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# Estimating the Needs and Planning for Sustainable Training of Professional and Ancillary Personnel in Developing Countries.


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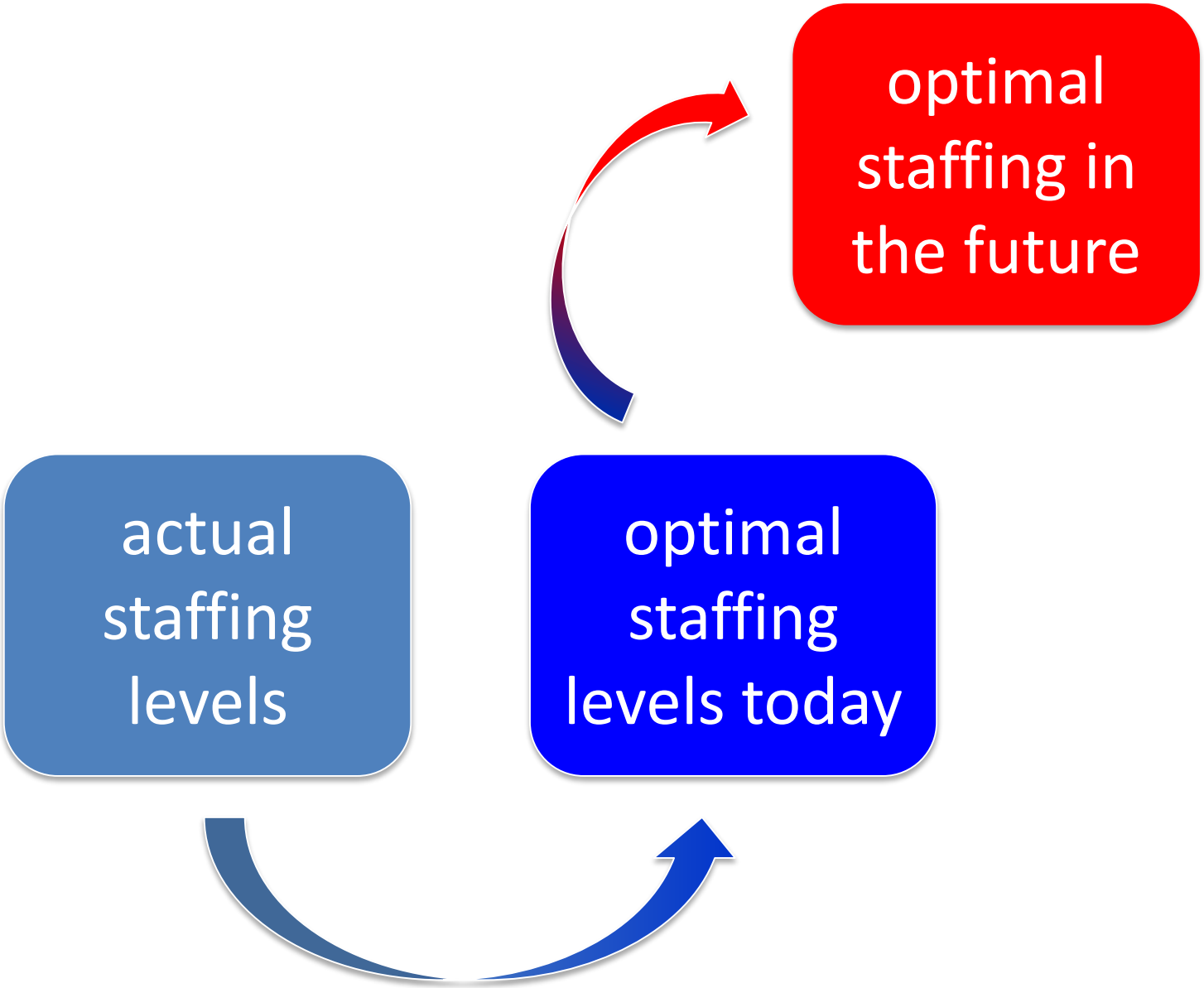
ESTRO president


ESTRO European Society for RADIOTHERAPY & ONCOLOGY

*“ The **shortfall** in radiotherapy*
*refers to the difference between*
*the **currently available** radiotherapy resources*
*and what would be **needed** worldwide*
*to **optimally** deliver*
*necessary radiotherapy services*
*to patients with cancer.”*

*Atun et al., Lancet Oncology 2015*


optimal staffing in the future
actual staffing levels
optimal staffing levels today

