Universitair Ziekenhuis Gent

UNIVERSITEIT GENT

Peer review in radiation oncology: from beam output to clinical audits.

Prof. Dr. Yolande Lievens

Chair Radiation Oncology Department

University Hospital Ghent, BELGIUM

President College Radiotherapy-Oncology

College van Geneesheren Radiotherapie-Oncologie

Collège des Médecins Radiothérapie- Oncologie

QA in radiotherapy

"all those procedures that ensure consistency of
the radiotherapy prescription
and the safe fulfilment of that prescription,
with regard to the dose to the target volume,
together with a minimal dose to normal tissues,
minimal exposure of personnel
and adequate patient monitoring
aimed at determining the end result of treatment."

Kouloulias et al. Eur J Cancer,

what you see
is NOT always what you get

VOLUME 28 · NUMBER 18 · JUNE 20 2010

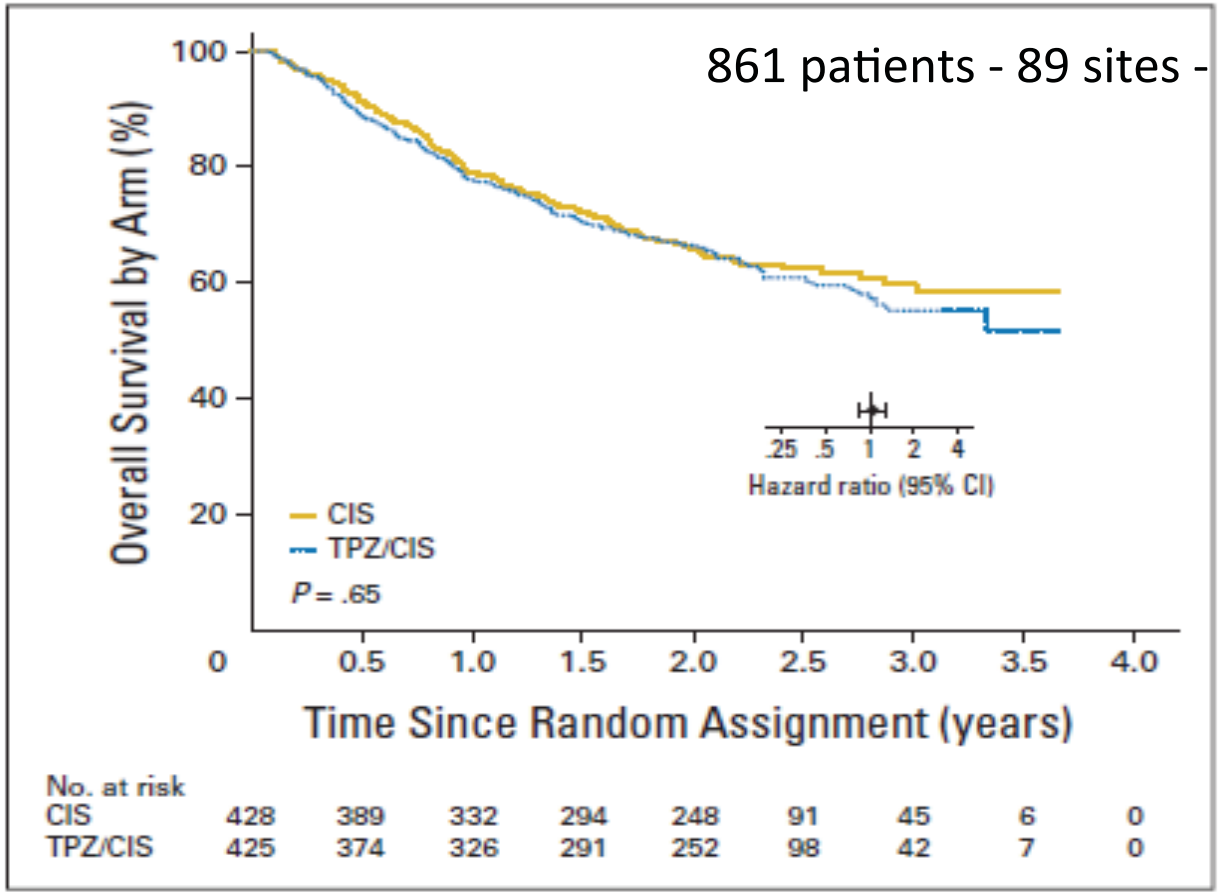
JOURNAL OF CLINICAL ONCOLOGY

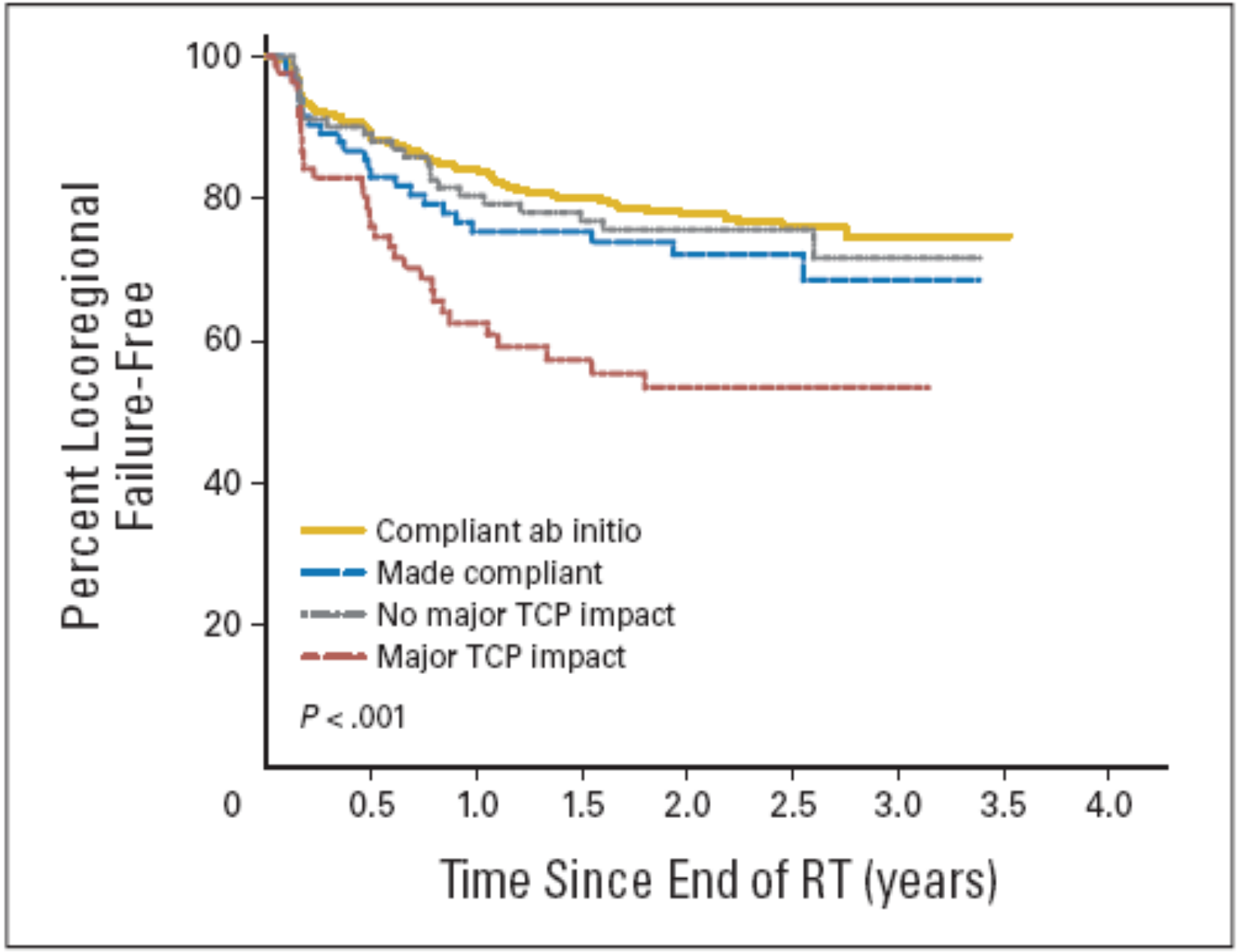
ORIGINAL REPORT

Tirapazamine, Cisplatin, and Radiation Versus Cisplatin and Radiation for Advanced Squamous Cell Carcinoma of the Head and Neck (TROG 02.02, HeadSTART): A Phase III Trial of the Trans-Tasman Radiation Oncology Group

Danny Rischin, Lester J. Peters, Brian O'Sullivan, Jordi Giralt, Richard Fisher, Kally Yuen, Andy Trotti, Jacques Bernier, Jean Bourhis, Jolie Ringash, Michael Henke, and Lizbeth Kenny

861 patients - 89 sites - 16 countries





Peters et al. J Clin Oncol,

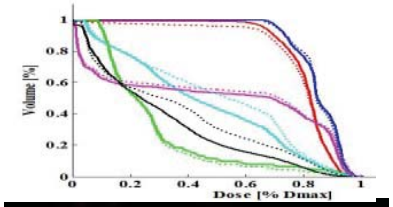
"It is sobering to note
that the value of good radiotherapy
is substantially greater
than the incremental gains
that have been achieved
with new drugs and/or biologicals.

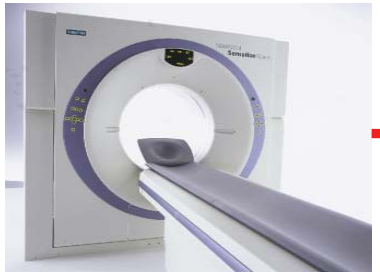
These results strongly reinforce
the importance of doing well
what we already know."

Peters et al. J Clin Oncol,

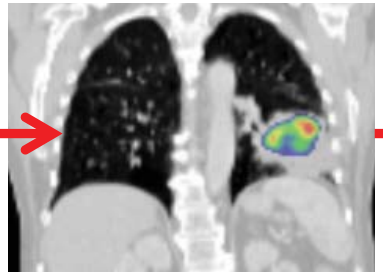
Image Guided / Adaptive Radiotherapy (IGRT/ART)

treatment preparation





imaging

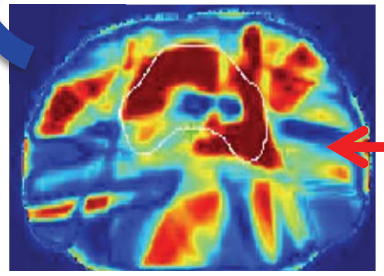


delineation

planning

pre-treatment dosimetry

treatment delivery



per-treatment dosimetry

treatment

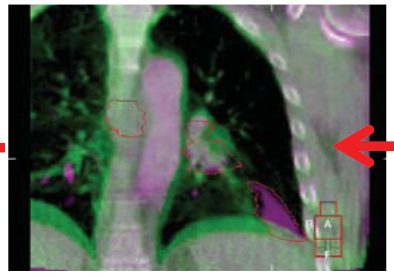


image registration & correction

imaging

daily

What do we hope to achieve with Quality Audits?

- Important tool for **improving quality** of the clinical physics and radiation oncology programs
- Enhance **patient safety**
- Ensure the **best possible treatment** for our patients
- Aid in the **professional development** of the radiation oncology professionals
- Meet **regulatory requirements**

Legal requirement

European perspective - EURATOM directive 97/43

- Article 8 which addresses **Equipment**, states:

"Member States shall ensure that ... appropriate quality assurance programmes including quality control measures and patient dose assessments are implemented ....".

- Article 9 with respect to **Special Practices**:

"...special attention shall be given to the quality assurance programmes, including quality control measures and patient dose or administered activity assessment, as mentioned in Article 8."

