Quantifying Quality: 'If you cannot measure it you cannot improve it'

Prof. Slavik Tabakov
President IOMP

International Organization for Medical Physics (IOMP), York, UK

19–20 September 2017

IAEA Scientific Forum

Nuclear Techniques in Human Health

Prevention, Diagnosis, Treatment

International Organization for Medical Physics

IOMP

IOMP – International Organization for Medical Physics

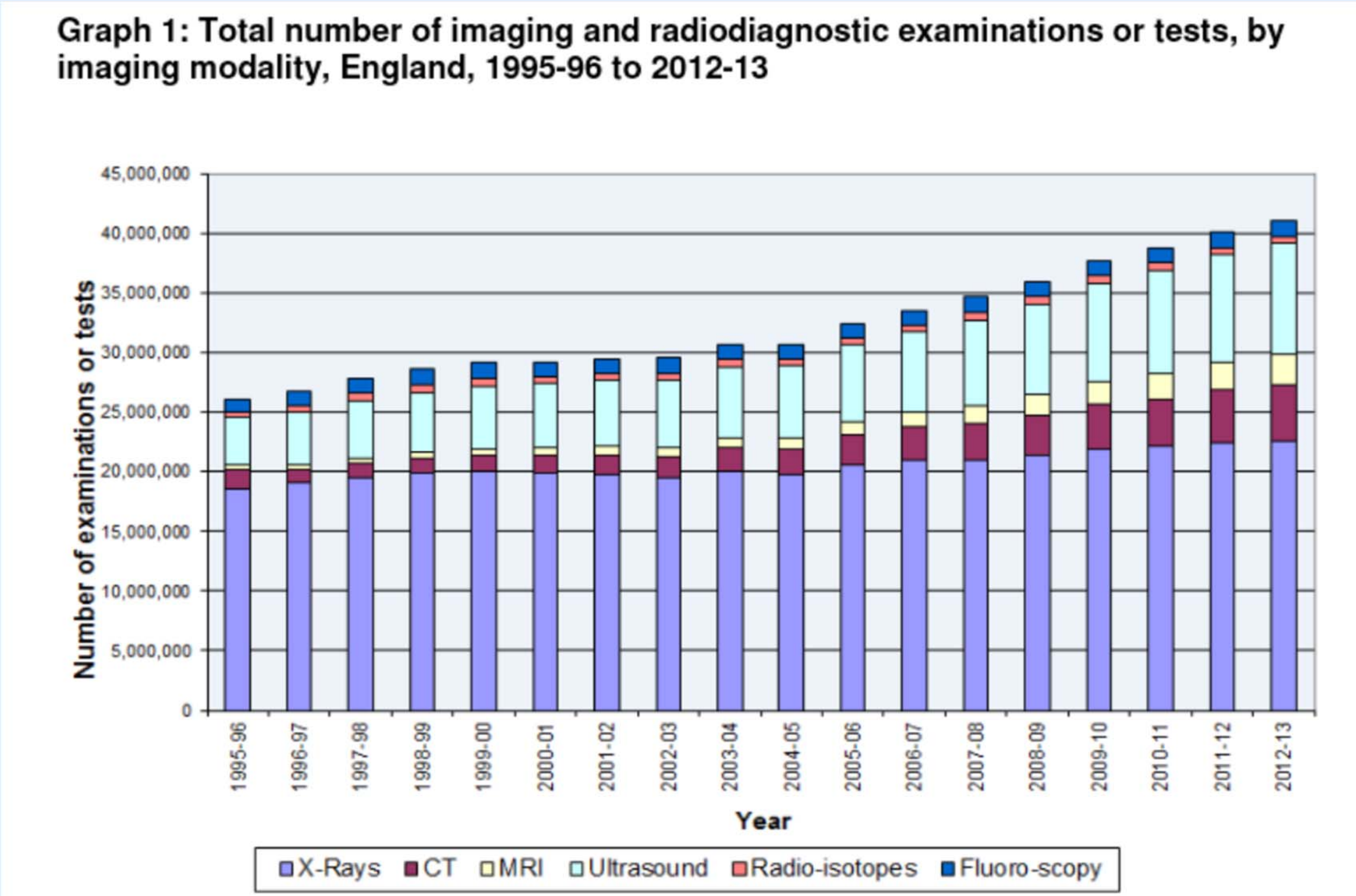
- Federative body of all medical physics societies in the world
- Created in 1963 by UK,USA,Canada,Sweden (6000 members)
- In 2016 IOMP has c.25,000 members in 86 National Societies
- 6 Regional Organisations (Federations)
- NGO to IAEA and WHO

