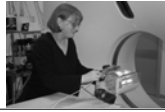


Need and Effectiveness of QA in X-ray Diagnostic Radiology

Dr Slavik Tabakov, FIPEM, Assoc.Prof.,
Chairman of IOMP Education and Training Committee

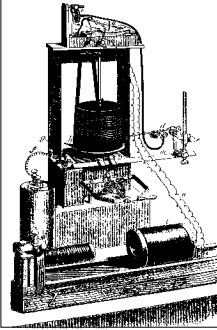
Dept. Medical Eng. and Physics, King's College London, UK
slavik.tabakov@kcl.ac.uk



Medical Physics before 1885

Mainly related to medical application of optics, electricity, acoustics, etc.

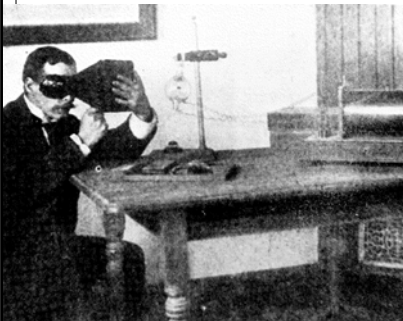
Short university courses and research, but not a separate profession



Medical Physics after 1886

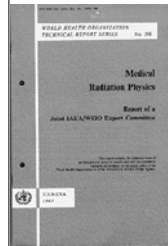
Related mainly to the medical use of radiation:

- X-rays
- Isotops
- Radiotherapy
- Physiol. measur.
- Imaging



Joint IAEA/WHO Expert Committee on Med.Rad.Phys. Recommendations

- Medical Physics should be recognised in all countries as a scientific discipline with full professional status in universities, medical schools, hospitals and allied institutions.
- Medical Schools should appoint teachers in medical physics to their faculties..
- In all countries, and especially in those with few or no medical physicists, the government authorities responsible for the health services and for education should initiate or expand medical physics activities..
- Hospitals requiring medical physics services should be provided with adequate space/equip..
- IAEA and WHO should provide support for seminars/training on medical physics..



INTERNATIONAL COUNCIL FOR SCIENCE

46 countries

International Federation for Medical and Biological Engineering

Federations
National Societies



72 countries



Minimum staffing of the Medical Physics support of:

Radiotherapy

- 1 high energy accelerator - 0.8
- 1 major item of equipment (simul.,Co unit,Plan.sys) - 0.4
- 1000 new courses of treat. p.a. with ext. beam therapy - 1.2
- 100 new courses of treat. p.a. with brachytherapy - 0.25

Nuclear Medicine

- 1 Gamma camera - 0.5
- 5000 exam. p.a. - 0.5
- 500 dynamic studies p.a. - 0.25
- 250 SPCT studies p.a. - 0.25
- 50 new courses of treat. p.a. - 0.25

