

# IAEA activities in medical radiation physics: achievements and challenges

Ahmed Meghzifene

Head, Dosimetry and Medical Radiation Physics



IAEA  
International Atomic Energy Agency

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## Contents



- IAEA: an overview
- IAEA programme development and delivery mechanisms
- Main achievements in medical physics
- Challenges in medical physics



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## Overview

### IAEA mandate and organization



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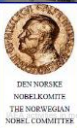
# IAEA Mandate

"The Agency shall seek to accelerate and enlarge the contribution of atomic energy to **peace, health and prosperity** throughout the world. It shall ensure, so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose."



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The Norwegian Nobel Committee awarded the 2008 Nobel Peace Prize to the IAEA and its Director General, Yukiya Amano, for their efforts to prevent nuclear energy from being used for military purposes and to ensure that nuclear energy is used in the safest possible way.



Medical physics

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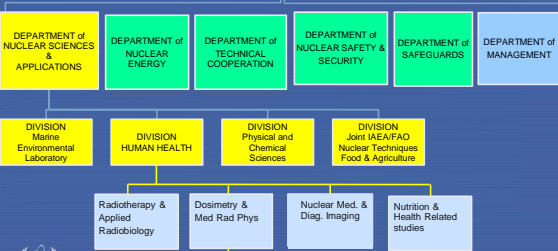
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# IAEA Organization

DG

~ 2500 staff



AAPM

Dosimetry Lab Seibersdorf

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# The IAEA "3 pillars"



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## IAEA Policymaking Bodies

IAEA programmes and budgets are set through the decisions of its policymaking bodies - the 35-member Board of Governors and the General Conference of all Member States



The Board of Governors



The General Conference



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## IAEA programme development and delivery mechanisms



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## IAEA mechanisms

### 1. Programme development

- Achieve standardization
- Promote best Practice

Consultations  
& networking  
Professional  
societies

### 2. Support to IAEA Member States

- Transfer of know-how
- Implementation of best practice

Mature  
technology

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## IAEA mechanisms

### 1. Programme development by the IAEA

- Achieve standardization
- Promote best Practice

### 2. Support to IAEA Member States

- Transfer of know-how
- Implementation of best practice

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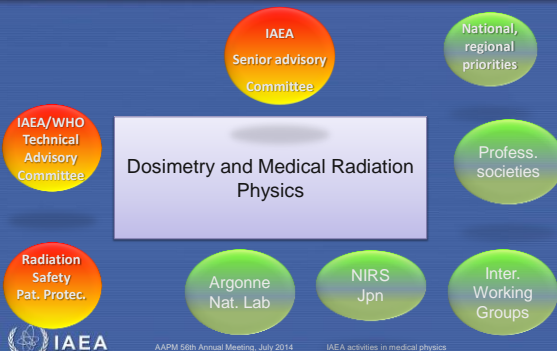
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## Consultations and partnerships



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## Programme development by the IAEA in medical physics

- **Standing Advisory Committee: 7 members** to review IAEA activities in dosimetry and medical physics & advise on trends and developments in the field
- Consultancy meetings (specific advice)
- Technical Meetings (advice on trends)
- Participation in external conferences
- Liaison with professional societies (IOMP, AAPM, EFOMP, ALFIM, FAMPO, ESTRO, EANM, SNM, ...)



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Programme development by the IAEA  
in medical physics

Main achievements

Publications

• Advice on planning and transitioning to new technologies

• Dosimetry CoP

• QA guidelines

Education & Training

• Harmonized Syllabi

• Clinical training guides

• Handbooks

• E-learning

Coordinated Research

• Development of CoPs, guidance material

• Capacity building in LMIs: Doctoral CRP

Dosimetry services

• Calibration of national standards

• Dosimetry audits (hospitals and national labs)

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Programme development by the IAEA  
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Main achievements