MISSION

International Organization for Medical Physics
IOMP

- To disseminate scientific and technical information
- To foster the educational and professional development
- To promote the highest quality medical services for patients

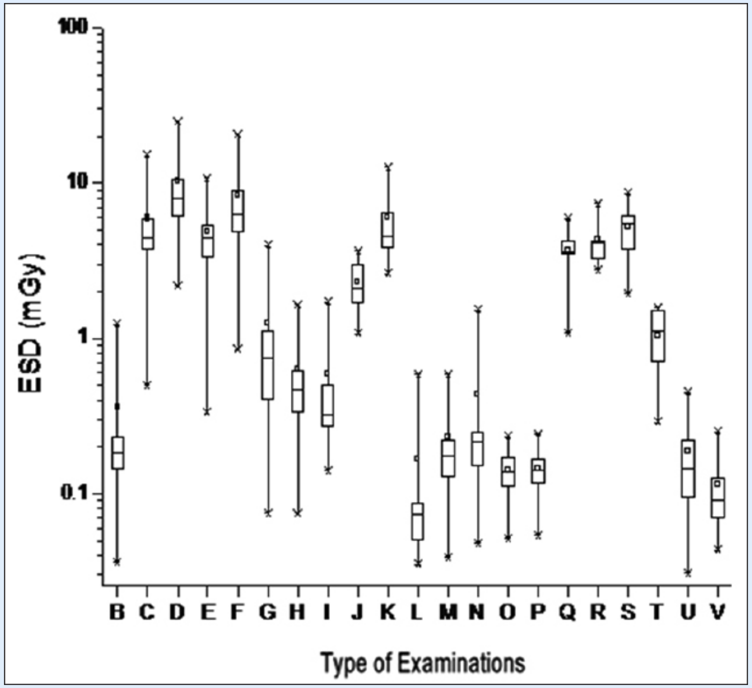
Diagnostic X-ray (DR) Examinations



Ref. 1

- X-ray examinations are about 3/4 of all Diagnostic Imaging
- X-ray DR delivers the highest patient dose in Imaging

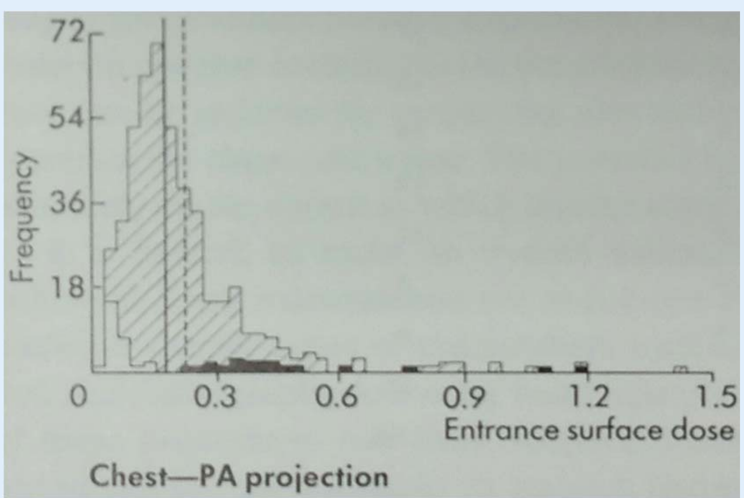
Variation of DR Patient Doses



Ref. 2

Entrance Surface Dose from Computed Radiography X-ray examinations in a LMIC country, 2014