Diagnostic Radiology

- Rad. Dept. with complex equip. -1
- Rad.Dept. serving 500,000 pat. -1

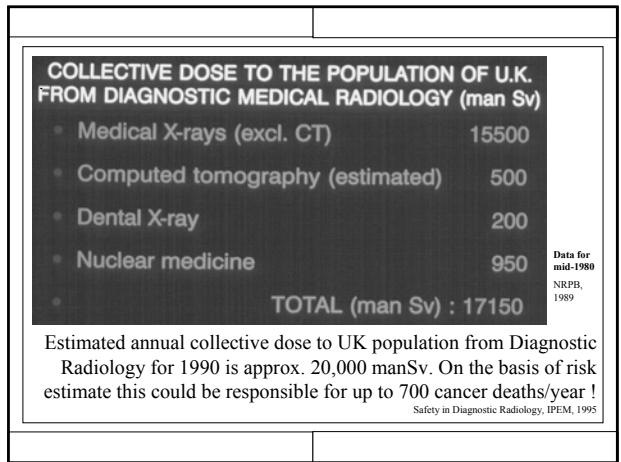
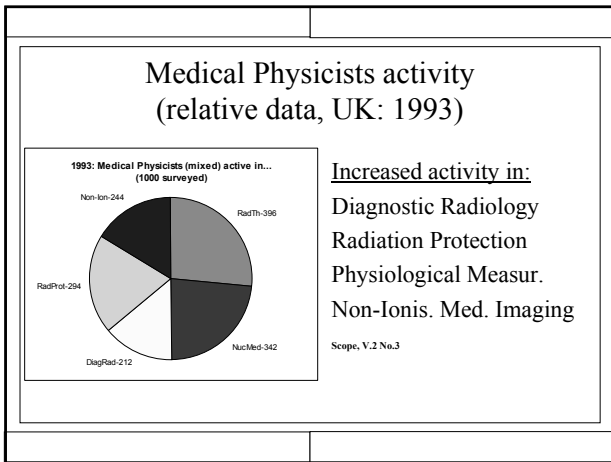
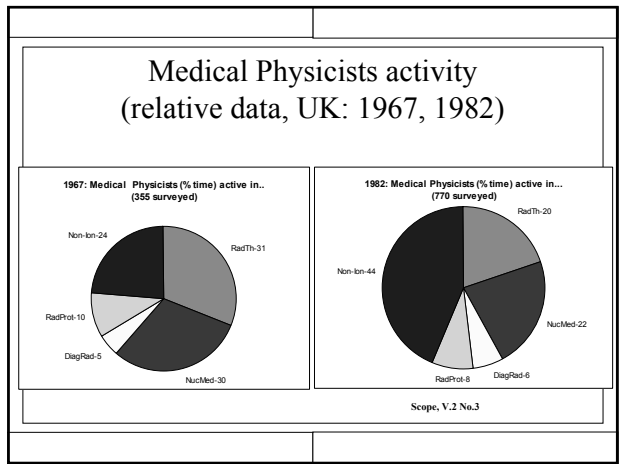
- Academic commitments - 0.5
- Radiation Protection (Adviser) 1

(depending on the QA program)

EFOMP Policy Statement

<u>Number of qualified physicits at Dept. (ex.-Sweden, ~10 mil)</u>	<u>Number of Departments</u>	<u>Total number of qualified physicits</u>
1 (at Central Hosp.)	13	13
2 - 7 (Central Hosp.)	10	42
7 - 9 (at Univ. Hosp.)	4	32
15-17 (Univ. Hosp.)	3	48
TOTAL	30	135 (+approx.110 n.q)

- Turkey (~ 60 mil.) - 21 Public + 7 Private Dept. with MP (Total number - approx 120 Med.Rad.Phys+30 others)
- Romania (~23 mil.) - spread in many Hosp. Dept. (Total number - approx. 60 Med.Rad.Phys. + 100 others)
- UK (~57 mil) - Tot. approx. 1200 Med.Phys. in 125 Dept.

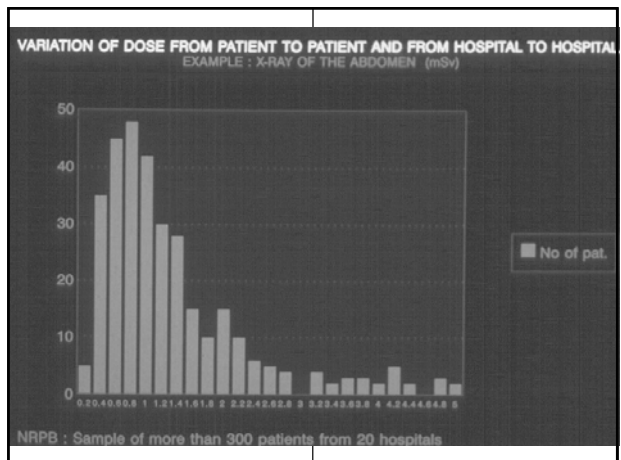


Approximately 90% of the total collective dose to UK population from man-made radiation sources arises from Diagnostic Radiology
Safety in Diagnostic Radiology, IPEM, 1995

In most industrialised countries there are between 300 and 900 X-ray examinations for every 1000 inhabitants every year. Over half of these are chest examinations (these figures does not include dental X-ray examinations or mass screening programs).