“QA in RT should explore

each step

from diagnosis

over treatment preparation and delivery

to the follow up of the irradiated patient”

Structure

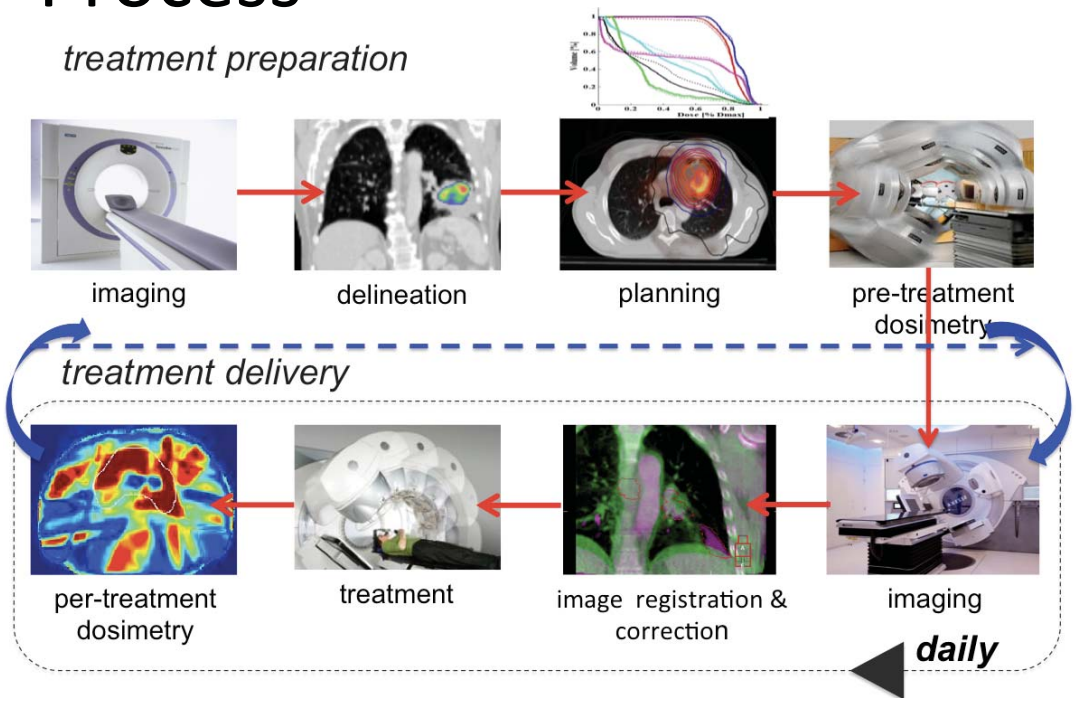
facilities
equipment
personnel

IAEA International Atomic Energy Agency

College van Geneesheren Radiotherapie-Oncologie

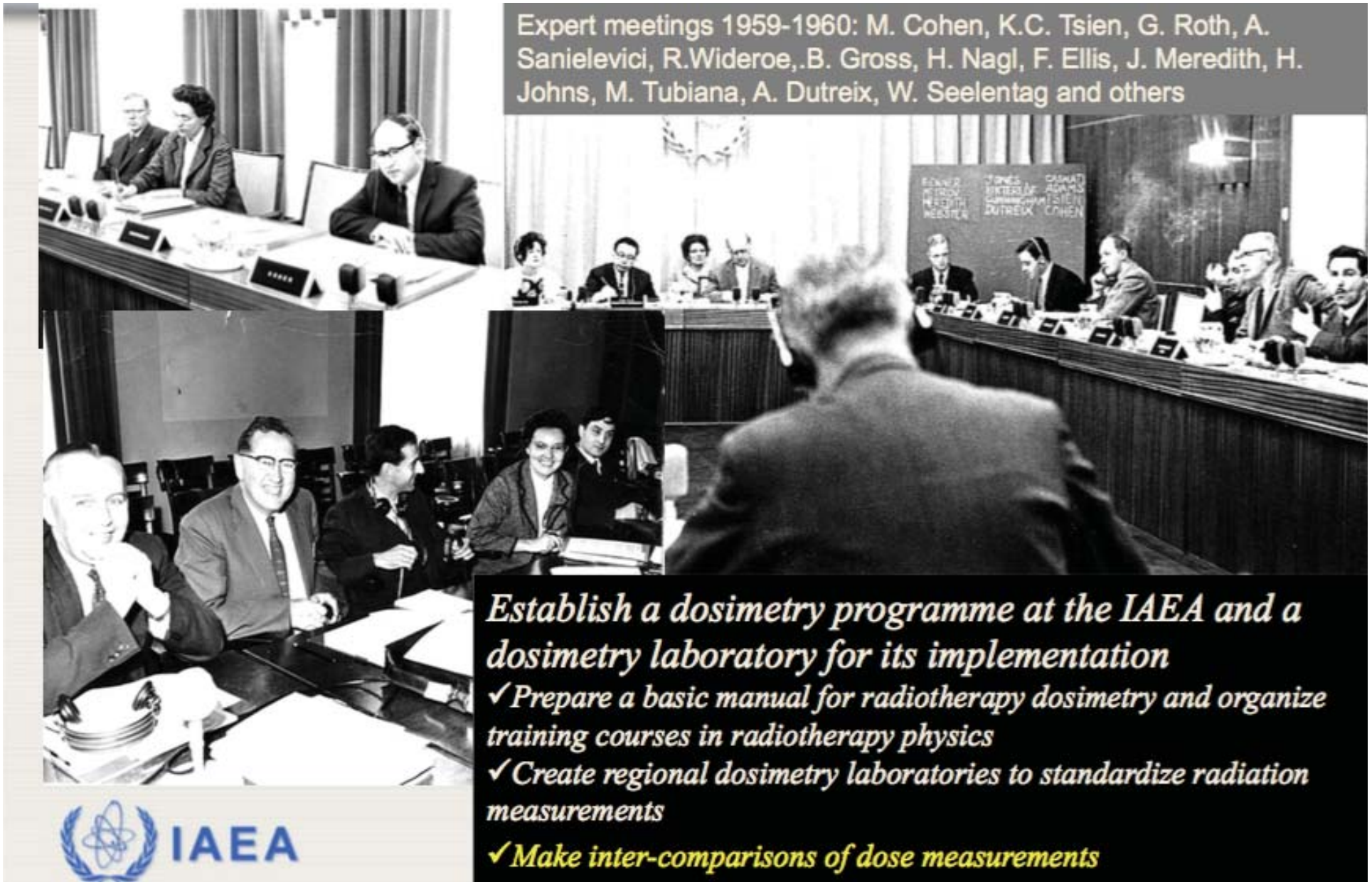
Collège des Médecins Radiothérapie- Oncologie