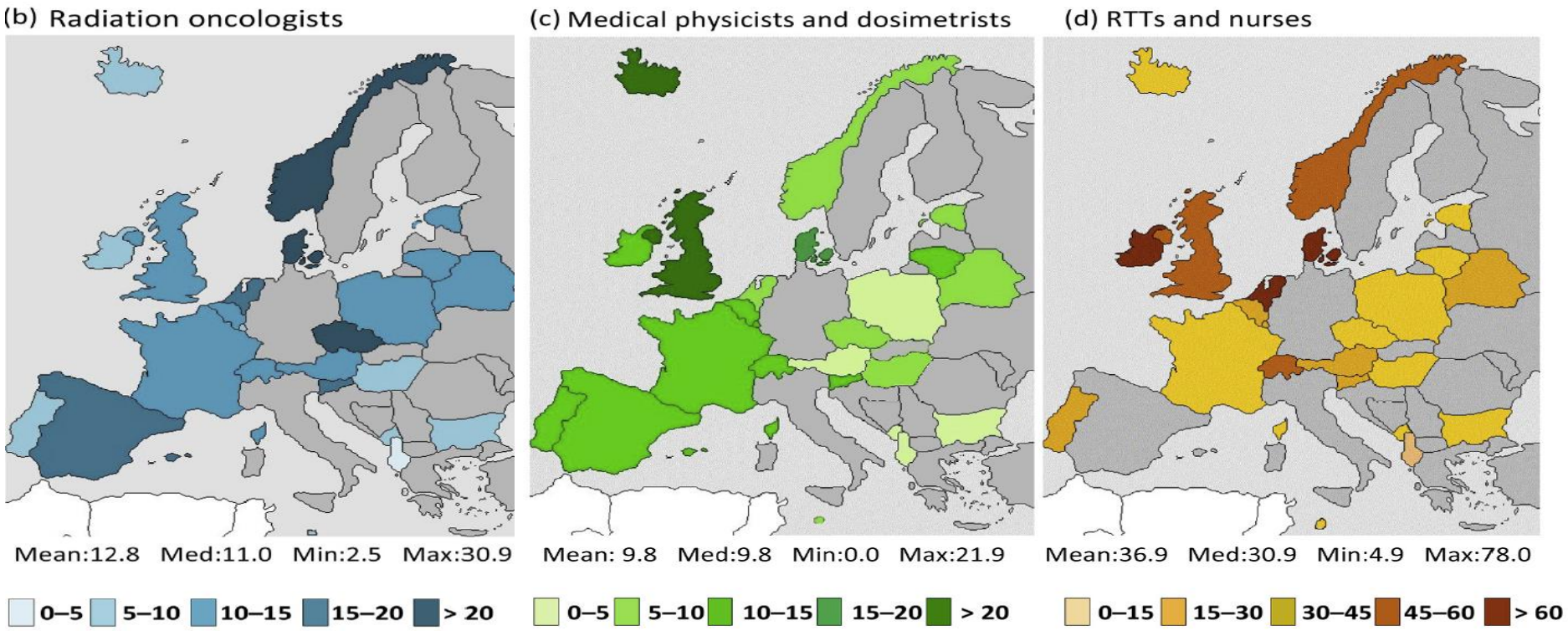
# currently available staff

| Countries | Population (2011) | GNI per capita (USD, 2011) | Ref. year courses | RT courses | Ref. year staffing | Radiation oncologists | | Medical physicists | | Dosimetrists | | Radiation technologists | | Radiotherapy nurses | | Radio-biologists | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | *N* | FTE | *N* | FTE | *N* | FTE | *N* | FTE | *N* | FTE | *N* | FTE |
| Albania | 2,829,337 | 4,050 | 2010 | 2,195 | 2010 | **7** | 7.0 | **6** | 6.0 | n.a. | n.a. | **13** | 13.0 | **1** | 1.0 | **n.a.** | n.a. |
| Austria | 8,406,187 | 48,170 | 2010 | 21,481 | 2010 2013 | **n.r.** | 95.0 | **n.r.** | 40.0 | n.a. | n.a. | **301** | 280.0 | **n.a.** | n.a. | **n.r.** | 8.0 |
| Belarus | 9,473,000 | 6,270 | 2009 | n.r. | 2009 | **117** | n.r. | **60** | n.r. | 20 | n.r. | **140** | n.r. | **150** | n.r. | **n.a.** | n.a. |
| Belgium | 11,047,744 | 45,840 | 2012 | 34,672 | 2013 | **154** | 138.5 | **113** | 107.9 | 52 | 45.3 | **21** | 20.6 | **471** | 403.1 | **4** | 4.0 |
| Bulgaria | 7,348,328 | 6,640 | 2012 | 13,794 | 2012 | **n.r.** | 49.0 | **n.r.** | 23.0 | n.a. | n.a. | **n.r.** | 113.0 | **n.r.** | 98.0 | **n.a.** | n.a. |
| Czech Republic | 10,496,088 | 18,720 | 2009 | 32,630 | 2009 | **254** | n.r. | **56** | n.r. | n.a. | n.a. | **251** | n.r. | **n.r.** | n.r. | **20** | n.r. |
| Denmark | 5,570,572 | 60,160 | 2010 | 17,680 | 2010 | **n.r.** | 172.0 | **n.r.** | 89.0 | n.r. | 15.0 | **n.r.** | 55.0 | **n.r.** | 340.0 | **n.r.** | 1.0 |
| Estonia | 1,327,439 | 15,260 | 2008 | 2,122 | 2012 | **14** | 14.0 | **10** | 10.0 | 1 | 1.0 | **16** | 16.0 | **6** | 6.0 | **n.r.** | n.r. |
| France | 65,343,588 | 42,690 | 2012 | 187,172 | 2012 | **670** | 510.0 | **n.r.** | 528.0 | n.r. | 342.0 | **n.r.** | 1,950.0 | **n.r.** | n.r. | **25** | n.r. |
| Hungary | 9,971,727 | 12,840 | 2011 | 19,951 | 2011 | **90** | n.r. | **60** | n.r. | 8 | n.r. | **207** | n.r. | **n.r.** | n.r. | **3** | n.r. |
| Iceland | 319,014 | 35,260 | 2010 | 595 | 2010 | **3** | 2.6 | **3** | 2.2 | 4 | 3.0 | **1** | 0.8 | **10** | 7.0 | **n.r.** | n.r. |
| Ireland | 4,576,794 | 38,960 | 2009 | 8,373 | 2009 | **30** | 30.0 | **54** | 54.0 | 12 | 12.0 | **291** | 249.0 | **35** | 35.0 | **n.a.** | n.a. |
| Lithuania | 3,028,115 | 13,000 | 2011 | 6,268 | 2011 | **37** | 35.5 | **31** | 27.0 | 5 | 5.0 | **70** | 67.0 | **10** | 10.0 | **1** | 0.5 |
| Luxembourg | 518,347 | 77,380 | 2010 | 1,180 | 2011 | **5** | 4.9 | **4** | 4.0 | 3 | 2.5 | **14** | 13.5 | **2** | 2.0 | **n.a.** | n.a. |
| Malta | 416,268 | 19,780 | 2012 | 1,395 | 2012 | **4** | 4.0 | **3** | 3.0 | 0[a] | 0.0[a] | **8** | 8.0 | **2** | 2.0 | **n.a.** | n.a. |
| Montenegro | 620,644 | 6,810 | 2011 | 1,500 | 2011 | **6** | 5.0 | **0**[a] | 0.0[a] | n.a. | n.a. | **4** | 4.0 | **11** | 11.0 | **n.a.** | n.a. |