Doses varies widely from hospital to hospital, even in the same country, sometimes by a factor of 100.

Radiation and You, EU, Luxembourg 1990



Introducing Quality Assurance programmes, which includes Quality Control surveys of X-ray equipment

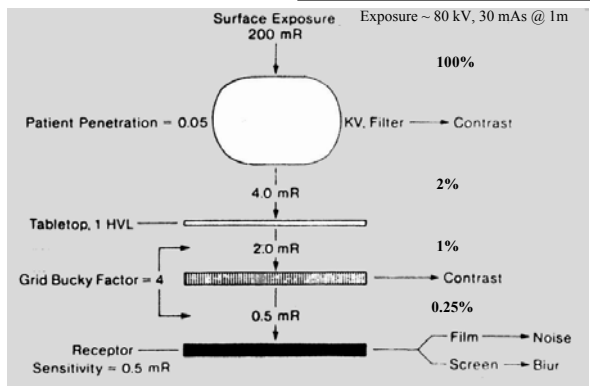
Quality Control (QC) in X-ray Diagnostic Radiology includes regular (yearly) tests of various parameters - accuracy and consistency of X-ray tube output, kVp, timer, variation of output with the mA, Half Value Layer, image resolution and contrast, noise, etc.

These parameters are directly related to equipment performance, image quality and patient dose.

Now QC is the main job of most Medical Physicists in Imaging



X-ray Dose distribution: from tube > through patient > to film



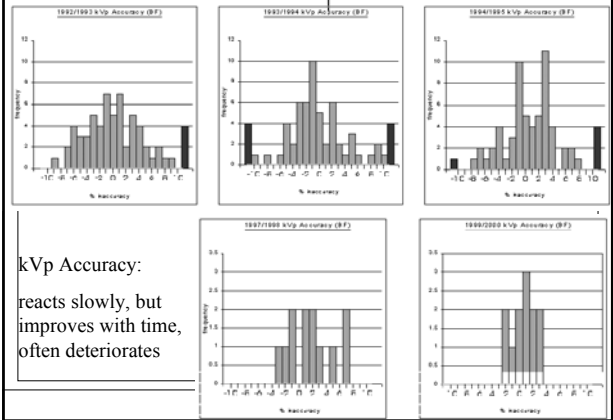
Revised radiation doses for typical X-ray examinations

B F Wall, D Hart, BJR, May 1997, p.437-439

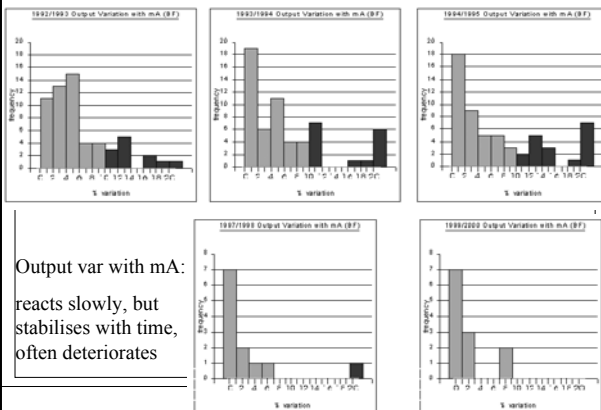
- For most non-CT procedures the new (1990-ties) typical effective doses to standard adult patient are between **25 and 60% lower** than the old ones (1980-ties);
- For abdominal and pelvic CT examinations the doses are about 35% higher (while head CT are with lower dose than before);

As an overall picture the collective effective dose in the UK has increased during late 90-ties, but large part of this is related to contrast examinations and CT examinations (these are ~4% of all examinations, but deliver ~40% of the collective dose)