Variations of the order of 10 to 50 times



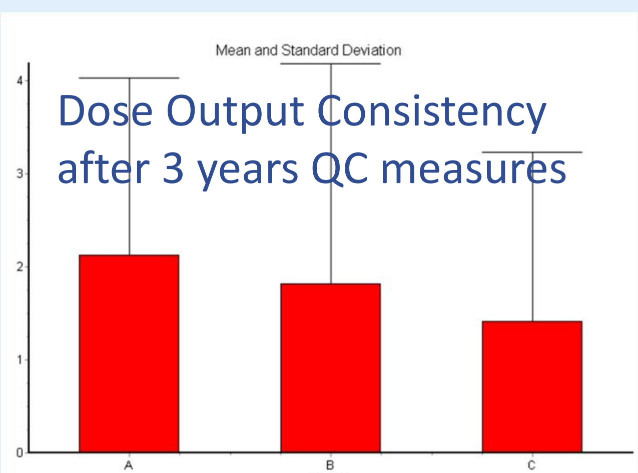
Ref. 3

Entrance Surface Dose from Film-Screen Radiography X-ray examinations in UK, 1990

Variations boosted QC activities

Quality Control activities over the years

- Dose Measurements
- Image Quality Assessment
- Test Objects
- Quality Factors
- Quality Assurance Systems
- Myriads of papers, many books
- The e-learning in the profession
- Dissemination
- Quick results



Ref. 4

Imaging Achievements and Challenges

Technical Achievements:

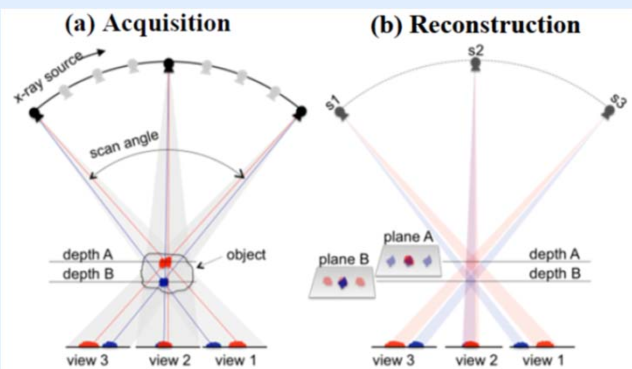
-Stable source of radiation

-High sensitivity detectors

-Image improvement software

-Precise quantitative measurements

-New imaging methods



Various Challenges:

-Dynamics of Innovations

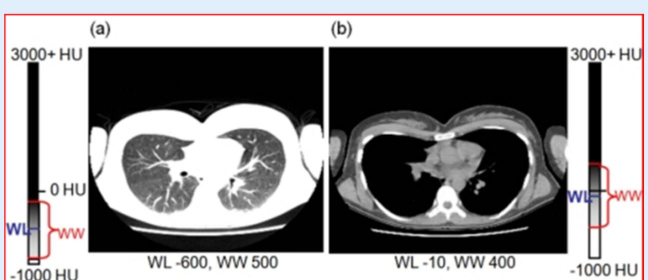
-Huge massive of data

-Lack of Information/Understanding

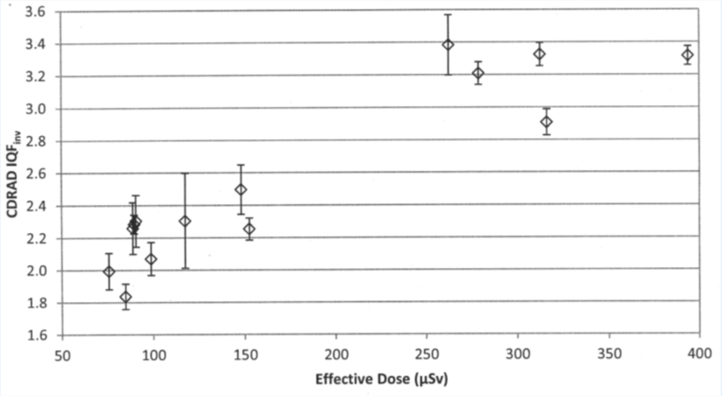
-Need of constant specialist re-training