| The Netherlands | 16,693,074 | 49,660 | 2011 | 55,683 | 2011 | **256** | 231.0 | **119** | 115.0 | n.a. | n.a. | **1,302** | 1,079.0 | **n.a** | n.a | **n.r.** | n.r. |
| Norway | 4,953,088 | 88,500 | 2010 | 13,483 | 2011 | **n.r.** | 135.0 | **n.r.** | 46.0 | n.a. | n.a. | **n.r.** | 267.0 | **n.a** | n.a | **n.r.** | n.r. |
| Poland | 38,534,157 | 12,340 | 2010 | 73,500 | 2012 | **471** | 471.0 | **97** | 97.0 | n.a. | n.a. | **900** | 900.0 | **19** | 19.0 | **n.r.** | n.r. |
| Portugal | 10,557,560 | 21,420 | 2012 | 19,858 | 2013 | **90** | n.r. | **65** | n.r. | 53 | n.r. | **239** | n.r. | **108** | n.r. | **2** | n.r. |
| Slovenia | 2,052,843 | 23,940 | 2012 | 6,023 | 2013 | **31** | 27.0 | **11** | 11.0 | 10 | 10.0 | **81** | 78.5 | **n.a.** | n.a. | **n.a.** | n.a. |
| Spain | 46,742,697 | 30,930 | 2011 | 98,525 | 2013 | **702** | 579.0 | **282** | n.r. | 249 | n.r. | **n.r.** | n.r. | **n.r.** | n.r. | **n.r.** | n.r. |
| Switzerland | 7,912,398 | 76,350 | 2009 | 19,000 | 2009 | **110** | 98.3 | **83** | 75.3 | 7 | 6.0 | **312** | 274.0 | **110** | 72.3 | **3** | 3.0 |
| United Kingdom | 63,258,918 | 37,840 | 2010 2011 | n.r. | 2010 2011 | **683** | 580.3 | **1,246** | 1,264.6 | 43 | 41.7 | **2,763** | 2,957.2 | **403** | 440.0 | **22** | 2.0 |
| England | 52,234,045 | n.a. | 2010 | 121,289 | 2010 | **561** | 482.0 | **1,206** | 1,096.7 | n.a. | n.a. | **2,222** | 2,468.0 | **388** | 437.0 | **20** | n.r. |
| Scotland | 5,254,800 | n.a. | 2011 | n.r. | 2011 | **61** | 58.75 | **143** | 133.0 | n.a. | n.a. | **267** | 243.6 | **12** | n.r. | **n.a.** | n.a. |
| Wales | 3,060,000 | n.a. | 2011 | 6,445 | 2011 | **42** | 39.5 | **27** | 24.9 | 27 | 25.7 | **187** | 163.2 | **3** | 3.0 | **n.a.** | n.a. |
| Northern Ireland | 1,800,000 | n.a. | 2010 | 4,180 | 2011 | **19** | n.r. | **13** | 10.0 | 16 | 16.0 | **87** | 82.4 | **n.r.** | n.r. | **2** | 2.0 |
| No. entries | 24 | 24 | 24 | 22 | 24 | **20** | 20 | **19** | 19 | 22 | 20 | **19** | 19 | **18** | 18 | **16** | 14 |
| Total | 331,997,927 | | | 635,179 | | **3,734** | 3,189.1 | **2,303** | 2,503.0 | 467 | 483.5 | **6,934** | 8,345.6 | **1,338** | 1,446.4 | **80** | 18.5 |
| Average | 13,833,247 | 33,034 | 2010 | 28,872 | 2011 | **187** | 159.5 | **121** | 131.7 | 33 | 40.3 | **365** | 439.2 | **96** | 103.3 | **10** | 3.1 |
| Median | 7,630,363 | 27,435 | 2010 | 15,737 | 2011 | **90** | 72.0 | **56** | 40.0 | 9 | 8.0 | **140** | 78.5 | **15** | 15.0 | **3** | 2.5 |
| Min | 319,014 | 4,050 | 2008 | 595 | 2009 | **3** | 2.6 | **0** | 0.0 | 0 | 0.0 | **1** | 0.8 | **1** | 1.0 | **1** | 0.5 |
| Max | 65,343,588 | 88,500 | 2012 | 187,172 | 2013 | **702** | 580.3 | **1,246** | 1,264.6 | 249 | 342.0 | **2,763** | 2,957.2 | **471** | 440.0 | **25** | 8.0 |