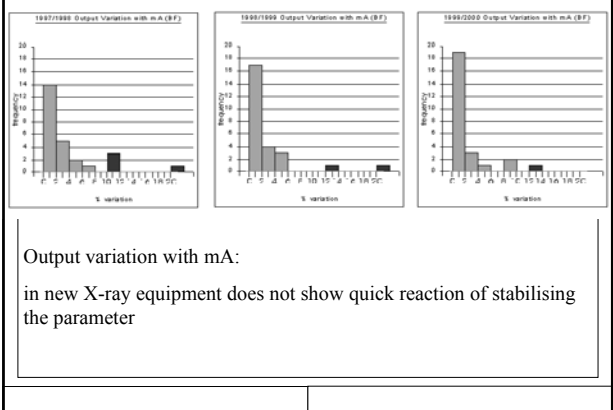
kVp Accuracy



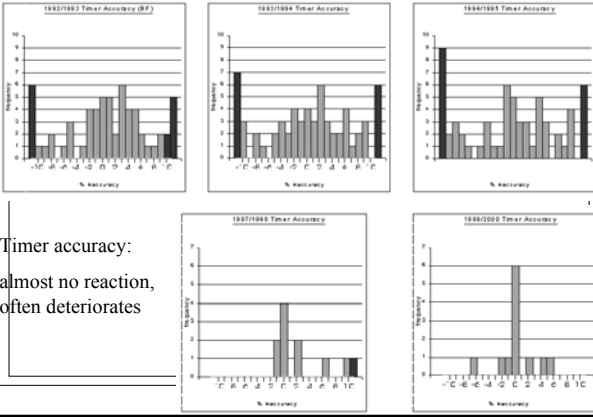
Output Variation with mA



Output Variation with mA

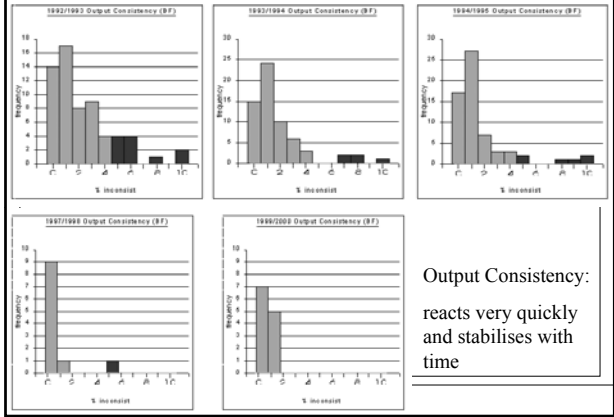


Timer Accuracy



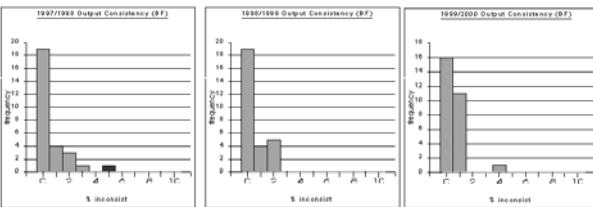
Timer accuracy:
almost no reaction,
often deteriorates

Output Consistency



Output Consistency:
reacts very quickly
and stabilises with
time

Output Consistency



Output consistency (as overall parameter):
in new X-ray equipment maintains stable parameters

LEARNING PROCESS

1. EDUCATION : UNIVERSITY (academic)

- first 3 (or 4) years - BSc level (undergraduate or graduate)

- next 1 (or 2 years) - MSc level (graduate or postgraduate)

* student - lecturer - diploma (grade) - can not work unsupervised

2. TRAINING: HOSPITAL (post-MSc, practical)

- junior level (specialize 6 to 24 months)

- senior level (varies, after X years experience)

* trainee (stagier) - supervisor (trainer) - professional recognition



3. CPD (experience on the working place, courses)

* lifelong learning - professional career

European Conference on Post-graduate Education in Medical Radiation Physics



- **Objectives:** To establish the status and needs of the European education/training in Med.Rad.Phys./Eng.;
- To increase East/West European cooperation;
- To formulate proposals for the advancement of MRP/E education/training in Europe
- 24 European countries