Process



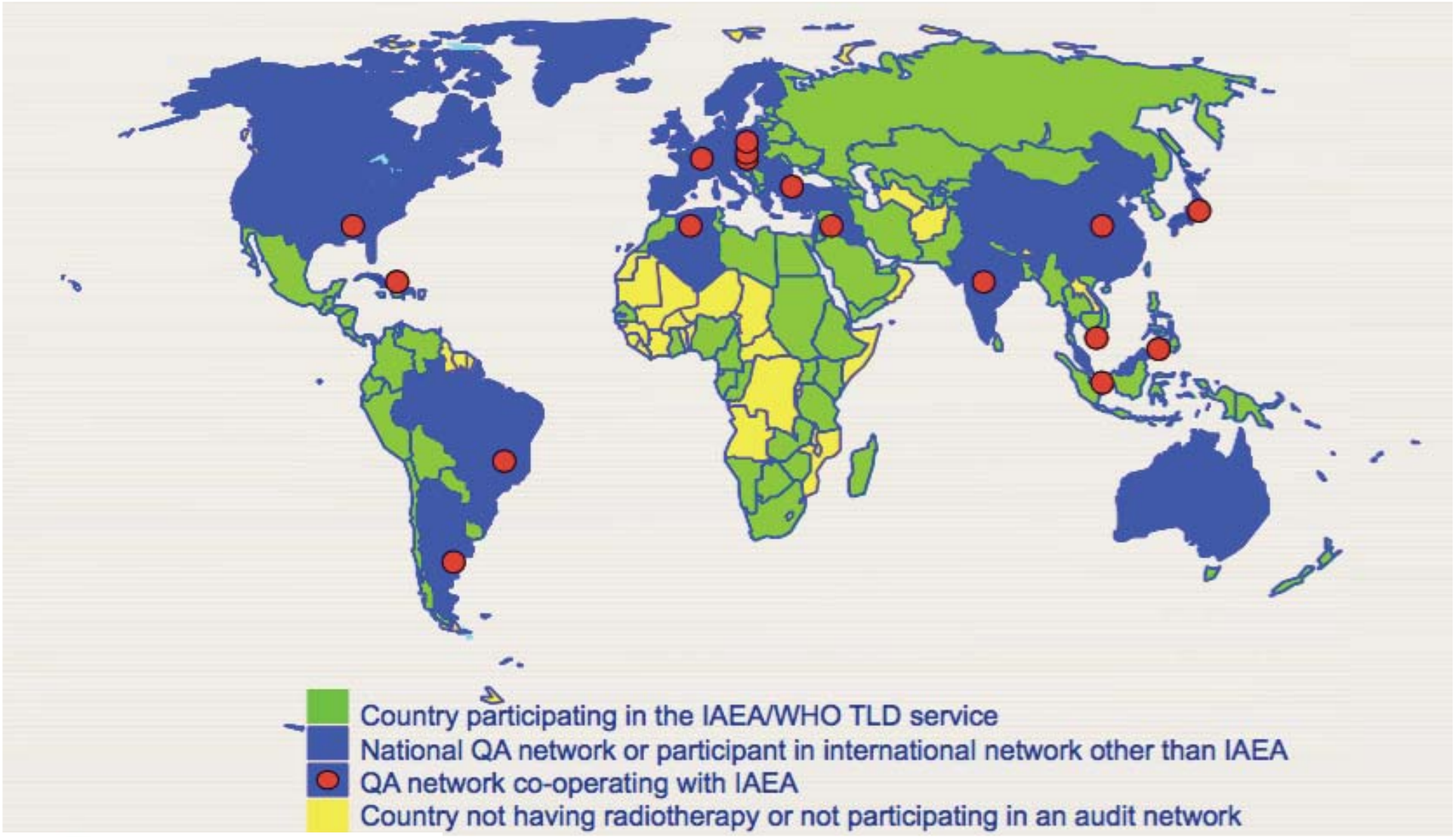
Outcome

local control
toxicity
survival
quality of life



Courtesy J. Izewska

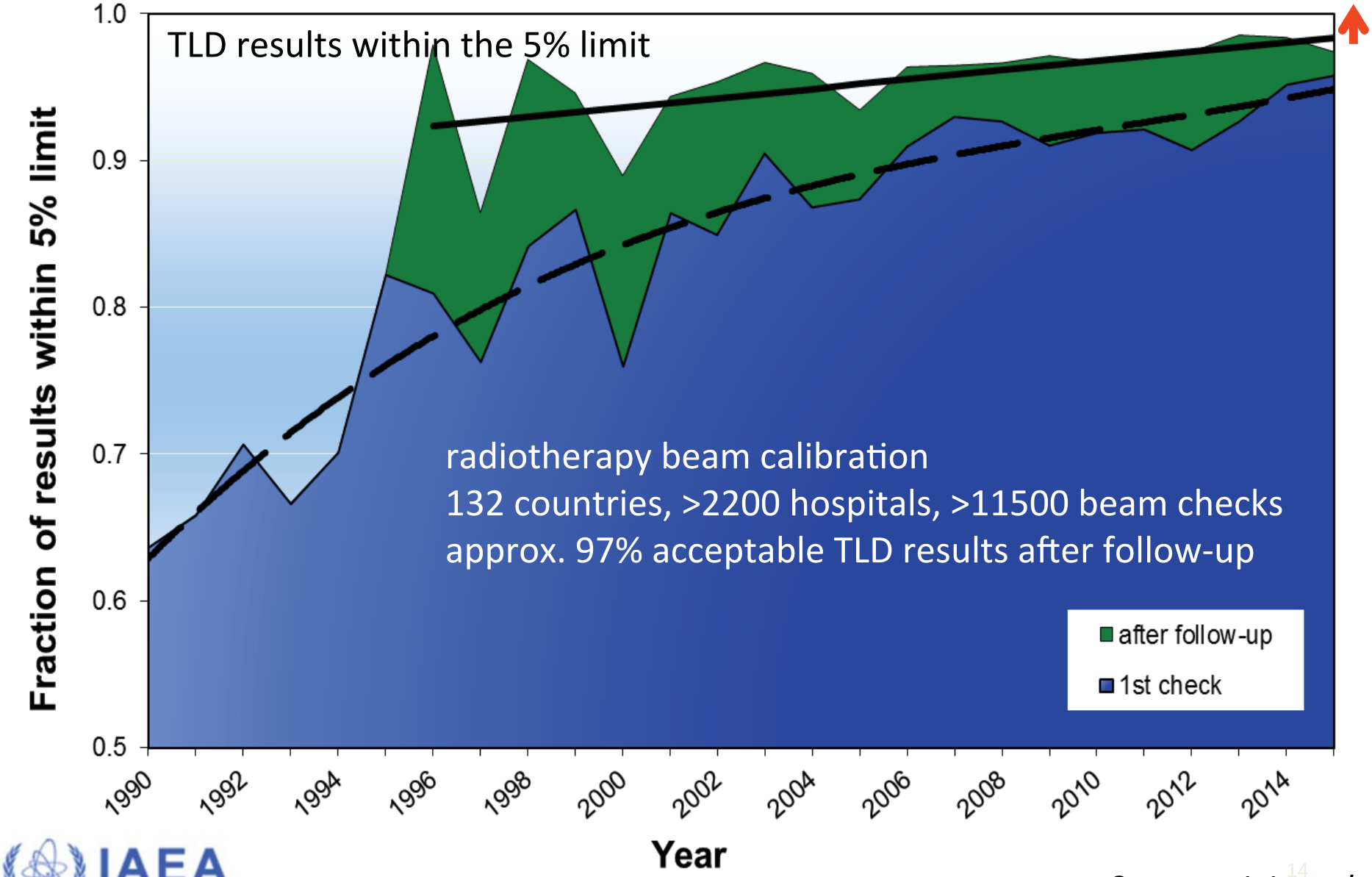
IAEA/WHO TLD postal dose audits



IAEA
International Atomic Energy Agency

Courtesy J. Izewska

IAEA/WHO TLD postal dose audits



IAEA International Atomic Energy Agency

Courtesy J. Izewska

BELdART – 1: beam output

Visit of all centres (+ satellites)

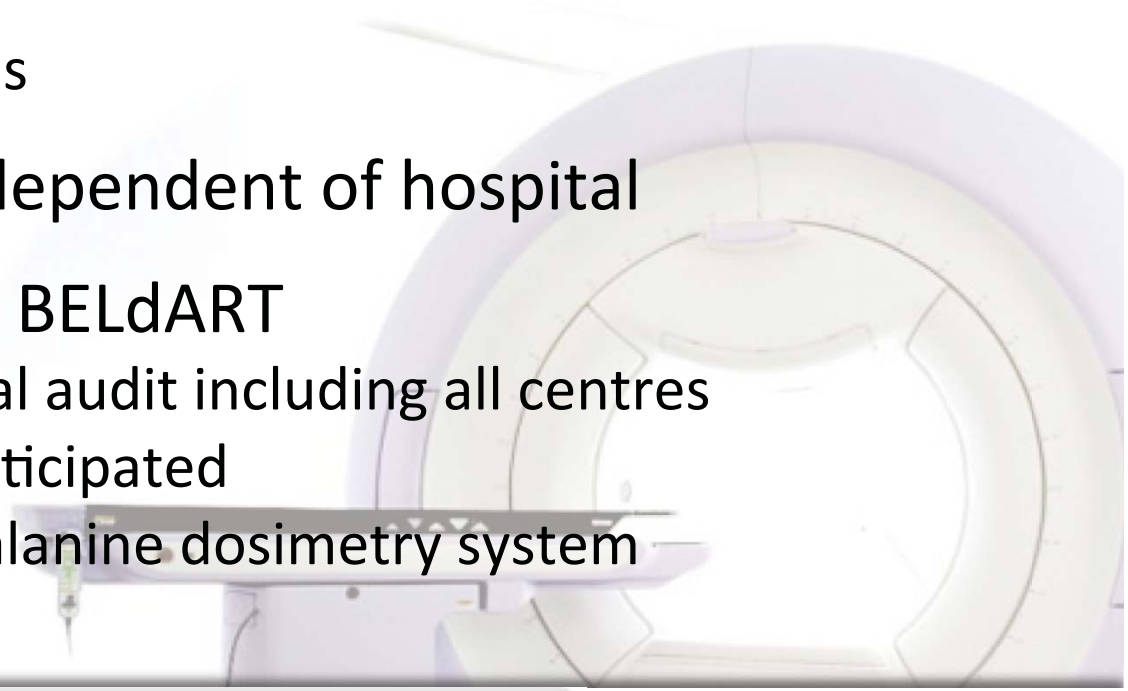
Auditing of

- Basic mechanical parameters
- Photon beams
- Electron beams

Equipment independent of hospital

Uniqueness of BELdART

- Visited national audit including all centres
- All centres participated
- Used the L-α-alanine dosimetry system



BELdART – 1: beam output

Mechanical parameters

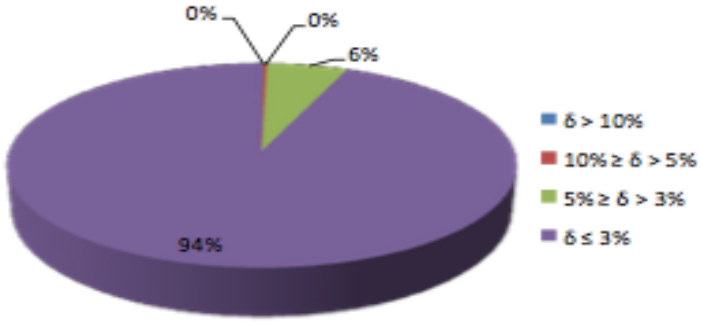
Test	Number Checked	Acceptable	Small Deviation	Large Deviation
Validation of the isocentre	61	60	1	0
Validation of the optical distance indicator	59*	59	0	0
Validation of the position of the laser lines	60**	60	0	0
Correspondence of light and irradiation field	61	60	0	1

(*) for 2 linacs it was not possible to perform a validation of the optical distance indicator because these specific linacs didn't had the classic telemeters available anymore

(**)for 1 linac it wasn't possible to validate the position of the laser lines because for this specific linac the position of the laser isocentrum is not equal to the position of the linacs isocentre

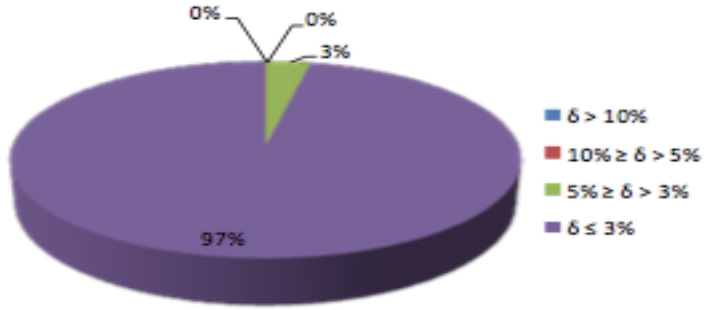
BELdART – 1: beam output

Dosimetric parameters



δ	#	%
δ > 10%	1	0,1
10% ≥ δ > 5%	4	0,3
5% ≥ δ > 3%	80	5,9
δ ≤ 3%	1270	93,7

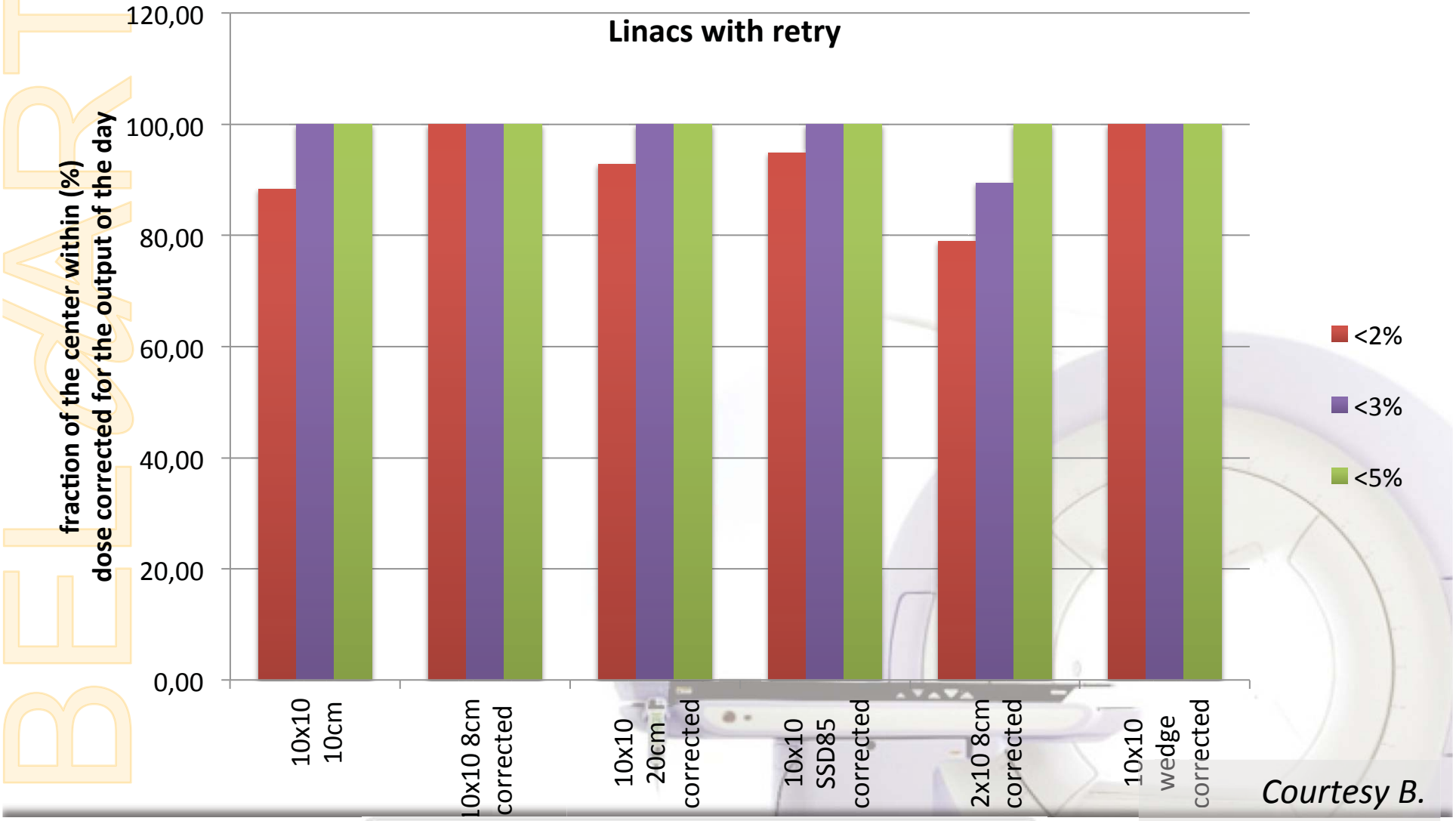
Fig. 3.6: *Relative and absolute frequencies for the four levels in deviation for the dosimetrical tests as a result of 1st run measurements in high-energy photon beams.*



δ	#	%
δ > 10%	0	0,0
10% ≥ δ > 5%	0	0,0
5% ≥ δ > 3%	44	3,3
δ ≤ 3%	1296	96,7

Fig. 3.7: *Relative and absolute frequencies for the four levels in deviation for the dosimetrical tests as a result of 2nd run measurements in high-energy photon beams.*