data for Europe, no reliable data available for the world

*Lievens et al, R&O 2014*

# European map of staff availability




different professional roles and responsibilities

*Lievens et al. Clin Oncol 2015*

how many professionals do we need?
optimal staff, now and in the future?

cancer incidence

radiotherapy utilisation: 62,5%

*(50% new patients – 12,5% retreatment)*

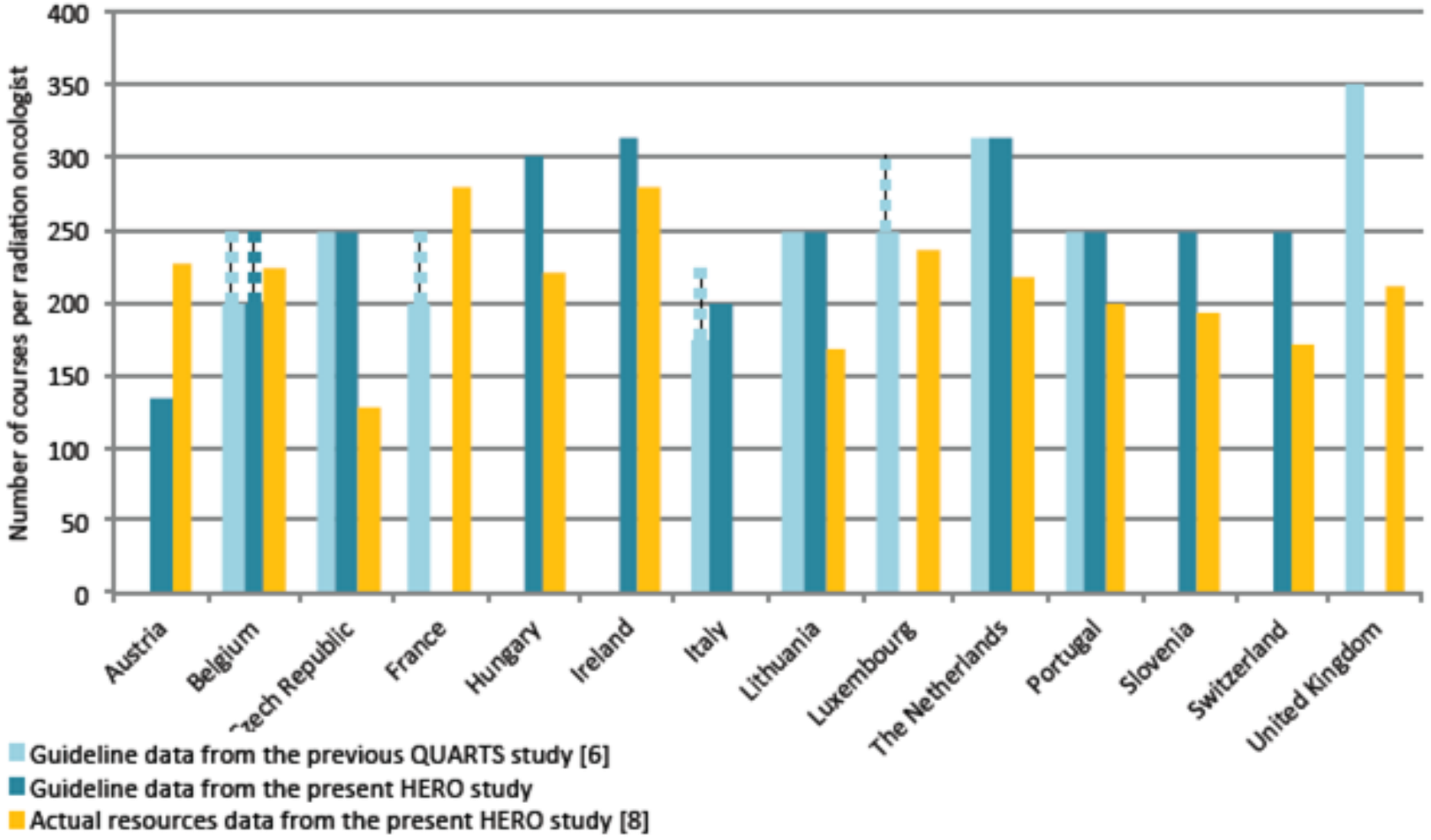
resource use recommendations

| Country | Cancer plans for RT needs | Guideline for personnel | Are working hrs for RT personnel limited by radiation protection regulations | Radiation Oncologists | Medical Phycisists | Dosimetrists | RTT |
|---|---|---|---|---|---|---|---|
| | | | | Criterion | Criterion | Criterion | Criterion |
| **European and International guidelines** | | | | | | | |
| **QUARTS [6]** | No | No | No | 250 patients / yr , Increasing complexity: 1 / 200 - 250 patients / yr | 450 - 500 patients / yr | No | Great diversity makes comparison between countries impossible |
| **IAEA [11]** | No | No | No | 250 - 300 patients / yr / RO | 300 - 400 patients / yr / MP | No | 100 - 150 patients / yr RTTs |
| **EORTC [13]** | No | No | No | ≤ 300 patients / FTE | ≤ 500 patients / FTE | No | ≥ 2 / treatment unit |
| **IPEM [14]** | No | No | No | No | Complex algorithm | No | No |
| **EFOMP [12]** | No | No | No | No | 0.37 WTE / L + 0.11 WTE / 100 patients / yr | No | No |

no account for treatments / patient
no account for complexity of the treatments
no account for evolution of fractionation schedules