-Training for medical staff

-Increased Patient Dose



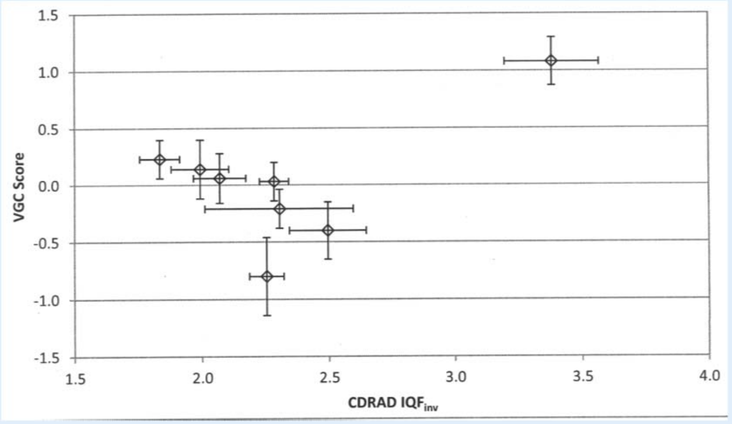
Precision and Optimisation



Precision of QC measurements:

-Quantification of performance quality
-Objective Quality indicators
-Precise Dose measurements
-Comparative Analysis
-Optimisation strategy research/plans

Effective Dose > Image Quality Factor
IQF > Visual Grading Criteria

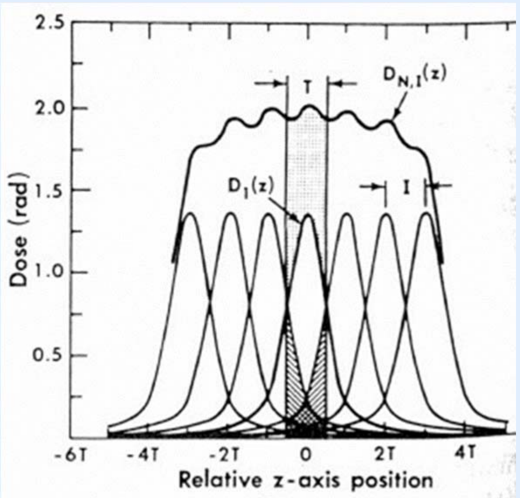


Ref. 5

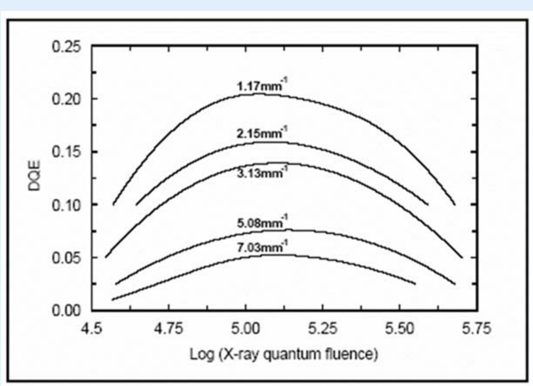
Optimisation:

-Quality benchmarks
-Dose reduction programme
-Training staff
-Tracing Optimisation results
-Disseminate Good practice

Quantification of Quality



$$\mathrm{CTDI} = \frac{1}{n.T}\int_{z1}^{z2} D(z)\,dz \quad \mathbf{mGy}$$



$$DQE = \frac{\left(SNR^2\right)_{out}}{\left(SNR^2\right)_{in}} = \frac{NEQ}{N}$$

Correct Quantification:

-Precision of tools
-Quality Procedures
-Plan for Optimisation
-Practical implementation
-Trained specialists

Entering Quality in the Education:

-Specifying the problem/parameter
-Parameter description
-Method of measurement
-Understanding the result
-Analysis of the outcome
-Improvement of the parameter

Optimisation: Ways Forward

Wrong:

-Relying on automatic QC only

-High number less-qualified QC assessors

-Privatisation of QC activities alone

Right:

-Increased links with the industry

-Forcing industry to intra-harmonization

-Standard measurements

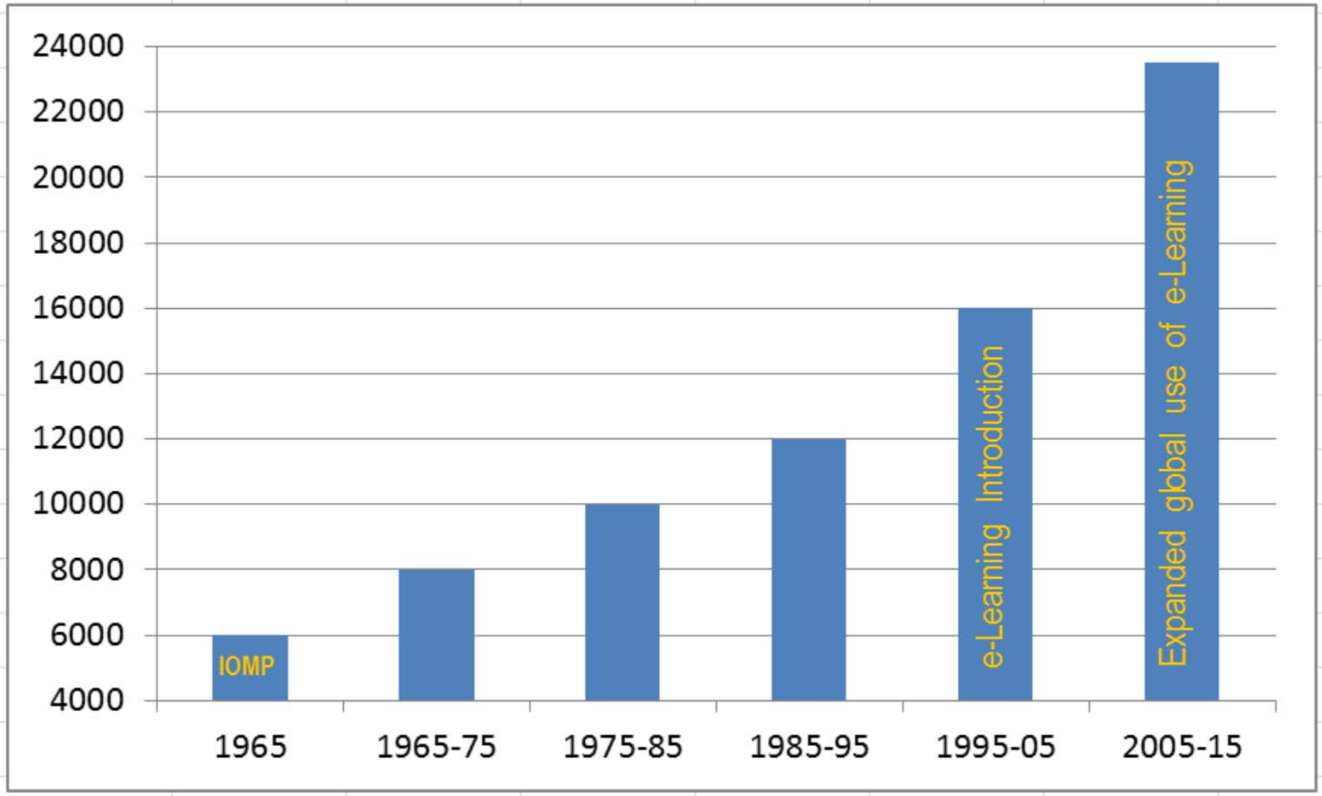
-Increasing the volume of curricula

-New types of re-training (e-learning)