BELdART – 2: basic beam output



Courtesy B. Reniers

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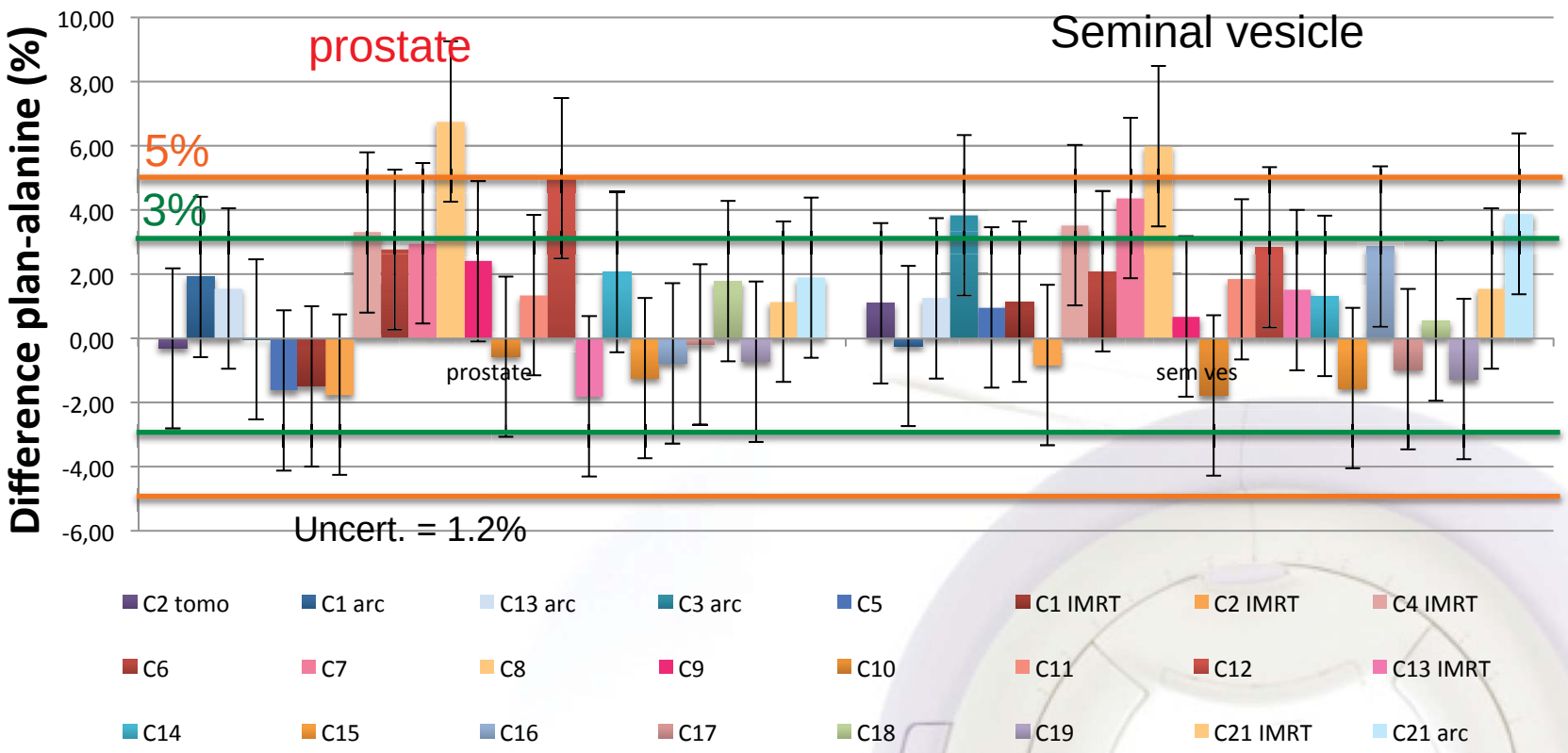
BELdART – 2: alanine high dose region



- Prostate: 87.9% within 3% (29 beams /33)
- Sem Ves: 78.8% within 3% (26 beams /33)

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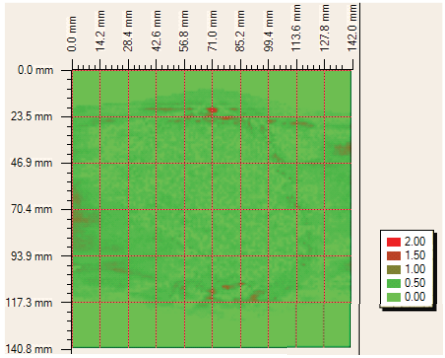
BELdART – 2: film results *(gamma 3%/3mm)*

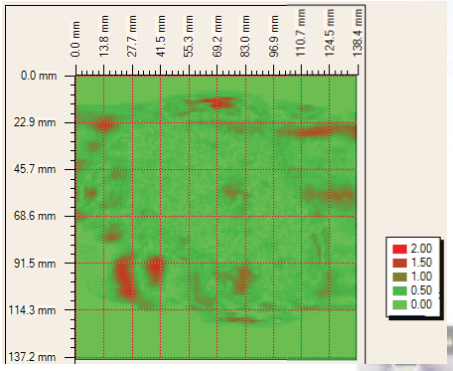
Gamma 3%/3mm

Center 1

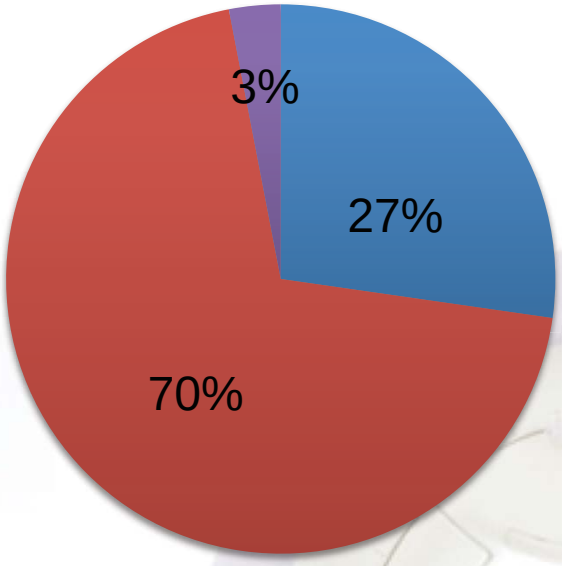


99.6%

Center 2



95.6%



Passing rates

98%>x>95%

>98%

95%>x>90%

<90%

Cutoff 10%

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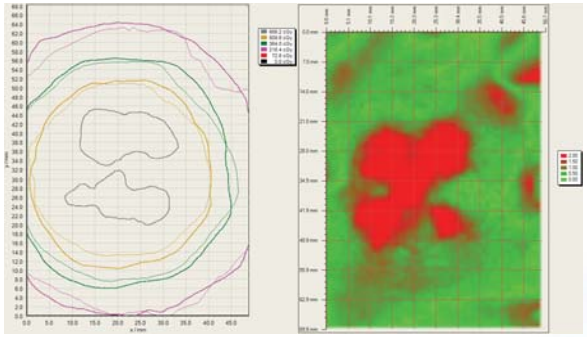
BELdART – 3: SRS and SBRT *(in preparation)*

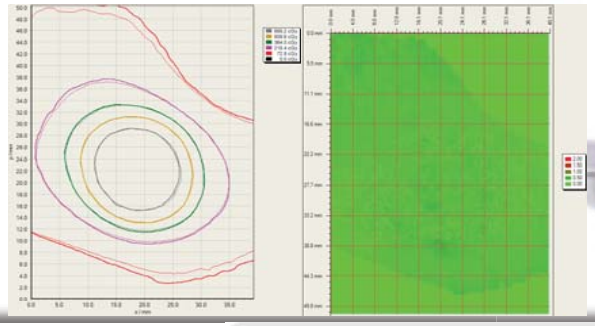
BELdART

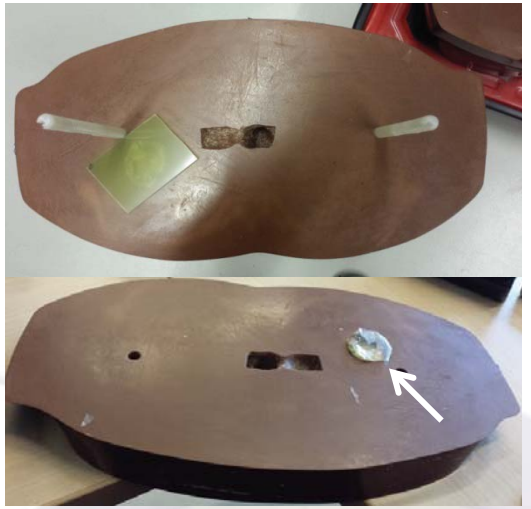
Development for SRS: Feasibility study

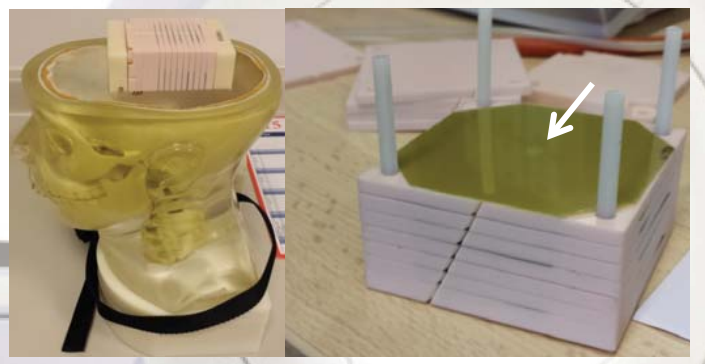
lung



head







Courtesy B. Reniers

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PROCARE
PROJECT ON CANCER OF THE RECTUM

PROCARE Radiotherapy

Guidelines based on local recurrences and patterns of lymph node spread

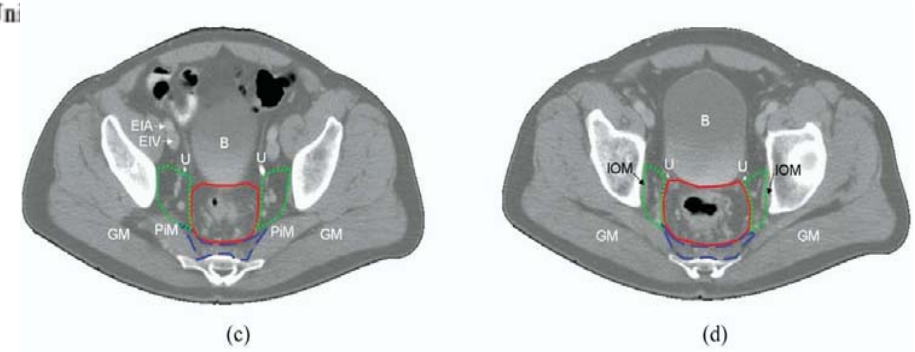
Central review to **homogenize the delineation** of Clinical Target Volume (CTV) and organs-at-risk delineation (OAR) of neoadjuvant rectal irradiation

CLINICAL INVESTIGATION **Rectum**

DEFINITION AND DELINEATION OF THE CLINICAL TARGET VOLUME FOR RECTAL CANCER

SARAH ROELS, M.D.,* WIM DUTHOY, M.D.,§ KARIN HAUSTERMANS, M.D., PH.D.,* FREDDY PENNINCKX, M.D., PH.D.,† VINCENT VANDECAVEYE, M.D.,‡ TOM BOTERBERG, M.D.,§ AND WILFRIED DE NEVE, M.D., PH.D.§

Departments of *Radiotherapy, †Surgery, and ‡Radiology, University Hospital Gasthuisberg, Leuven, Belgium; and §Department of Radiotherapy, Ghent Uni



