improvement

organizing on-site visits by local or international experts

Support to end-users in dosimetry:
Verification of clinical beam calibration



TLD postal dose verification of radiotherapy beam outputs

Online video tutorial for TLD irradiation

TLD video irradiation tutorial for participants in the IAEA/WHO Postal Dose Audit Service

**Correct procedure
of TLDs
irradiation by
Centres**



**Optimization of
audit services**



**Available in English, Spanish and
Russian**



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Support to clinical medical physics: Expert missions, fellowships, training courses, scientific visits, workshops - Technical Cooperation Programme

Overview of TC programme

Through the Technical Cooperation (TC) programme, the IAEA helps Member States to build, strengthen and maintain capacities in the safe, peaceful and secure use of nuclear technology in support of sustainable socioeconomic development

The TC programme:

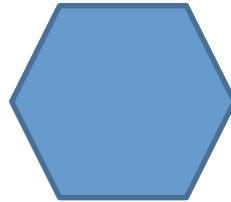
- operates in four geographic regions: **Africa, Asia and the Pacific, Europe and Latin America**
- supports **human resource capacity building** through **expert missions and meetings, fellowships, scientific visits, special training courses and workshops**
- can offer **procurement of equipment** often accompanied by training



Map courtesy of Presentation Magazine website

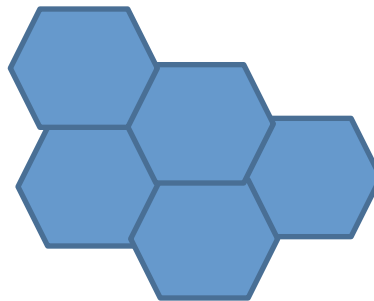
Types of TC projects

National when a single country is involved



They address national development priorities

Regional if several Member States in a Region are involved



They take into account national development objectives but are developed according to regional development priorities

Interregional when support is delivered across national and regional boundaries



They address the needs of several Member States in different regions

Support to Member States in Medical Physics through TC programme

Member States can receive different types of direct support and training through the IAEA Technical Cooperation (TC) programme.

Human Health, including **Medical Physics** related activities, has a predominant role in the TC core activities.

Some projects are related to medical physics only, e.g. initiating a national medical physics education program, whereas others involve **collaborations with other clinical areas, including radiation safety**.

During project implementation of human health projects, the IAEA Technical Officers (TO) work with TC programme managers for **equipment procurement**, fielding of **experts, training of fellows** and provide **advice** on the design of facilities in human health and QA/QC programmes.

Medical Physics support through Technical Cooperation

Technical advice on appropriate technologies

Fellowships

Competence building

Expert missions

Customized support to Member States

Transfer of know-how

Workshops

Medical Physics in Technical Cooperation projects

Scientific Visits

Dissemination of best practices

Procurement of equipment

Meetings

On-the-job training

Comprehensive audits of clinical radiation facilities

Training courses

Dosimetry and Medical Radiation Physics in the TC programme

Support is given for:

Starting or improving QA programmes in hospitals

Setting up national medical physics education and clinical training programmes

Setting up or upgrading national calibration laboratories and establishment of national dosimetry audit programmes

Training, fellowships and scientific visits designed and customized for professionals working in the field

Training and workshops at the national and regional level in specialized topics

Example of support to national TC projects

Improving Access to Radiotherapy and Establishing a Plan for Nuclear Medicine Services from 2012 – Calmette Hospital, Cambodia

Support to Medical Physics in Radiotherapy and Nuclear Medicine through:

- Expert missions to review the design of the radiotherapy facility
- Expert mission to advise on design and shielding of the new nuclear medicine department
- Fellowship to train a medical physicist
- Support to define the specifications of technical equipment



National project

Situation as of December 2015



Radiotherapy bunker construction

Photo courtesy of ICTP

	AFRICA	ASIA	EUROPE	LATIN AMERICA	TOTAL
FIRST CYCLE 14/15	6	4	1	2	13
SECOND CYCLE 15/16	5	3	1	4	13
THIRD CYCLE 16/17	8	3	2	8	21
TOTAL	19	10	4	14	47



Collaboration is ongoing with the **Master's Programme in Medical Physics (MMP)**, run jointly by ICTP and the University of Trieste. The programme helps addressing the scarcity of specialized and trained medical physicists in many countries.