-Increasing the number of medical physicists

www.mpijournal.org

Number of medical physicists worldwide since the establishment of IOMP



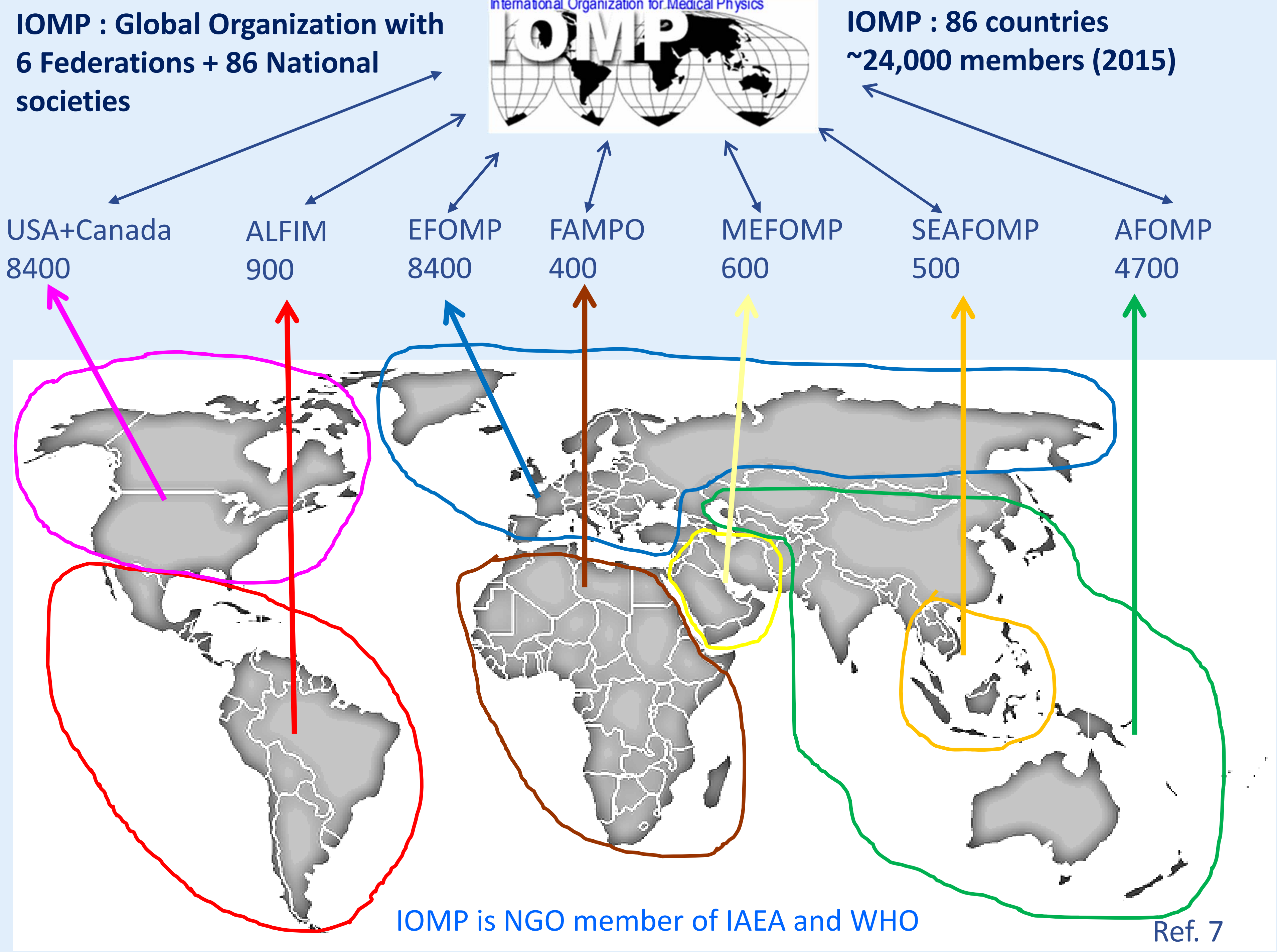
UNSCEAR 2008:

- 3,600 millions X-ray examinations
- 37 million Nucl. Medicine procedures
- 7.5 million Rad. Oncology treatments

Work force necessary for Radiotherapy:
2035 Report of the Global Task Force on Radiotherapy for Cancer Control (GTFRCC) [Ref.6]

Needs to achieve adequate healthcare in the field of oncology until 2035:
- In countries with low and middle income – needed 13,000 Megavoltage machines and about 22,000 medical physicists.
-In countries with high income needed 9,000 Megavoltage machines and about 17,000 medical physicists.