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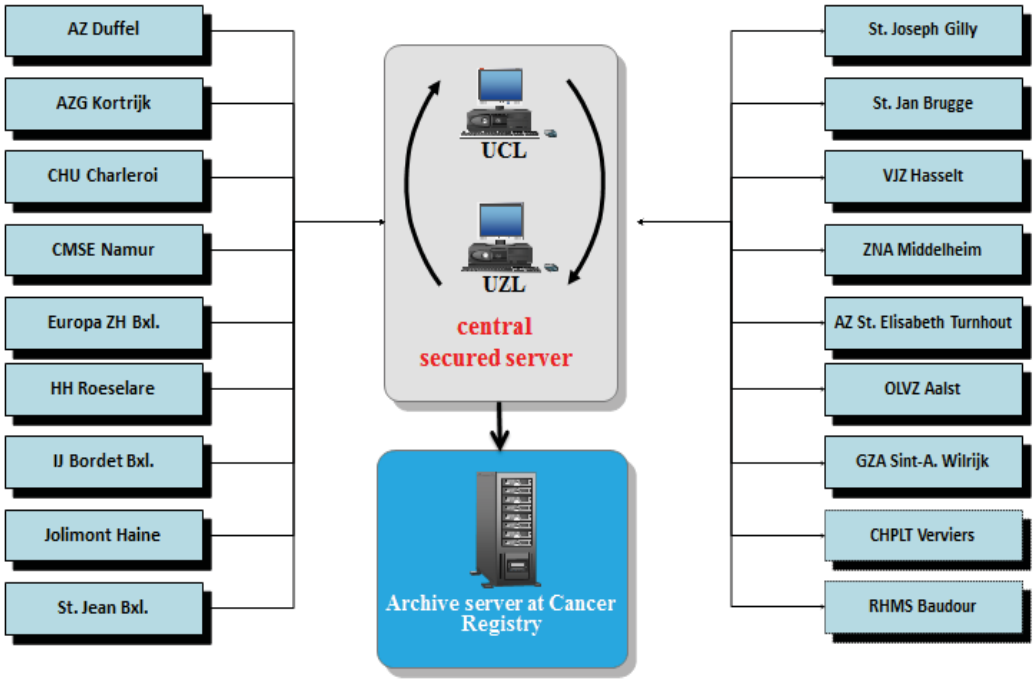
PROJECT ON CANCER OF THE RECTUM

PROCARE Radiotherapy

National CTV review project
3/2010-9/2012



- Profession-driven
- National
- Voluntary participation
- Multidisciplinary
- Anonymized registration (BCR)
- Feedback and benchmarking
- Governmental support

20/25 RT centres
1224 CTV cases

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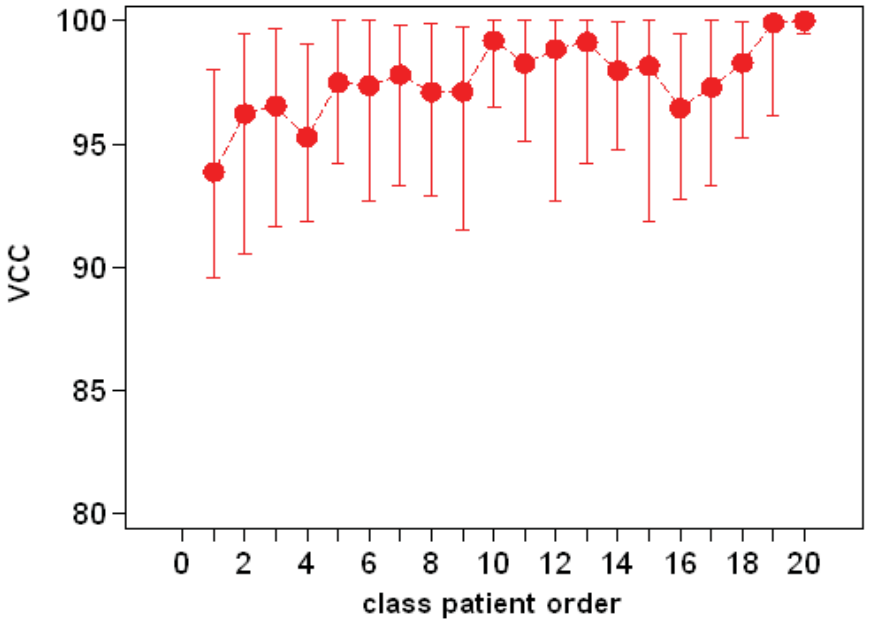
Joye I, et al. Radiother Oncol 2014

PROCARE
PROJECT ON CANCER OF THE RECTUM

PROCARE Radiotherapy



VCC = Commonly Contoured Volume
(CTVsub∩CTVmod)/CTVmod

- High level of agreement from the beginning of the project
- Modification suggested for 909/1224 cases 74%
- Steep increase in VCC for the first ten patients, stabilised thereafter
- Central review significantly improved the uniformity in CTV delineation

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Joye I, et al. Radiother Oncol 2014

Contents lists available at ScienceDirect

Radiotherapy and Oncology

journal homepage: www.thegreenjournal.com

Guidelines

Vessel based delineation guidelines for the elective lymph node regions in breast cancer radiation therapy – PROCAB guidelines

Karolien Verhoeven [a,*], Caroline Weltens [a], Vincent Remouchamps [b], Khalil Mahjoubi [b], Liv Veldeman [c], Benoit Lengele [d], Eszter Hortobagyi [a], Carine Kirkove [d]

[a] University Hospitals Leuven/KU Leuven; [b] Clinique Sainte Elisabeth (AMPR), Namur; [c] Ghent University Hospital; and [d] Catholic University of Louvain, Brussels, Belgium

Radiotherapy and Oncology 114 (2015) 3–10

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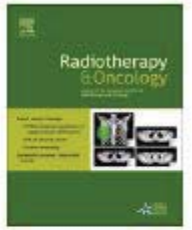

ESTRO consensus guidelines

ESTRO consensus guideline on target volume delineation for elective radiation therapy of early stage breast cancer

Birgitte V. Offersen [a,*], Liesbeth J. Boersma [b], Carine Kirkove [c], Sandra Hol [d], Marianne C. Aznar [e], Albert Biete Sola [f], Youlia M. Kirova [g], Jean-Philippe Pignol [h], Vincent Remouchamps [i], Karolien Verhoeven [j], Caroline Weltens [j], Meritxell Arenas [k], Dorota Gabrys [l], Neil Kopek [m], Mechthild Krause [n], Dan Lundstedt [o], Tanja Marinko [p], Angel Montero [q], John Yarnold [r], Philip Poortmans [s]

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PROCAB

federal public service

HEALTH, FOOD CHAIN SAFETY AND ENVIRONMENT

Belgian Cancer Plan – Action 16

10 March 2008

Quality Management Program for Radiotherapy
5 centres per year as of 2010

- develop a Quality Management System
- develop an Incident Reporting System (PRISMA-RT)
- implement systematic Clinical Audits

Euratom council directive 97/43)

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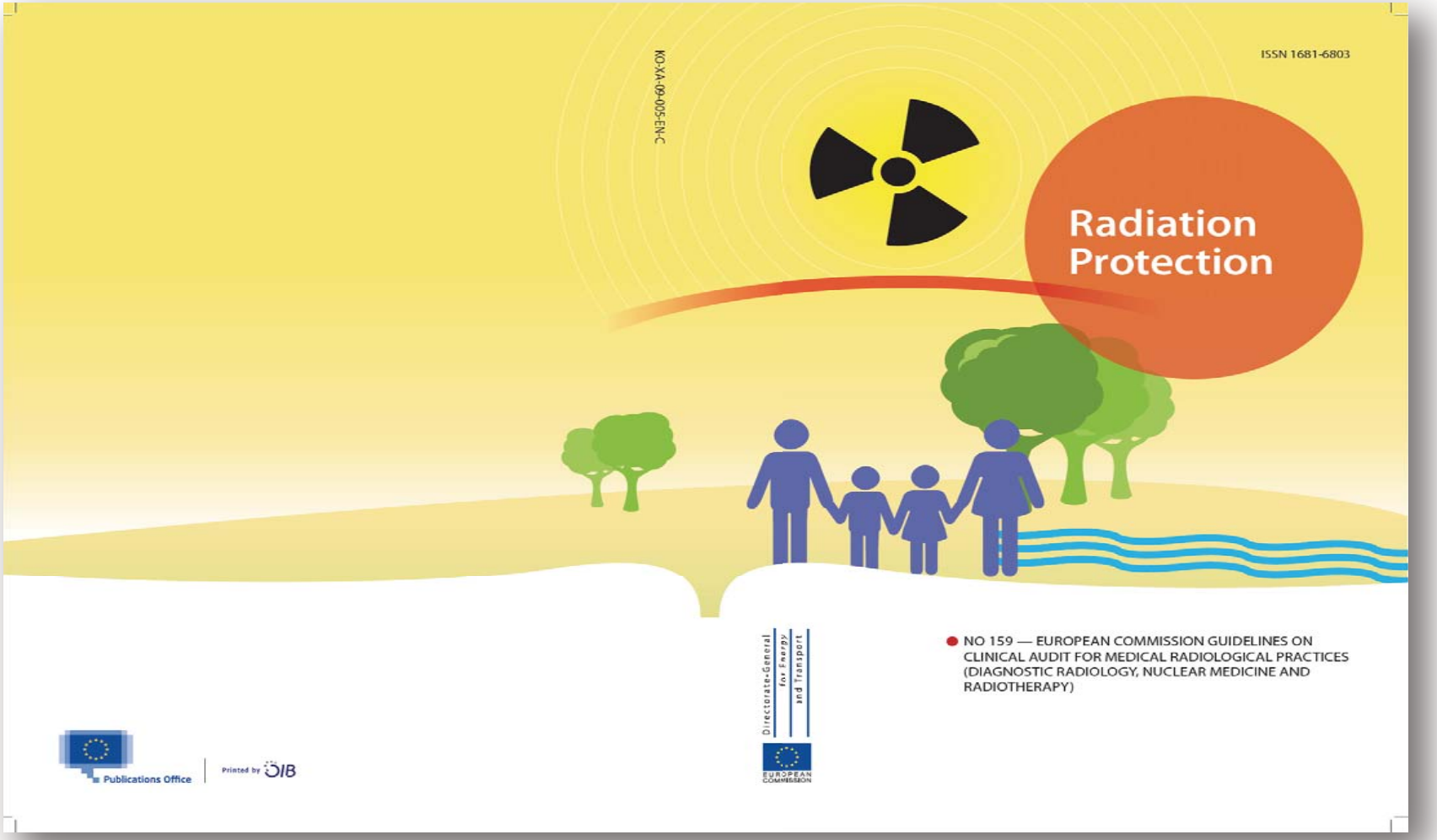
Selection of a methodology