Publications

Guidelines on setting up programmes

Reference document used for guidance in TC Projects

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Main achievements

Publications

Dosimetry in radiotherapy



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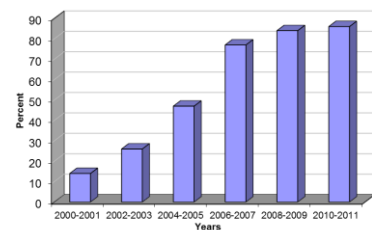
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Harmonization of radiation dosimetry

Use of  $N_{D,w}$  for radiotherapy beam calibration  
(1998–2011, based on % participants in TLD audits)



Years	Percent
2000-2001	15
2002-2003	25
2004-2005	40
2006-2007	75
2008-2009	85
2010-2011	88



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Main achievements

Publications

Dosimetry in X-ray Diagnostic Radiology



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# Main achievements

## Publications

Standardization in activity measurements in NM

Measurement procedures and QA/QC in labs & hospitals



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# Programme development by the IAEA in medical physics

## Main achievements

Publications	Education & Training	Coordinated Research	Dosimetry services
<ul style="list-style-type: none"><li>Advice on planning and transitioning to new technologies</li><li>Dosimetry CoP</li><li>QA guidelines</li></ul>	<ul style="list-style-type: none"><li>Harmonized Syllabi</li><li>Clinical training guides</li><li>Handbooks</li><li>E-learning</li></ul>	<ul style="list-style-type: none"><li>Development of CoPs, guidance material</li><li>Capacity building in LMIs: Doctoral CRP</li></ul>	<ul style="list-style-type: none"><li>Calibration of national standards</li><li>Dosimetry audits (hospitals and national labs)</li></ul>



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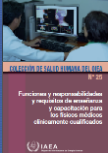

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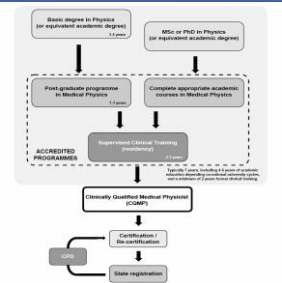
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# Main achievements

## Education & Training

### IAEA education & training material





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## Main achievements

### Education & Training

Reference education material for medical physicists

Endorsed by professional societies

- Nuclear Medicine Physics: A handbook for teachers and students (editing)

In press

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## Main achievements

### Education & Training

Reference material for clinical training of medical physicists

Example of structured clinical training programmes

English-Spanish-French-Russian (TCS-37)

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## Programme development in medical physics

### Main achievements

Publications	Education & Training	Coordinated Research	Dosimetry services
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## Main achievements

### Coordinated Research

#### Coordinated Research Activities

- >100 CRPs and ca. 1500 research institutions involved in contracts/agreements
- Duration of a CRP: 5 years
- €7 million in 2013 (for all IAEA CRPs)
- Average award: ca. €6500 (contracts for LMI countries)
- 75 Research Coordination Meetings (RCMs) in 2013
- Dedicated webpage: <http://cra.iaea.org>



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## Current coordinated research projects in dosimetry & medical physics

1. Doctoral CRP on imaging physics
2. Development of Quality Audits for Advanced Technology in Radiotherapy Dose Delivery
3. Investigate the relationship between end to end accuracy and QA extent and depth in radiotherapy
4. Development of quantitative nuclear medicine imaging for patient specific dosimetry
5. Development of advanced dosimetry techniques for diagnostic and interventional radiology

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## Main achievements

### Coordinated Research

#### Doctoral Coordinated Research Projects (CRP) scheme

- Overall topic is selected by the IAEA, following a consultancy
- CRP proposal is advertised for applications
- Teams are selected (PhD student, local and remote supervisors)
  - ✓ PhD student registers with a local university
  - ✓ PhD student has a local supervisor
  - ✓ PhD student has a remote supervisor/mentor

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## Main achievements

Coordinated Research

### Doctoral CRP scheme - Cont

- Funding possibilities for PhD work at the remote supervisor's site and for the remote supervisor's visit to the PhD student's site (Tech Coop projects)
- 2-3 Research Coordination meetings are funded
  - All teams meet and review progress of work of all PhD students
  - Opportunities for peer-review of PhD work
  - Opportunities for networking and cross links between projects