*Dunscombe et al, R&O 2014*

# (no) evolution of the recommendations

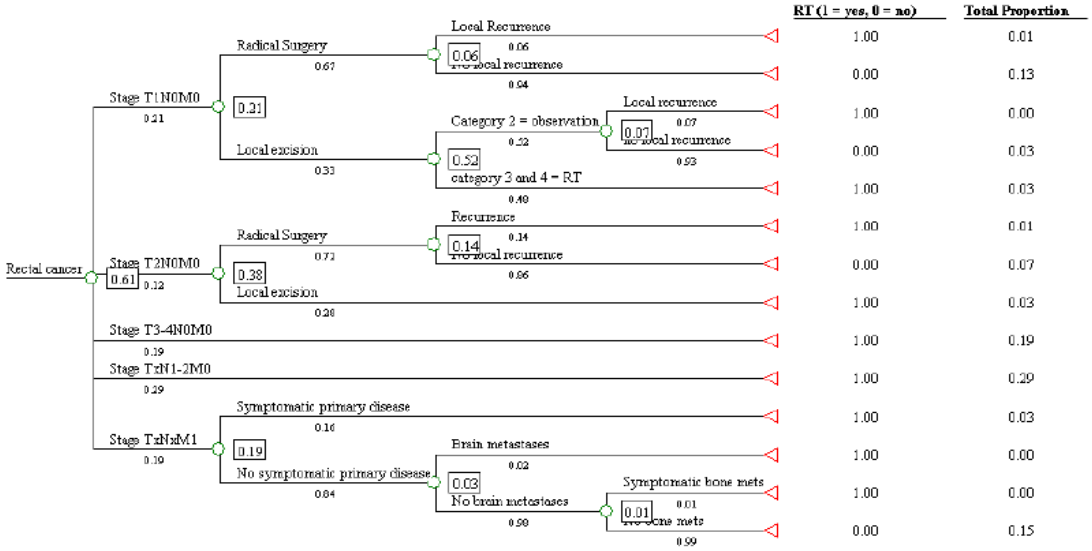



*Dunscombe et al, R&O 2014*

# EBEST: evidence-based estimation

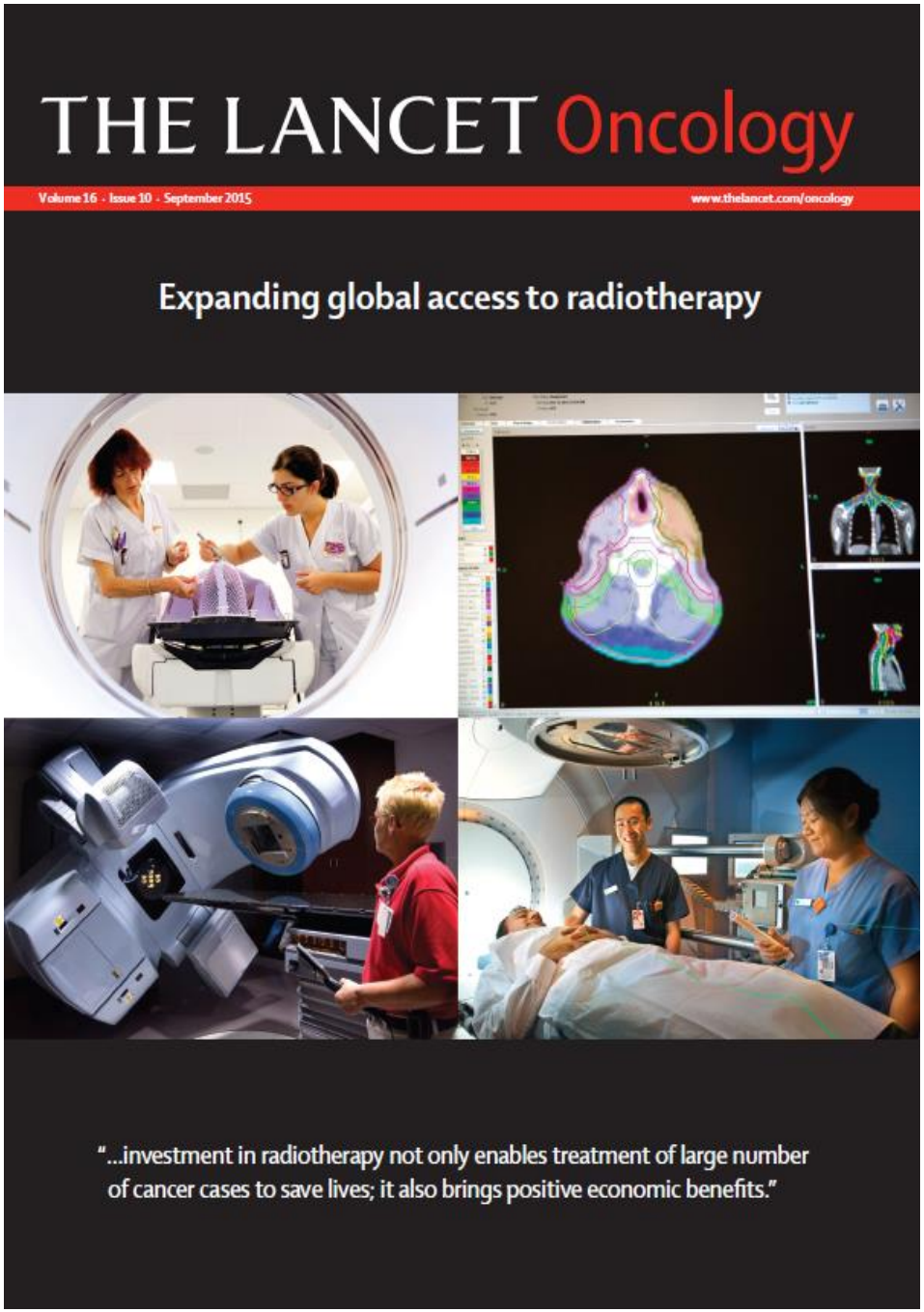
**decision-analytic model** based on available guidelines

the optimum **radiotherapy utilisation** rate (RTU)
= **proportion of new cancers** with indication for RT




CCORE
Collaboration for Cancer Outcomes Research and Evaluation

cancer incidence → distribution of tumour sites and stages → evidence-based radiotherapy utilisation → projection incidence (2035)




# Cost Calculator
# Staffing Estimator

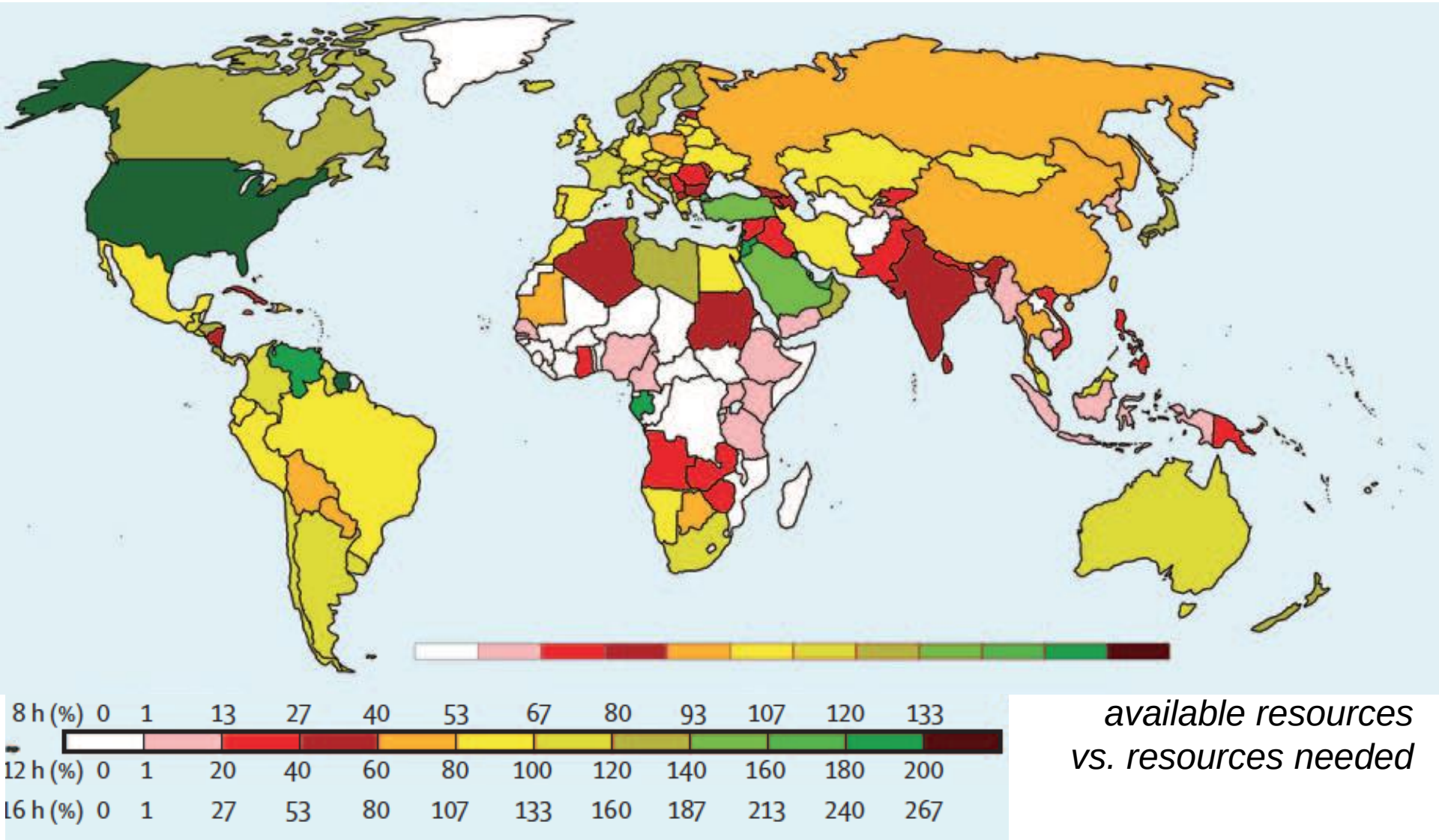
http://nucleus.iaea.org/HHW/RadiationOncology/Makingthecaseforradiotherapyinyourcountry/Roleofradiotherapyincancercare/Radiotherapyisacosteffectivesystemwhichneedsabalance/index.html