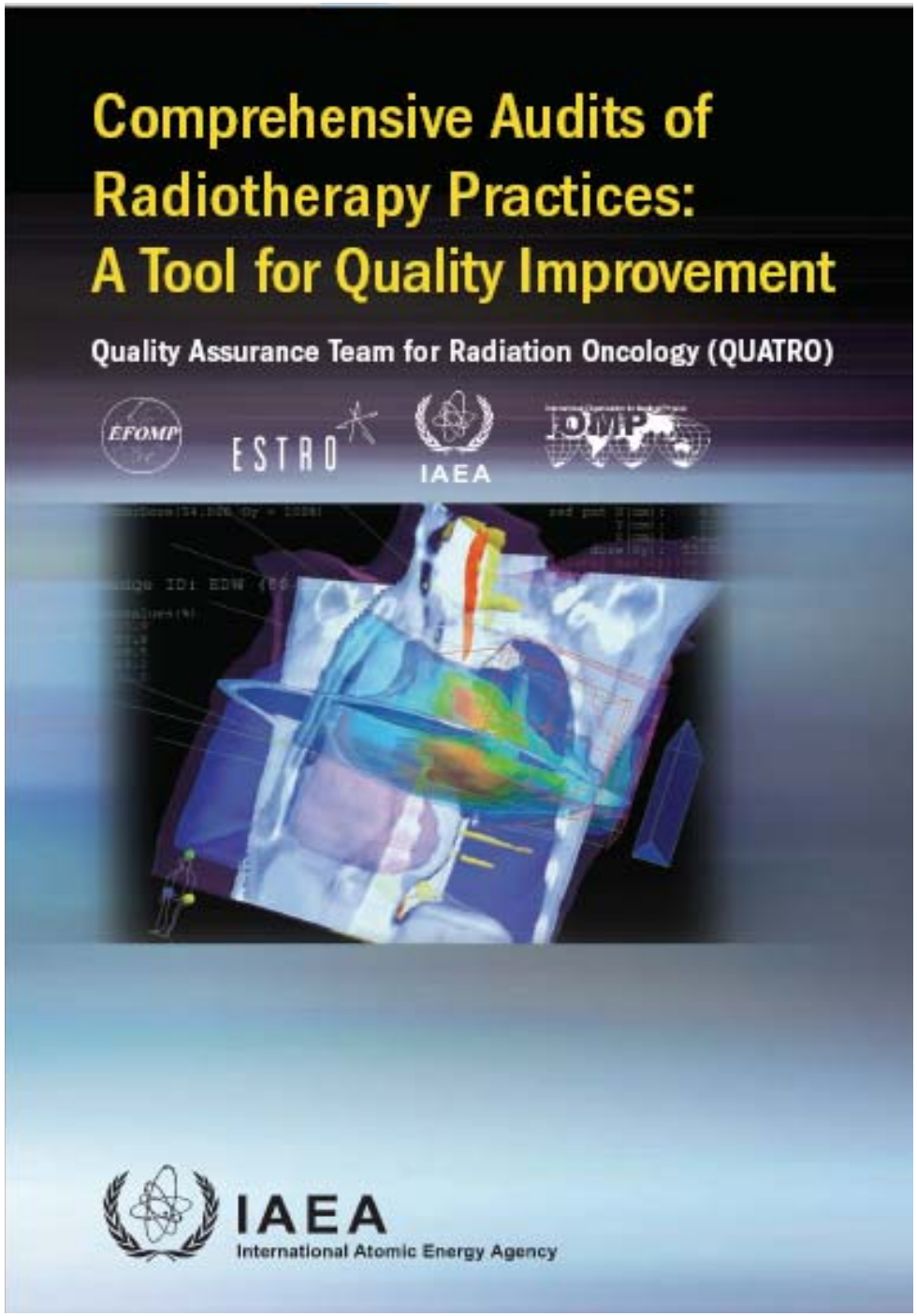
QUATRO



Radiation Protection Series n° 159

QUATRO

Quality Assurance Team for Radiation Oncology



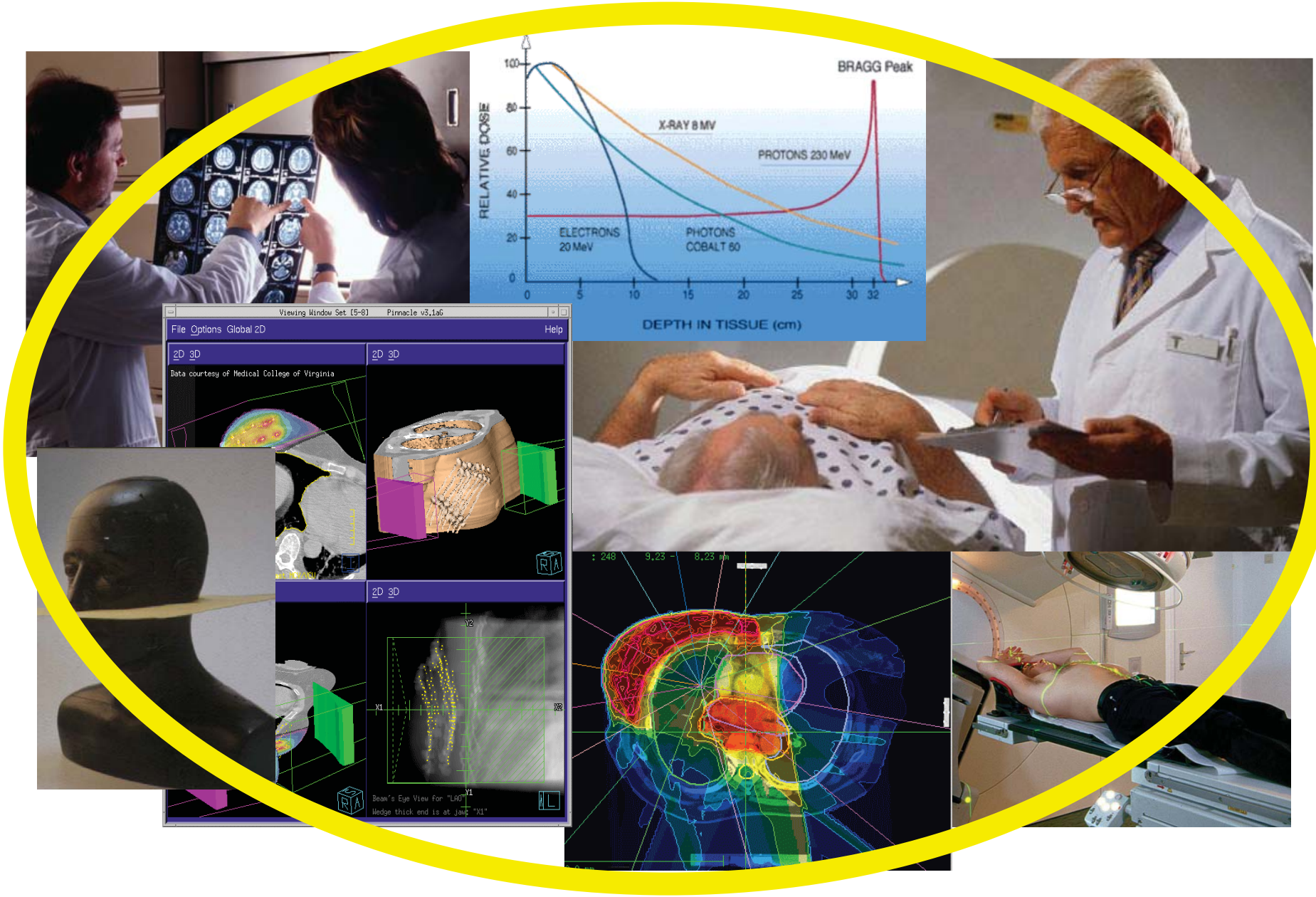
Comprehensive

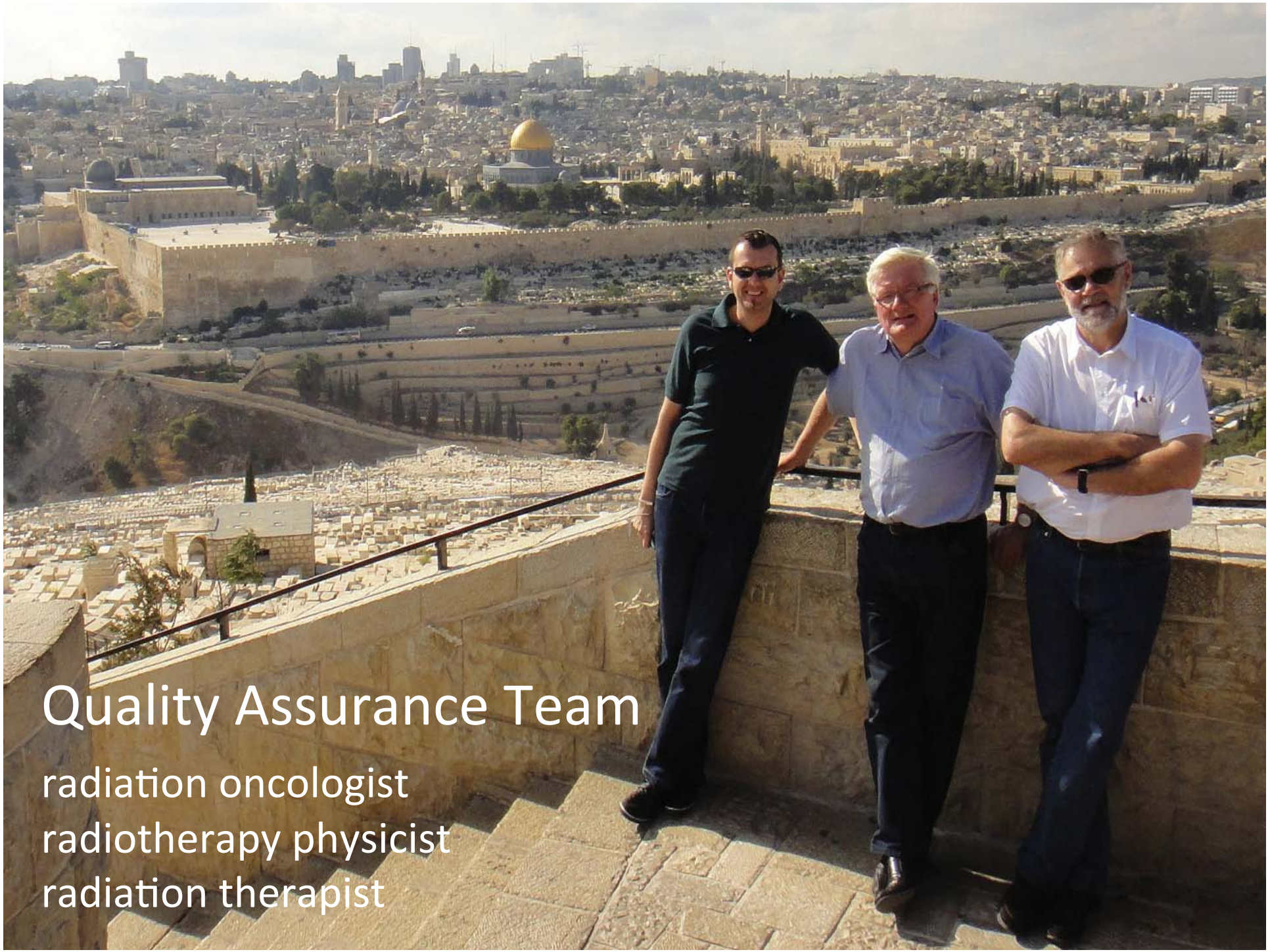
Multidisciplinary

Peer review

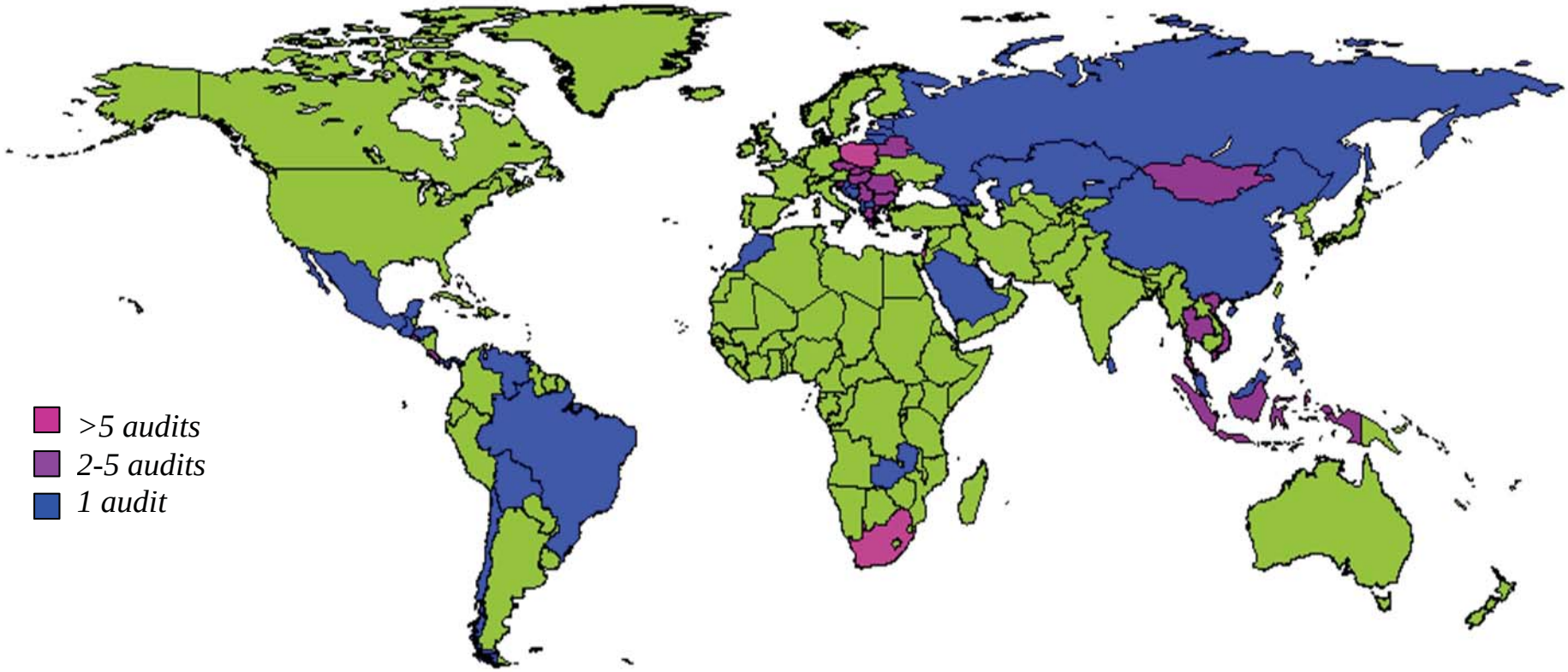
External and independent

Processes and


BRAGG Peak
X-RAY 8 MV
PROTONS 230 MeV
ELECTRONS 20 MeV
PHOTONS COBALT 60
RELATIVE DOSE
DEPTH IN TISSUE (cm)
Viewing Window Set [5-8] Pinnacle v3.1aG
File Options Global 2D Help
2D 3D
Data courtesy of Medical College of Virginia
Beam's Eye View for "LAO"
Wedge thick end is at jaw "X1"


Quality Assurance Team
radiation oncologist
radiotherapy physicist
radiation therapist

QUATRO activities by 2015

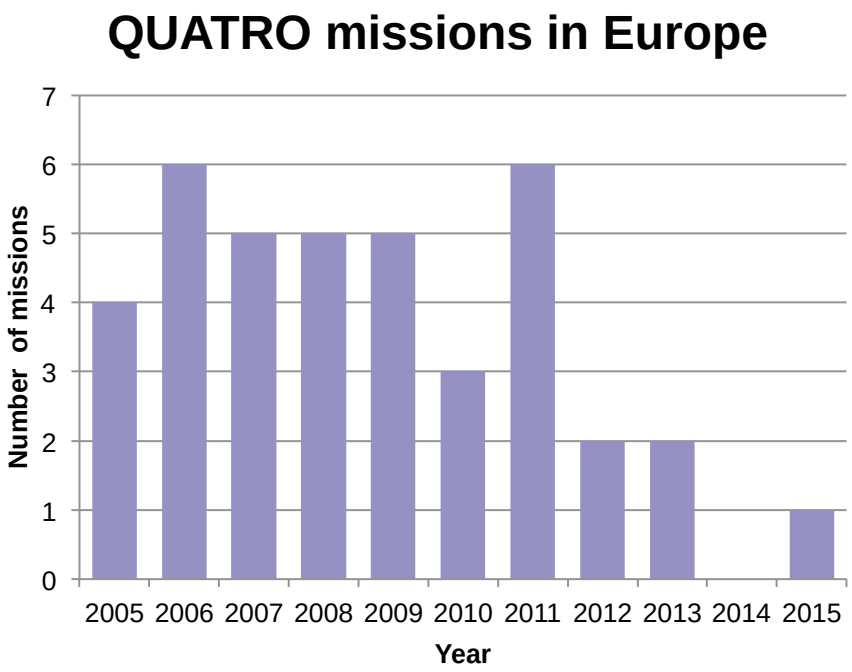


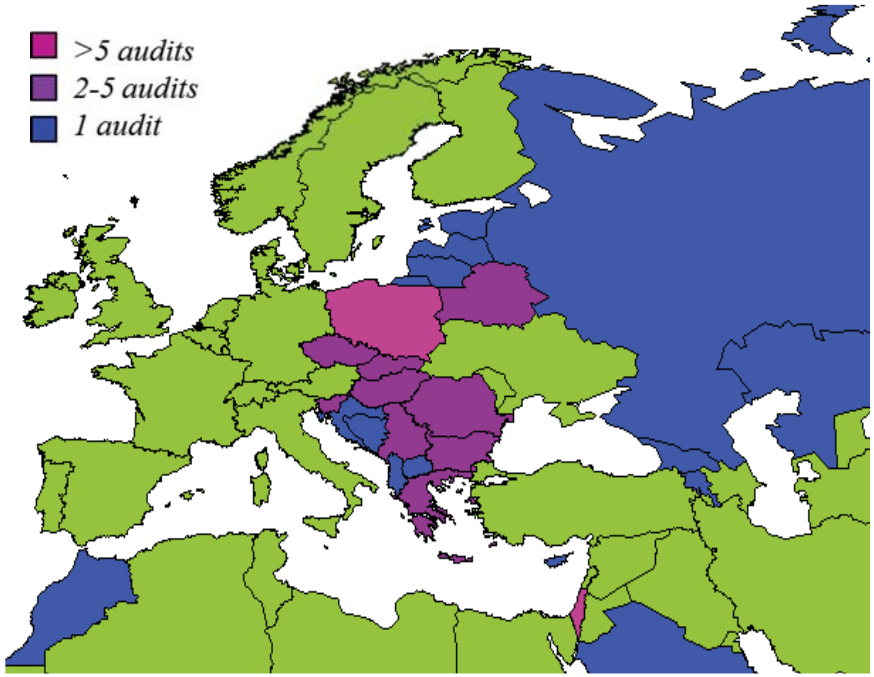
- Training of auditors and regional QUATRO workshops in all regions
- **87 QUATRO** missions:

Africa – 7; Asia – 21 + 10 re-audits; Europe – 32 + 4 re-audits + 1 QUATRO physics audit; Latin America – 12 + 1 re-audit

Courtesy J. Izewska

QUATRO audits in Europe