?? Need of Medical Physicists in Imaging – work in progress …


IOMP : Global Organization with 6 Federations + 86 National societies
International Organization for Medical Physics
IOMP
IOMP : 86 countries
~24,000 members (2015)
USA+Canada 8400
ALFIM 900
EFOMP 8400
FAMPO 400
MEFOMP 600
SEAFOMP 500
AFOMP 4700
IOMP is NGO member of IAEA and WHO
Ref. 7

Medical Physics Dictionary and Encyclopaedia WWW.EMITEL2.EU:

- Translated in 29 languages (8 alphabets): English, French, German, Italian, Swedish, Spanish, Portuguese, Bulgarian, Czech, Greek, Hungarian, Lithuanian, Polish; Estonian, Romanian, Turkish, Latvian, Russian, Thai, Arabic, Iranian, Bengal, Slovenian, Malay, Chinese, Croatian, Japanese, Finnish, Korean

EMITEL e-Encyclopaedia of Medical Physics and Multilingual Dictionary of Terms

Leonardo da Vinci · Education and Culture · King's College London Founded 1829 · King's College Hospital NHS Foundation Trust · Universitetssjukhuset i Lund · Lund University · IOMP International Organization for Medical Physics

ENCYCLOPEDIA | DICTIONARY | COMBINED | Project | Contributors | User Guide | Copyright | Disclaimer

Choose Input Language: English
Output Language: Chinese

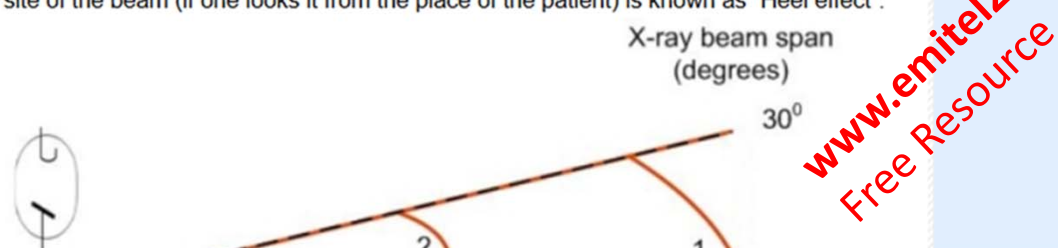
anode — Translate

Anode	阳极	General; Diagnostic Radiology
Anode acceleration	阳极加速度	Diagnostic Radiology
Anode angle	阳极角	Diagnostic Radiology
Anode cooling chart	阳极冷却图表	Diagnostic Radiology
Anode cooling curve	阳极冷却曲线	Diagnostic Radiology
Anode heel effect	阳极跟部效应，阳极效应	Diagnostic Radiology

Anode heel effect

Diagnostic Radiology

The X-ray anode generates radiation in all directions (only a fraction of it is at the direction of the patient). At diagnostic energy, this fraction is mainly at direction 90° from the direction of the incident electron beam (anode current) in the X-ray tube. The intensity of the radiation beam towards the patient has significant spatial variation. Figure 1 (curve 1) presents an example where the maximal intensity of a new X-ray tube (marked with 100%) is at direction 15° measured from the anode surface (this depends on the type of the X-ray tube). There is a notable loss of X-ray beam intensity (up to 50%) at the anode side of the beam. This is due to lesser production of X-ray photons at this direction (mainly due to absorption of the X-rays in the anode itself at the lower end of the target surface). This decreased intensity of radiation at the Anode site of the beam (if one looks it from the place of the patient) is known as "Heel effect".



CONCLUSION:

- High Quality could be maintained only by Qualified Specialists

- Medical Physicists are at the forefront of Safety and Quality Assurance in Radiation Medicine

References:

1. NHS Imaging and Radiodiagnostic activity, 2013-2014 release, NHS England Analytical Services (Operations)
2. Sharma R et al, Radiation dose to patients from X-ray radiographic examinations using computed radiography imaging system, J. of Medical Physics, 2015
3. Patient Dose Reduction in Diagnostic Radiology, NRPB, 1990, 1(3), UK
4. Effectiveness of Quality Control in Radiography, Tabakov S, Stoeva M, Proceedings WC 2003
5. Optimisation of Dual Energy Subtraction and Digital Tomosynthesis of the Chest, S Nicholson MSc Thesis, KCL, 2015
6. Expanding global access to radiotherapy , Rifat Atun et al, The Lancet Oncology, Volume 16, No. 10, 2015
7. Global Number of Medical Physicists and its Growth 1965-2015, S Tabakov, Medical Physics International, 2016, No2

THANK YOU