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## Main achievements

Coordinated Research

- Support for Doctoral CRPs
- Radiotherapy physics (2009-2013): 6 PhD students, 4 completed, 2 planned completion in 2014
- Imaging physics (2013-2017): 6 PhD students

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## Programme development in medical physics

### Main achievements

Publications	Education & Training	Coordinated Research	Dosimetry services
<ul style="list-style-type: none"><li>• Advice on planning and transitioning to new technologies</li><li>• Dosimetry CoP</li><li>• QA guidelines</li></ul>	<ul style="list-style-type: none"><li>• Harmonized Syllabi</li><li>• Clinical training guides</li><li>• Handbooks</li><li>• E-learning</li></ul>	<ul style="list-style-type: none"><li>• Development of CoPs, guidance material</li><li>• Capacity building in LMIs, Doctoral CRP</li></ul>	<ul style="list-style-type: none"><li>• Calibration of national standards</li><li>• Dosimetry audits (hospitals and national labs)</li></ul>

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# Main achievements

Dosimetry services




## Calibration service for national dosimetry standards




Calibration setup at the IAEA for dosimetry in X-ray diagnostic radiology

## IAEA/WHO TLD postal service for external beam radiotherapy



Material used in the IAEA/WHO TLD audits



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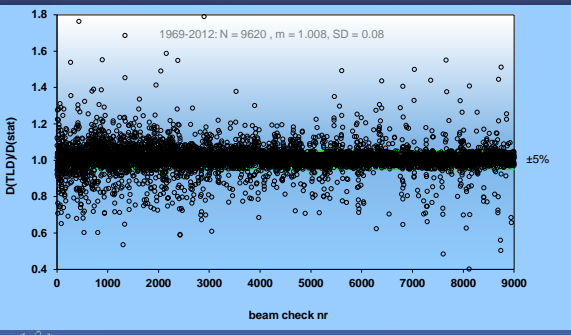
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# IAEA/WHO TLD audits for hospitals



1969-2012: N = 9620, m = 1.008, SD = 0.08

$\pm 5\%$

beam check nr



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# IAEA/WHO TLD audits for hospitals


## TLD results within the 5% limit



Fraction of results within 5% limit

Year

after follow-up    5% limit



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### Comprehensive audits-radiotherapy: a tool for quality improvement

#### Quality Assurance Team for Radiation Oncology QUATRO

- ✓Radiation oncologist
- ✓Medical physicist
- ✓RTT
- ✓Safety specialist (local)

IAEA dosimetry travel kit used for QUATRO missions



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Comprehensive Audits of Radiotherapy Practices: a Tool for Quality Improvement  
Quality Assurance Team for Radiation Oncology (QUATRO)



Checklists for Radiotherapy Centres: Medical Physics Procedures  
IAEA



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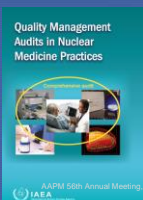
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### Comprehensive audits-diagnostic radiology: a tool for quality improvement

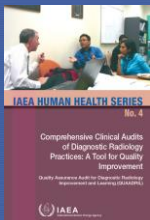
Multi-disciplinary team

- ✓Radiologist
- ✓Medical physicist
- ✓Radiographer
- ✓Radiation Safety specialist


Focussed on internal audits



Quality Management Audits in Nuclear Medicine Practices  
IAEA



Comprehensive Clinical Audits of Diagnostic Radiology Practices: A Tool for Quality Improvement  
IAEA HUMAN HEALTH SERIES No. 4



IAEA

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### IAEA mechanisms

#### 1. Programme development by the IAEA

- Standardization
- Best Practice

#### 2. Support to IAEA Member States

- Transfer of know-how
- Implementation of best practice

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IAEA Technical Cooperation Programme

- Transfer of know-how through
- Implementation of best practice
- Country or region specific
  - ✓ National projects (2-5 years)
  - ✓ Regional & Inter-regional projects
- Driven by Member States
- Support only for eligible Member States
- Formal process for requesting assistance
- Support includes: advice on planning, training, experts missions, equipment