Missions were conducted under regional projects dedicated to QUATRO in 2005-2011; afterwards individual requests for QUATRO missions were organized under national projects. In total there were **32 comprehensive QUATRO audits**, 4 re-audits and 1 QUATRO physics audit.

Courtesy J. Izewska

QUATRO in Europe: findings & recommendations

Analysis of 31 QUATRO reports was performed:

- ✓ 11 audited centres were designated as 'centres of competence'
- ✓ 607 positive findings and 759 recommendations were analysed

Category	Positive findings	Recommendations
Staff	143	155
Infrastructure	**210**	124
Processes	159	**290**
General organizational items	95	**190**

Courtesy J. Izewska

Implementation of QUATRO in Belgium

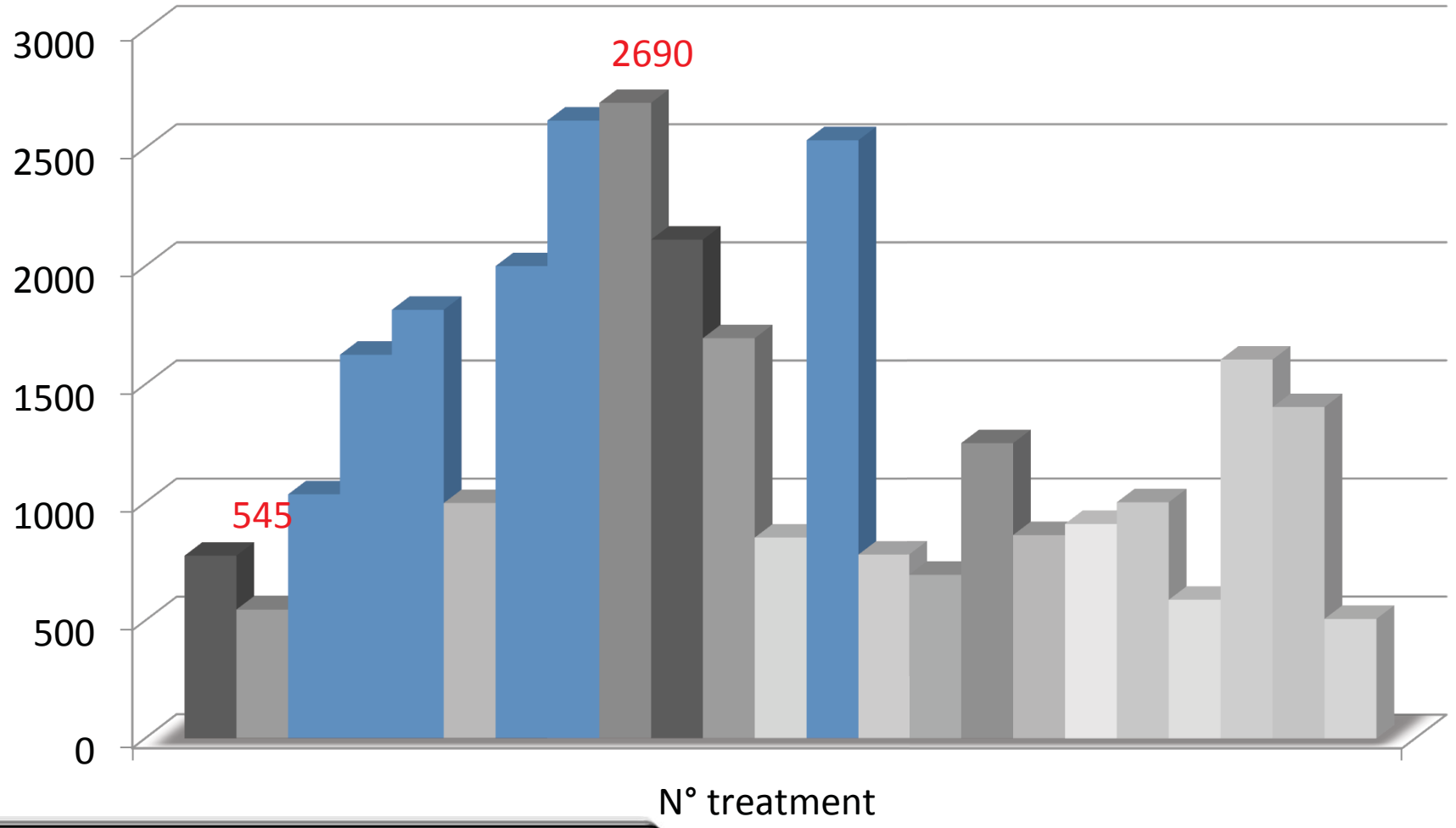
Use of IAEA program and checklists

Priority to external beam radiotherapy, no evaluation of satellites, no brachytherapy, no dosimetry checks

Training seminar on 11-12/3/2011, Durbuy
4 supervisors previously trained at IAEA and with a broad experience in auditing:

Pr. P. Scalliet (RO, UCL)
Pr. S. Vynckier (MP, UCL)
Mrs Mary Coffey (RTT, Trinity College, Dublin)
Mr G. Vandevelde (RTT, KULeuven)