IAEA
International Atomic Energy Agency

as we lack valid data on current radiotherapy professionals worldwide,

staff requirements were assumed to align to the available equipment

# worldwide radiotherapy coverage




*available resources vs. resources needed*

*Atun et al., Lancet Oncology 2015*

# how many resources / staff will we need in 20 years from now?

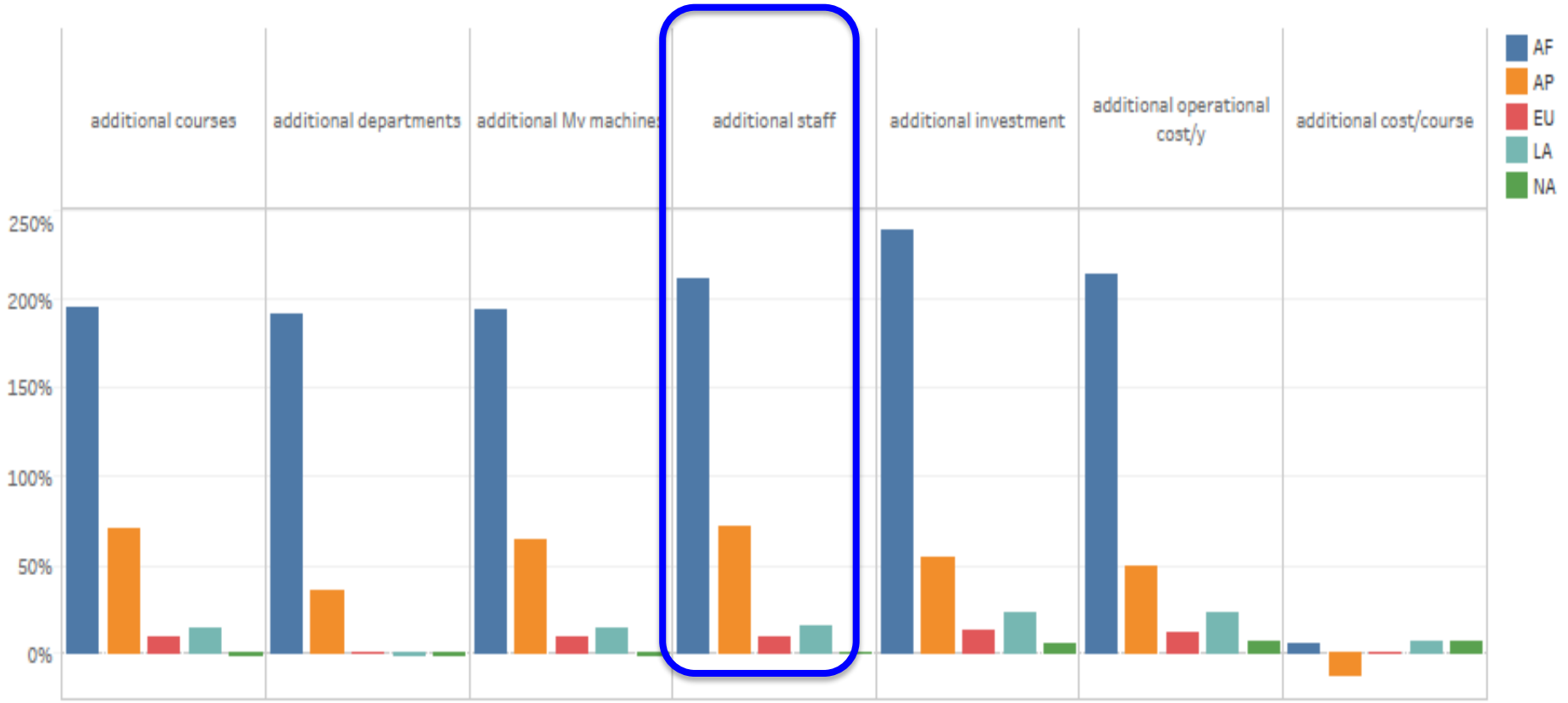
**2035**

| | High-income countries | Upper-middle-income countries | Lower-middle-income countries | Low-income counties |
|---|---|---|---|---|
| Fractions | 76 424 000 | 77 014 000 | 40 974 000 | 13 268 000 |
| Radiotherapy departments | 4600 | 3700 | 2000 | 600 |
| Megavoltage machines | 9200 | 7400 | 3900 | 1300 |
| CT scanners | 4600 | 3700 | 2000 | 600 |
| Radiation oncologists to be trained | 15 500 | 16 800 | 9900 | 3300 |
| Medical physicists to be trained | 17 200 | 12 500 | 7200 | 2400 |
| Radiation technologists to be trained | 51 900 | 45 300 | 24 900 | 8100 |