EC project CIPA/2623

University of Plovdiv

Rad.Prot.Lab
Rad.Meas.Lab

Medical University

Anat./Physiol.
Radiology

Technical University

Laser/US Lab
Med.Eng.Lab

Inter-University Medical Physics & Engineering Centre, Plovdiv, Bulgaria



MSc course in Medical Radiation Physics (running 5-th year)

Florence University

King's College London

Dublin University

<http://www.kcl.ac.uk/erm>

MSc/Diploma course on Medical Radiation Physics Curriculum

TERM 1 (September - December)

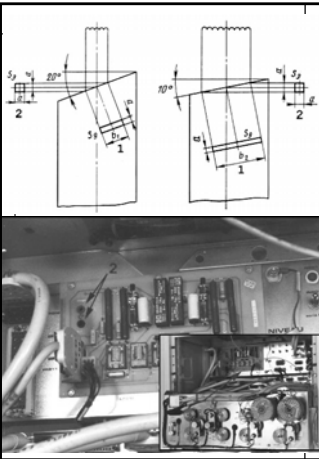
1. Basis of Human Anatomy and Physiology
(approx. 90 acad. hours in total; Tests)
2. Radiation Physics
(approx. 90 acad. hours in total; Tests + Exam)
3. Radiation Measurements
(approx. 90 acad. hours in total; Tests + Project + Exam)
4. Radiobiology
(approx. 60 acad. hours in total; Tests)

5. Physics and Equipment of Ultrasound, Lasers, NMR
(approx. 90 acad. hours in total, Tests + Project* + Exam)

MSc/Diploma course on Medical Radiation Physics Curriculum

TERM 2 (January - May)

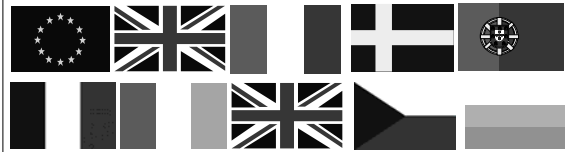
6. Physics and Equipment of Diagnostic Radiology
(approx. 80 acad. hours in total, Tests + Project* + Exam)
 7. Physics and Equipment of Nuclear Medicine
(approx. 80 acad. hours in total, Tests + Project* + Exam)
 8. Physics and Equipment of Radiotherapy
(approx. 80 acad. hours in total, Tests + Project* + Exam)
 9. Image and Signal Processing in Medicine
(approx. 50 acad. hours in total, Tests)
- MSc assignm. (for > 50%)
10. Radiation Protection&Hospital Safety (~ 80 h., Tests, Certificate)
 11. Medical Informatics (approx. 30 h.)
 12. European Integration (approx. 30 h.)
- DIPLOMA**



MSc course specifics

- Elements of Medical Radiation Engineering
 - Design and characteristics
 - Various measurements
 - QA and Maintenance
- Intensive Practice: Lectures/Labs ratio ~ 2/1
- Special practical sessions
- A full set of Lecture Notes (in English)

A Project for European Medical Radiation Learning Development - **EMERALD**

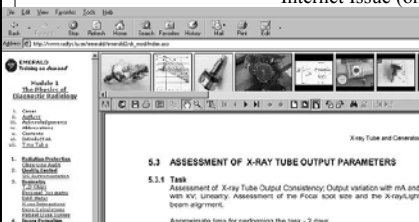


EC Leonardo Training Project EMERALD

Three training modules (DR, NM, RT)
Course Guide with Timetables

European Medical Radiation Learning Development

Student Workbooks (e-Workbooks)
Image Database (3 CD-ROMs)
Internet Issue (on CD and Internet)



www.radfys.lu.se/emerald2/



- IOMP - EFOMP - IAEA – AAPM - Summer schools, courses, meetings with various national societies (including special sessions on QC)

International Medical Physics College
02-27 September 2002, ICTP, Trieste
www.ictp.trieste.it