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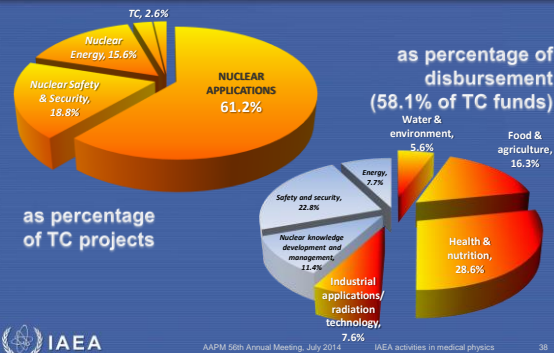
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IAEA Technical cooperation programme



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IAEA Technical cooperation programme

- National and regional TC projects in medical physics
  - 30 national projects
  - 6 regional projects & 1 Interregional
- National and regional TC projects with medical physics support:
  - 160 projects
  - 10 regional projects



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## IAEA Technical cooperation programme

- Supporting continuous professional development for medical physicists through: workshops, fellowships, SVs, etc.
- Supporting national and regional projects on education and clinical training programmes in medical physics
- INT project to support the international MSc programme in MP with the ICTP (Trieste)



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## IAEA Technical cooperation programme

In the past 10 years:

- 256 fellowships (3 months-2 years) in medical radiation physics
- 58 workshops in medical radiation physics
- 62 on-site National Group Training events



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## Challenges



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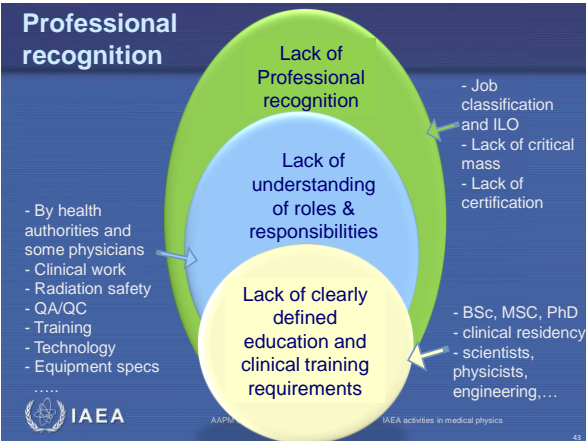
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**Technology**

- Gap between implementation of new technology and corresponding CoP or QC guidelines (small field dosimetry)
- How much prospective risk assessment is carried out before a new technology is used?
- Patient safety might be compromised (example: use of inadequate dosimeters for small fields)

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**The technology should not fill the vacuum...**

- In some hospitals (especially radiology) where there no (qualified) medical physicists, some physicians ask manufacturers to fill the vacuum
- Physicians and hospital administrators should be convinced about the added value of clinical medical physics support

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### Lack of clinical training

- Many medical physics education programs (BSc, MSc, PhD) lack clinical training
- Many existing clinical training programs are not competence-based and lack proper supervision
- Lack of certification process in many countries



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### Quality Assurance

- Too much or too little QA?
- QA/QC programs are prescriptive and take a considerable amount of MPs 'time
- A false sense of protection because we do a lot of QA
- Risk-based and balanced QA approach for a more effective use of resources for QA (TG-100)



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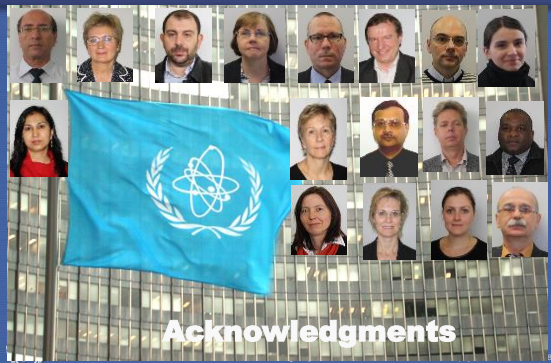
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### THANK YOU



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H. Eisenhofer, 1971-1987

H. Svensson, 1987-1994

P. Andreev, 1995-2000  
2003-2008

K. Shortt, 2000-2007

**Acknowledgments**  
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