*215,000 professionals!*

*Atun et al., Lancet Oncology 2015*

# how many resources / staff will we need in 20 years from now?



# role of the different organisations

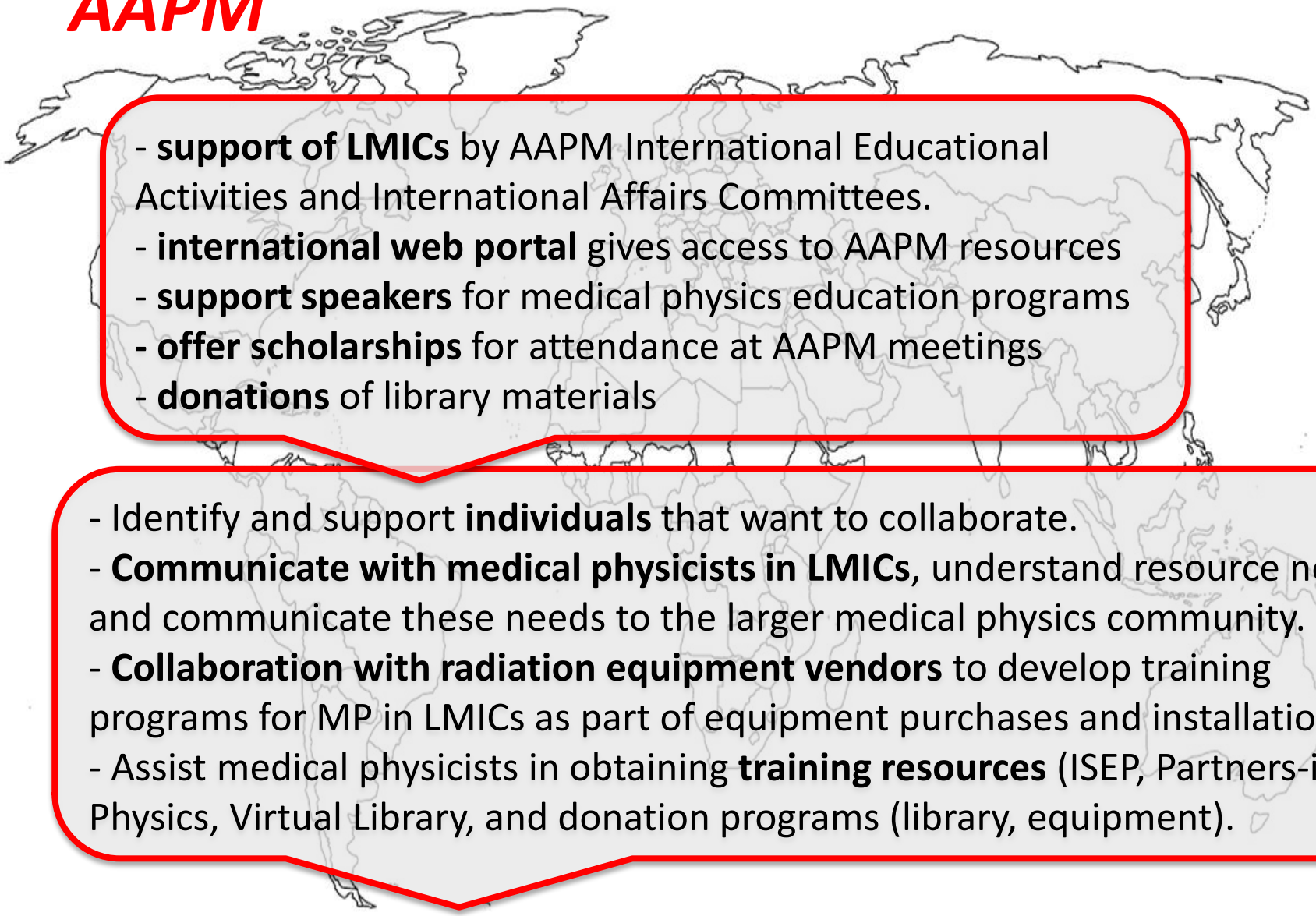
## *ASTRO*

- the International Education Subcommittee plays the role of **educational exchange** and **promotion** of fellowship, research and clinical expertise
- **international hub** and coordination of ASTRO's **global health effort**
- **collaboration** with many other societies

- **SE Asia:** current Treatment Protocols; Integrating advanced technologies IMRT/IGRT/SBRT
- **India:** Clinical Trials Workshop in conjunction with AROI; BOA + Econtouring; Web-based Chart Rounds
- **Africa:** Needs survey (RO, MP, Dosi); Gabon (Econtouring, breast); Ethiopia: facilitate a modern radiation facility at Mekelle University
- **China:** Quality assurance and safety survey; Survey for acceptance of Multidisciplinary Tumor Boards; Best of ASTRO with CISTRO Annual Meeting
- **Latin America:** Promote Educational Hubs; Collaborate with eCancer/SEOR to develop online interactive training for therapists/dosimetrists in Spanish

