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 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
IAEA and Medical Physics

Why and how the IAEA is linked to medical physics?
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.”
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.)

<table>
<thead>
<tr>
<th>Area of responsibility</th>
<th>Radiation therapy</th>
<th>Nuclear medicine</th>
<th>Diagnostic and interventional radiology</th>
</tr>
</thead>
</table>
| (b) Radiation safety and protection of patients, staff and the general public | (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. | (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. | (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.
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)

- Consult relevant scientific journals and literature
- Attendance at national and/or international conferences
- Courses on topics related to field of specialization

CPD

Maintain and enhance professional competence
Reinforce ability to work independently
Exchange of knowledge
Keep professional knowledge and skills up to date

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Recommendations for CQMP

Basic Degree in Physics (or equivalent) 3-4 years

MSc or PhD in Physics (or equivalent)

Postgraduate programme in medical physics 1-3 years

Complete academic medical physics

Supervised clinical training (residency) 2-3 years

Clinically qualified medical physicist

Certification / re-certification

State registration

CPD

ACCREDITED PROGRAMS

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

achieve harmonized standards of competence worldwide
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

Standardized guidelines for implementation of clinical training in every medical physics sub-specialty

- Modular in structure
- Competency-based

Now available on Moodle through CLP4net

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## Module 3: Radiation Dosimetry for External Beam Therapy

- **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

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### Pilot project to support a structured Clinical Training in Asia.

**AMPLE - RT**

Currently 188 participants

Of which 88 residents

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

After about 1 month > 750 downloads
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

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.

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 States.

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

- Radiotherapy Program Implementation
- Acceptance tests and commissioning of radiotherapy equipment
- Topics of special interest

Mobile phone version available

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Web-based e-learning material for medical physics

IAEA Human Health Campus

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

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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
Web-based e-learning material for medical physics

Joint ICTP-IAEA International Workshop on the Implementation of IGRT - Trieste 8 -12 May 2017
Clinical medical physics: guidelines and technical documents
Scientific and technical guidelines

Comprehensive clinical audit guidelines

Guidance on how to safely transition to new technologies

Professional Medical Physics publications
Endorsed by major medical physics professional societies

Support for best practice

How to plan and set up radiation facilities

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Radiotherapy publications

Freely downloadable from IAEA.org

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

Freely downloadable from IAEA.org
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
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
Calibration facilities at the IAEA dosimetry laboratory, central laboratory for the IAEA/WHO Network of SSDLs

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
IAEA/WHO Postal TLD service

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*

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**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
- Competence building
- Expert missions
- Transfer of know-how

Medical Physics in Technical Cooperation projects

- Scientific Visits
- Procurement of equipment
- On-the-job training
- Training courses
- Comprehensive audits of clinical radiation facilities
- Dissemination of best practices
- Meetings
- Fellowships
- Customized support to Member States
- Workshops

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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

Situation as of December 2015

Radiotherapy bunker construction
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.
Medical Physics training courses through Technical Cooperation

Examples of recent training courses in radiotherapy delivered through Technical Cooperation

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

QUATRO audits for medical physicists, Ghana 2015
Procurement

Senegal

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

- Radiotherapy: 62%
- Nuclear Medicine: 16%
- Radioprotection - SSDL: 12%
- Education and training: 5%
- Diagnostic Radiology: 5%
Technical Cooperation 2010-2015

Total number of projects: **345**

Number of Countries: **112**

Projects per Region:
- Africa: 99 (29%)
- Asia and Pacific: 76 (22%)
- Europe: 101 (29%)
- Latin America: 66 (19%)
- Interregional: 3 (1%)

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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

Publications
- Handbooks
- Technical documents

Human Health Campus
- E-learning

Dosimetry Laboratory
- Dosimetry and calibration services for Member States

Activities through Technical Cooperation
- Competency building
- Expert Missions
- Fellowships

Research activities
- Research networks

Procurement

Guidelines for professionals

Guidelines for the harmonization of education and training of medical physics

Topics and information for professionals

Link to selected articles and publications

Audit services

Support on the field

Transfer of know-how

International scientific collaboration

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Thank you!

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