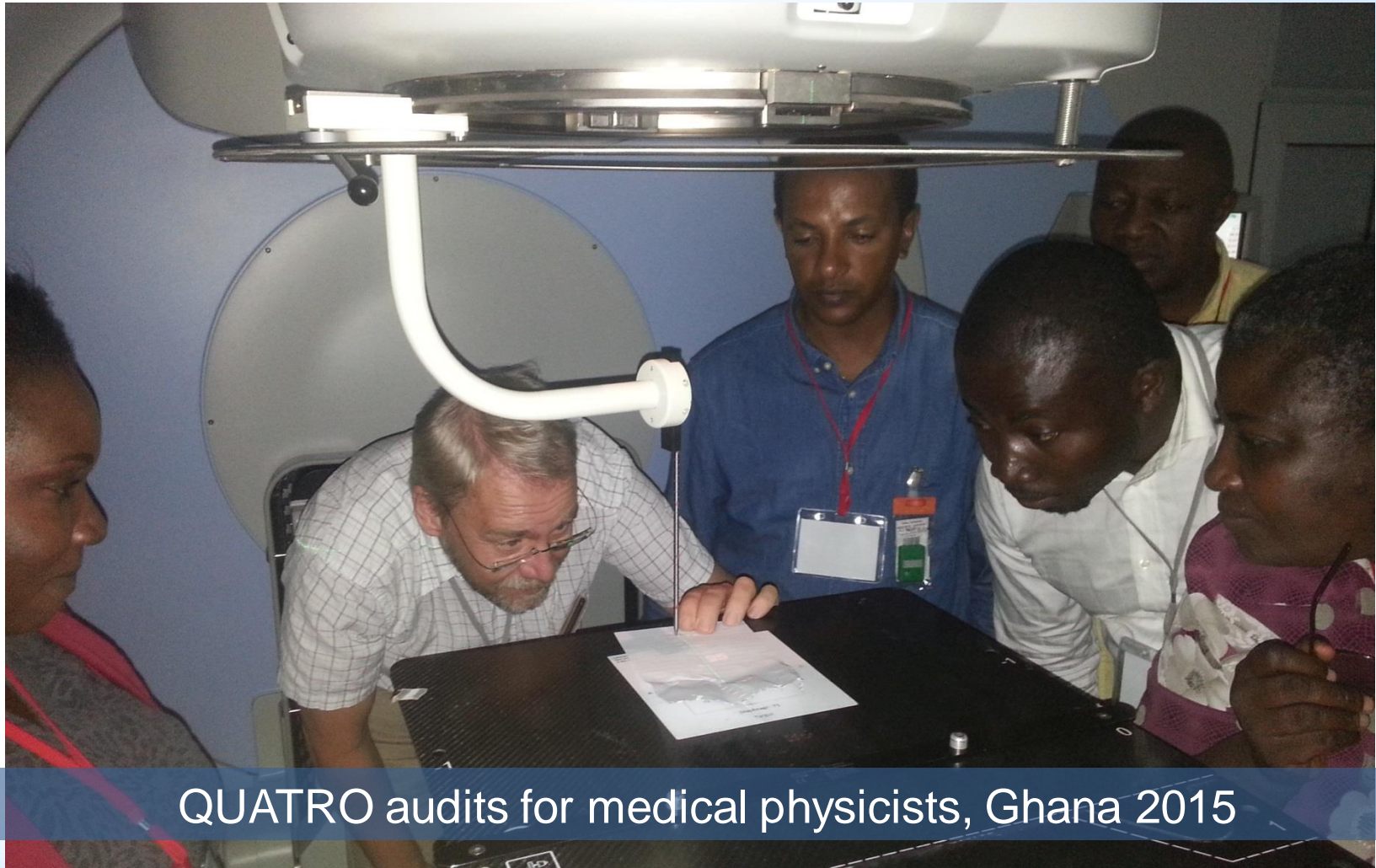
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Medical Physics training courses through Technical Cooperation

Examples of recent training courses in radiotherapy delivered through Technical Cooperation

QA for Record and verify system
Selection, Acceptance and commissioning of radiotherapy equipment
Regional training course on intensity modulated radiotherapy for prostate cancer and other urological cancers
Regional Training Course on Medical Physics for Clinical Radiotherapy
Small field dosimetry
Regional Training Course on Brachytherapy Physics
Regional Workshop on Quality Assurance Teams for Radiation Oncology
Regional Hands-on Training Course on VMAT Treatment Planning
Regional training course on clinical applications of Stereotactic Body Radiotherapy (SBRT) in oligometastasis, pancreatic, and recurrent cancers needing re-irradiation
Training Course on the Role of Imaging in Clinical Radiotherapy
Training Course on Transition from 3D Conformal Radiation Therapy to Intensity Modulated Radiation Therapy
Regional training course on intensity modulated radiotherapy for pancreas, anorectal and breast cancers