QUATRO audits Belgium



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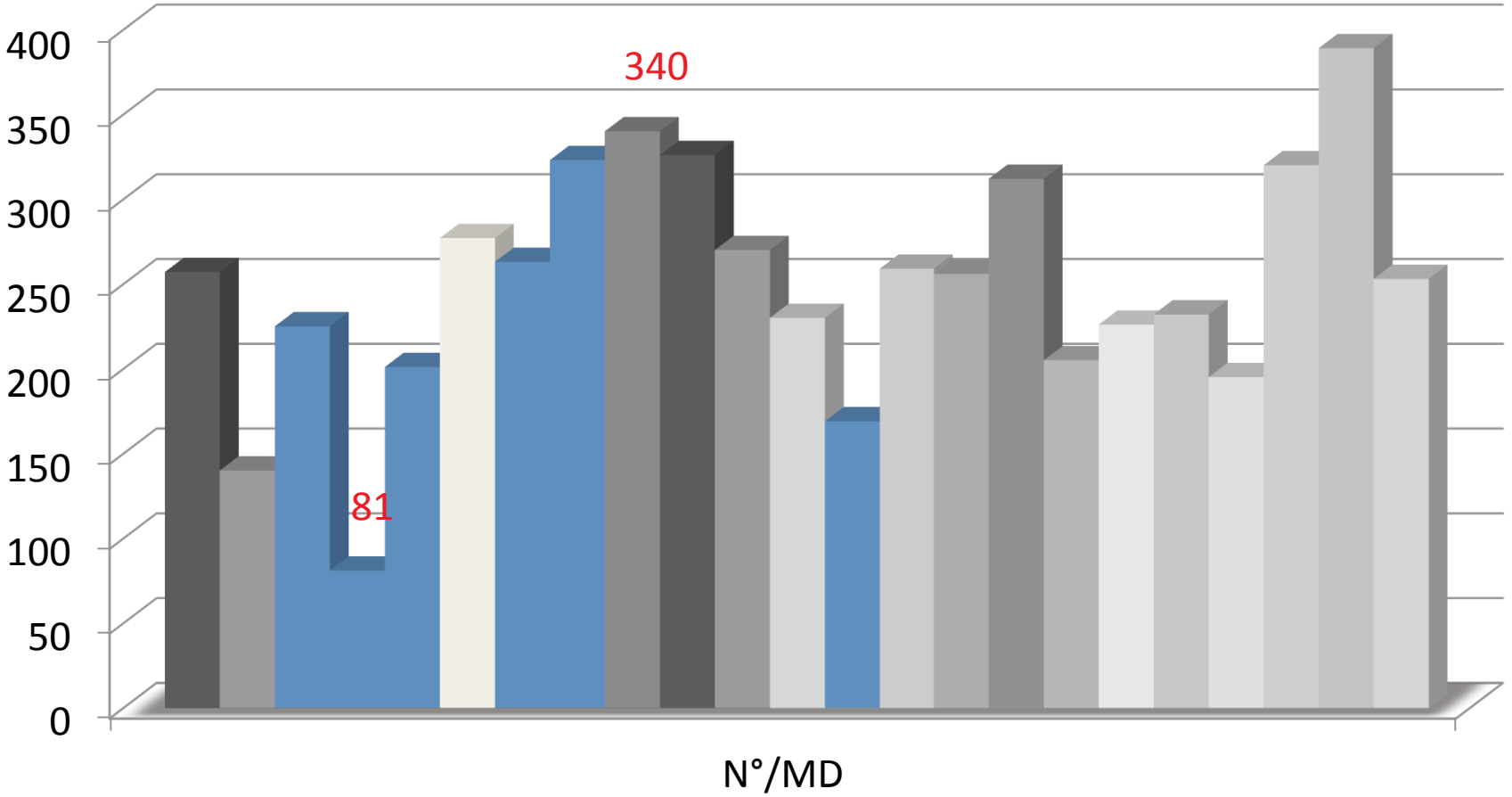

Mean 250, SD ± 69

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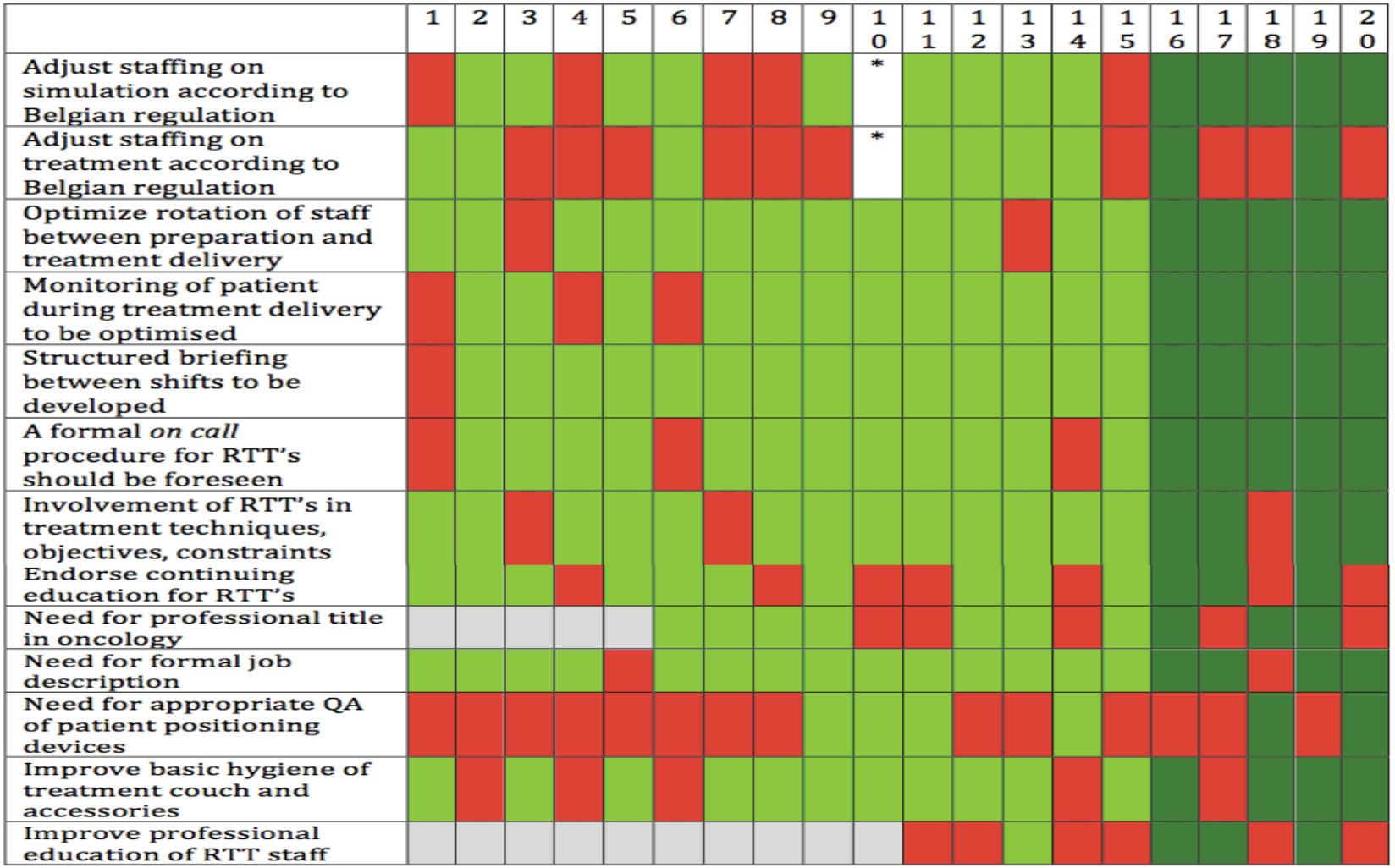
Table III: recommendations to nursing staff



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First 5-year cycle of audits is terminated

- there were *no significant deficiencies*
- there were only *minor issues* ("food for thought")
- there was a lot of *convergence* between the departments
- the quality and safety of patient treatments was ensured

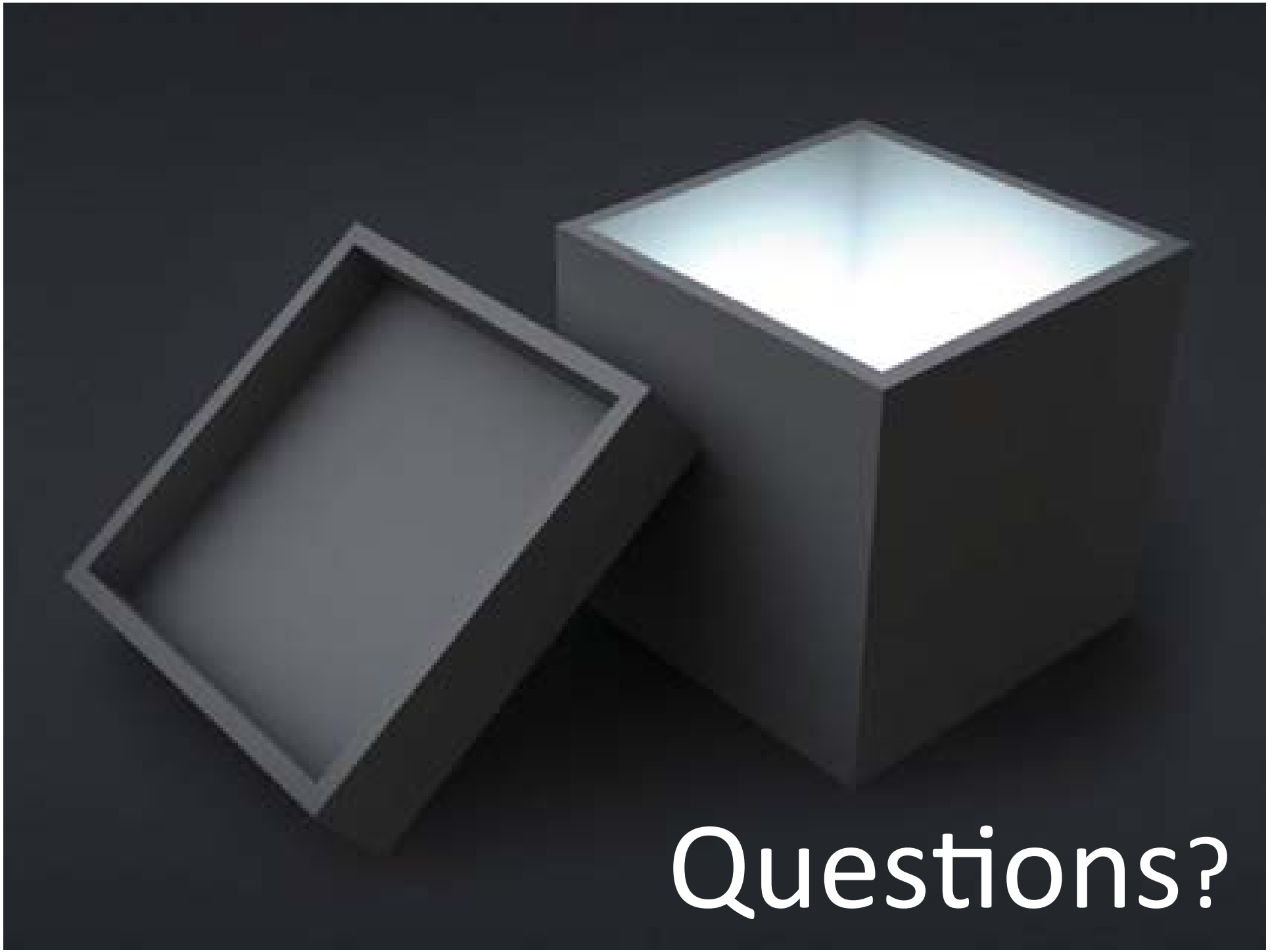
all centres were declared "center of competence"
"a Belgian approach to radiotherapy"

Further in-depth analysis (evolution over years, differences in complexity, reference to benchmarks and quality indicators)

Redesign audit for next round (Quality Managers, structure)

Conclusion

- Radiation Oncology is a continually evolving **complex** and highly **technical** treatment modality
- Delivered **doses** can be quantified precisely
- Errors can occur at every step of the **process chain**, calling for a comprehensive approach
- QUATRO audits provide such an approach, based on **multidisciplinary peer review**
- Quality audits have improved the delivery of radiotherapy treatments **worldwide**
- The international experience has been translated with succes to the **Belgian** context


Questions?