Ghana – Regional Training course



QUATRO audits for medical physicists, Ghana 2015

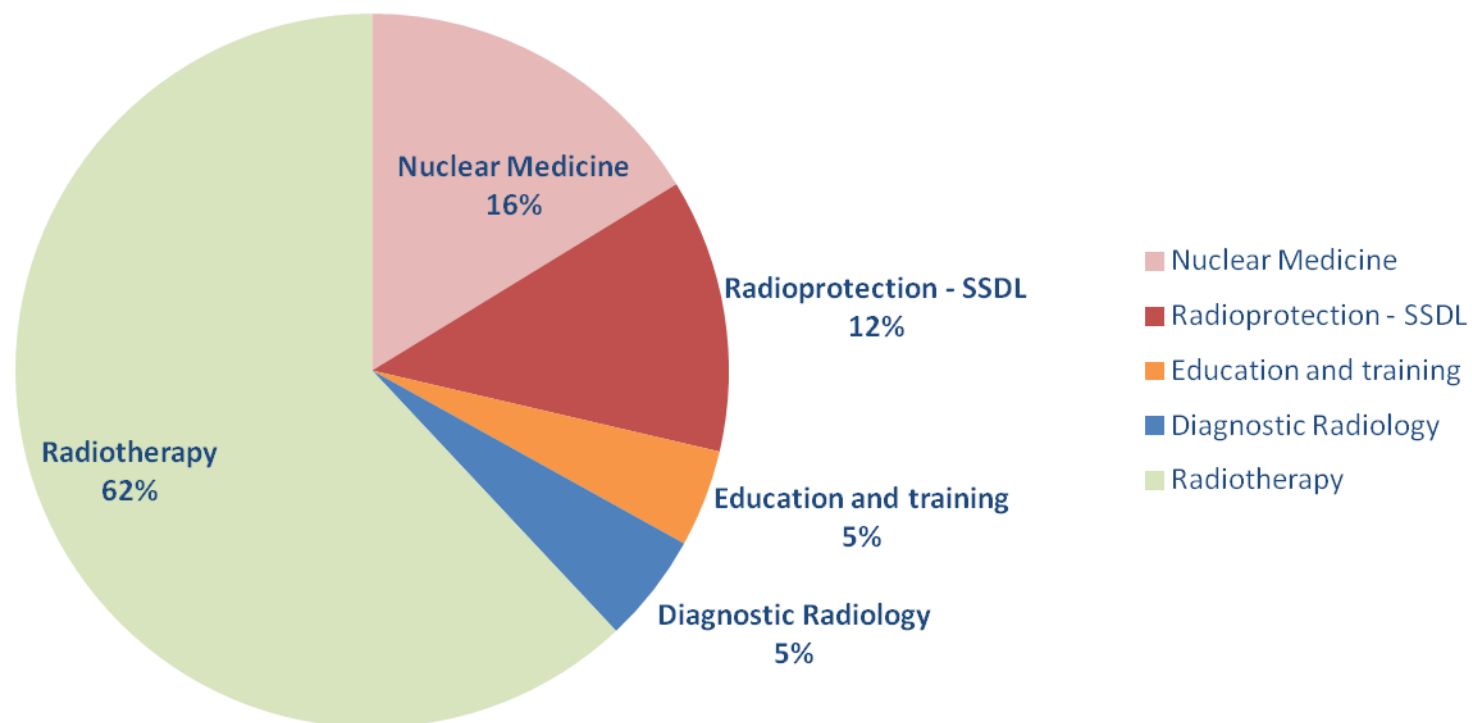
Procurement



Senegal

Technical Cooperation 2010-2015

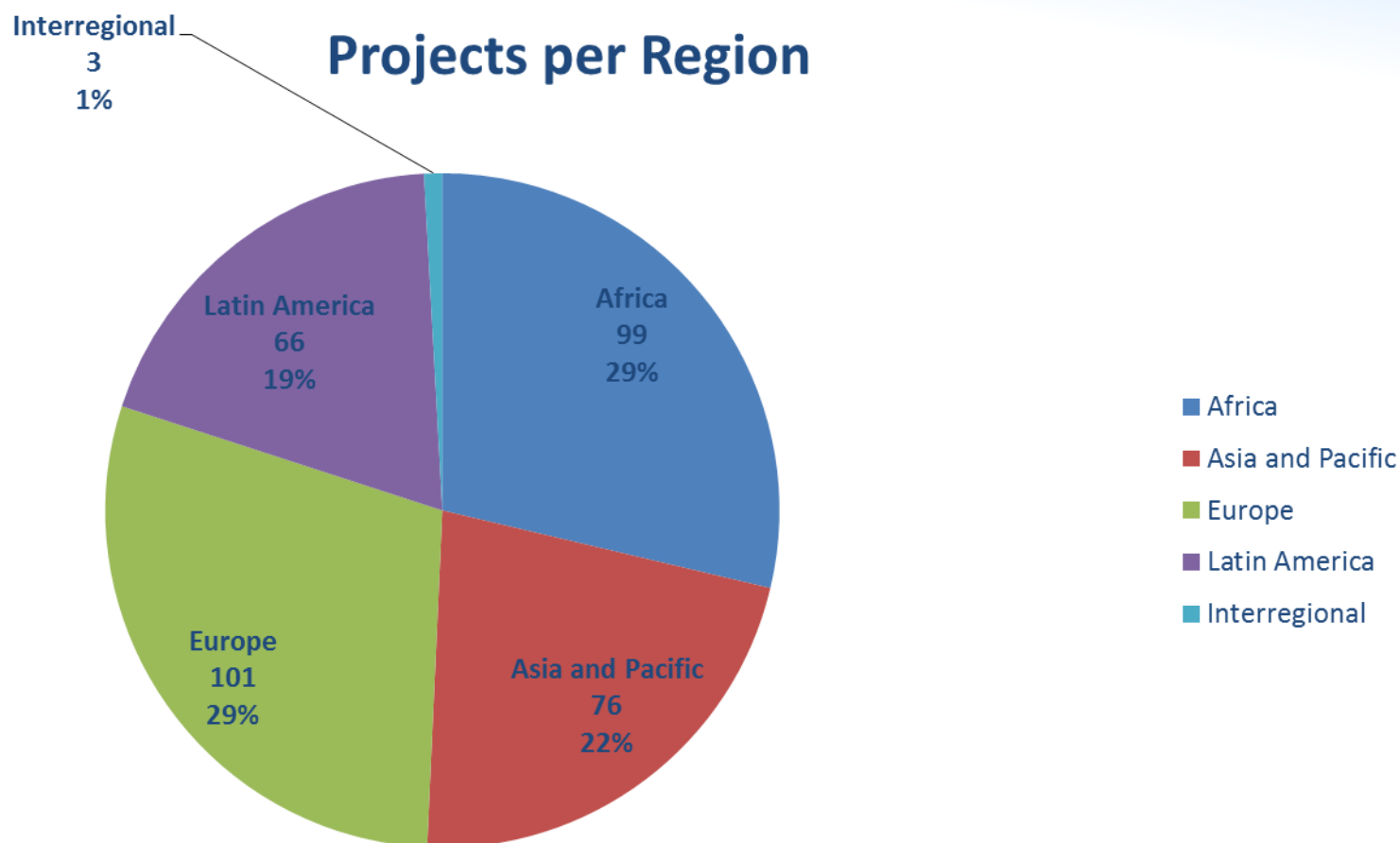
dosimetry and medical radiation physics field of activities by subject 2010-2015



Technical Cooperation 2010-2015

Total number of projects: **345**

Number of Countries: **112**





IAEA

60 Years

Atoms for Peace and Development

Research Activities in Medical Physics

Research Projects

Coordinated Research Activities

The IAEA also encourages research in medical physics through dedicated Coordinated Research Activities (CRAs). Most of the CRAs are carried out under Coordinated Research Projects (CRPs), which bring together experts from high income to lower and middle income countries to work and collaborate on topics of common interest.

These projects aim at transferring knowledge and know-how among the participants while achieving specific research and development objectives consistent with the IAEA programme of work.

Coordinated Research Projects

The Coordinated Research Projects (CRP) participants prepare the project work plan, regularly meet and review the ongoing work, thus creating a network that often favours new collaboration and leads to new developments.

THE IAEA ROLE

The IAEA ensures that the end results of the research and collaboration activities are freely available to all its Member States. This is usually achieved through the publication of the results in the form of a technical document, an IAEA report or in the open literature.

Medical Physics support through coordinated research

Knowledge exchange

Fostering scientific collaboration

Scientific meetings

Medical Physics in CRP

Creating scientific networks

Publishing results

Sharing results with Member States

IAEA activities Medical Physics





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Thank you !

More information and material available on
<https://www.iaea.org/>
<https://humanhealth.iaea.org>