# role of the different organisations

## *AAPM*

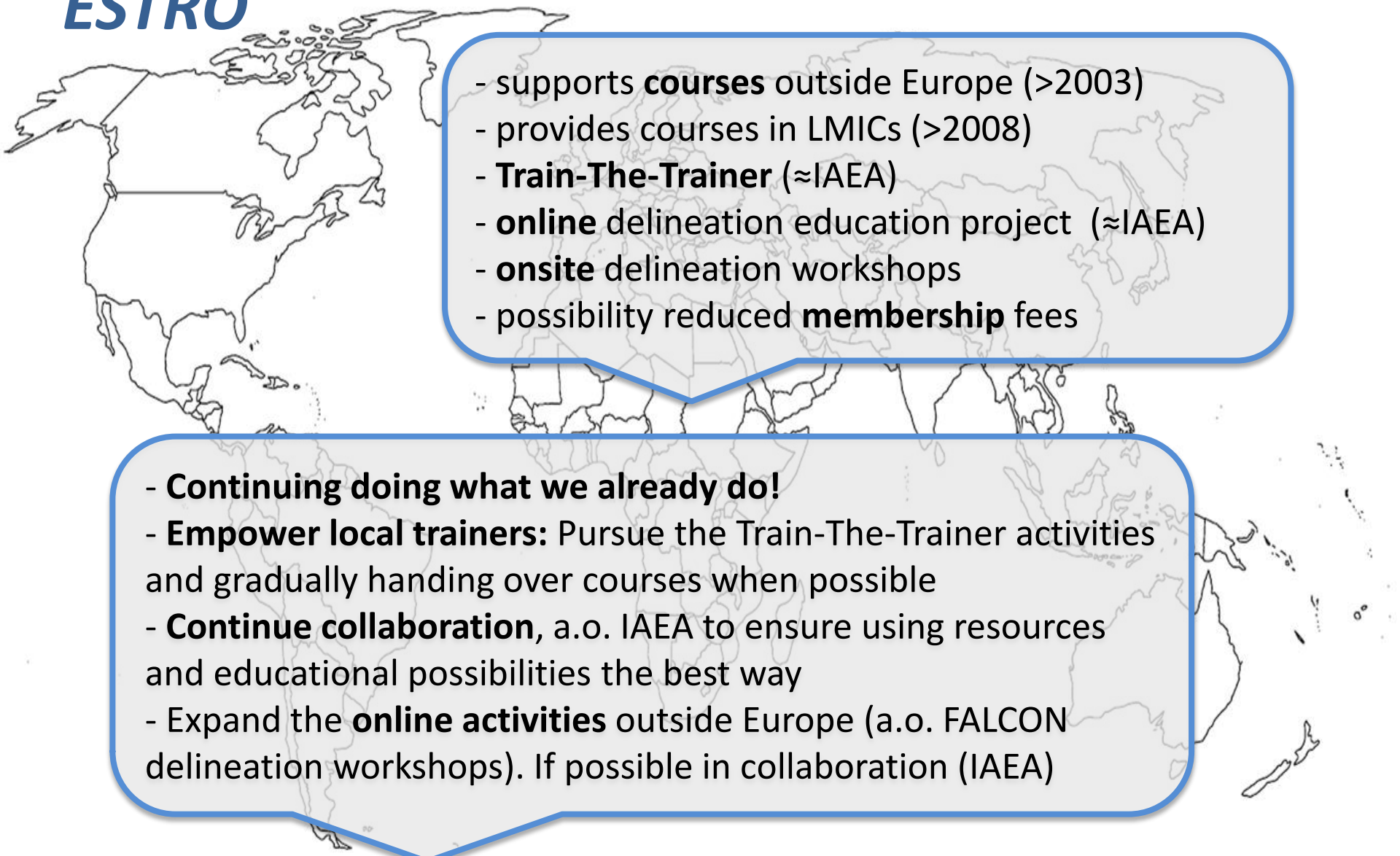


- **support of LMICs** by AAPM International Educational Activities and International Affairs Committees.
- **international web portal** gives access to AAPM resources
- **support speakers** for medical physics education programs
- **offer scholarships** for attendance at AAPM meetings
- **donations** of library materials

- Identify and support **individuals** that want to collaborate.
- **Communicate with medical physicists in LMICs**, understand resource needs and communicate these needs to the larger medical physics community.
- **Collaboration with radiation equipment vendors** to develop training programs for MP in LMICs as part of equipment purchases and installation.
- Assist medical physicists in obtaining **training resources** (ISEP, Partners-in-Physics, Virtual Library, and donation programs (library, equipment).

# role of the different organisations

## *ESTRO*



- supports **courses** outside Europe (>2003)
- provides courses in LMICs (>2008)
- **Train-The-Trainer** (≈IAEA)
- **online** delineation education project (≈IAEA)
- **onsite** delineation workshops
- possibility reduced **membership** fees

- **Continuing doing what we already do!**
- **Empower local trainers:** Pursue the Train-The-Trainer activities and gradually handing over courses when possible
- **Continue collaboration**, a.o. IAEA to ensure using resources and educational possibilities the best way
- Expand the **online activities** outside Europe (a.o. FALCON delineation workshops). If possible in collaboration (IAEA)

# role of the different organisations

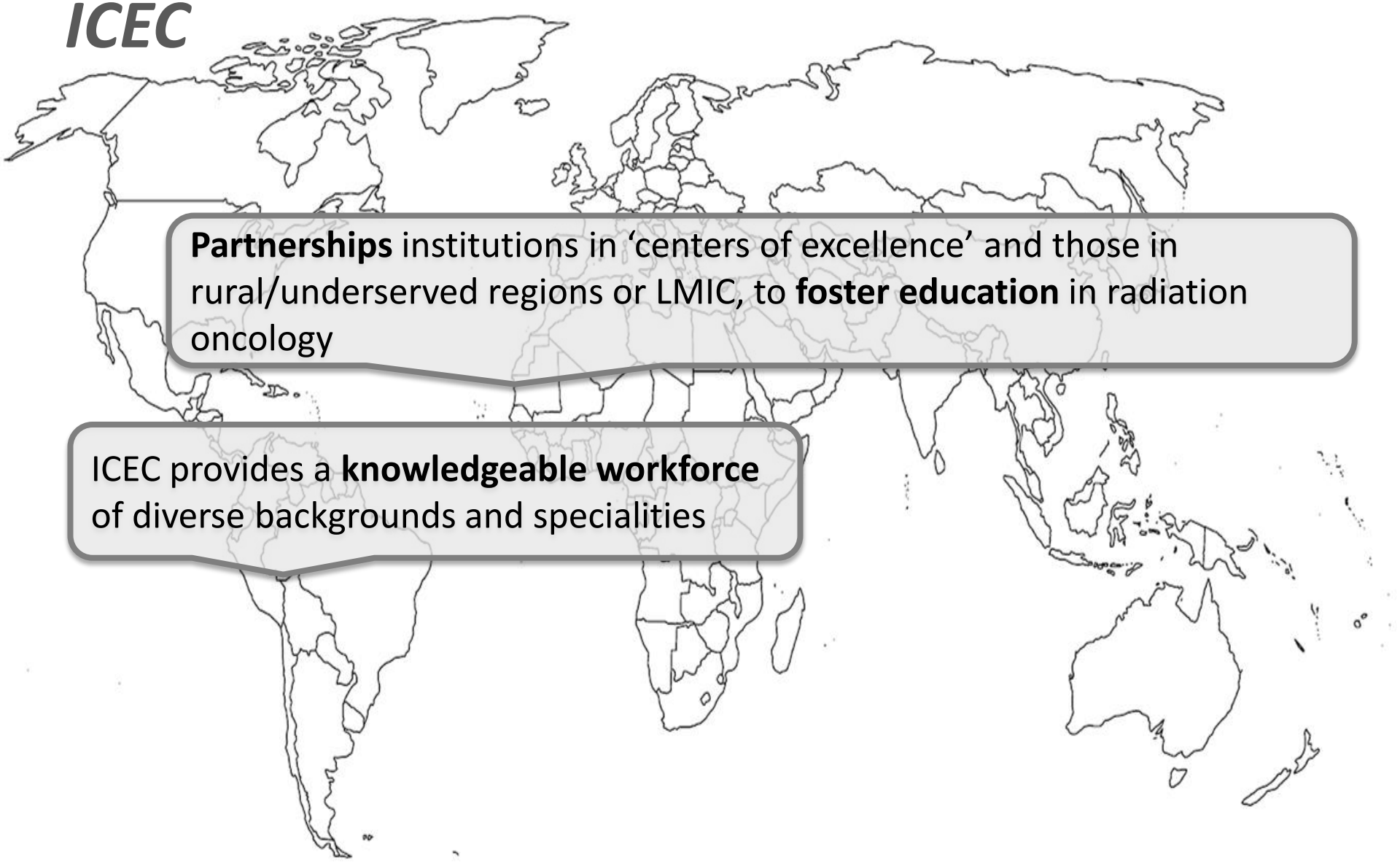
## *IAEA*

- develops education and training **material**
- financially **supports the training (abroad)** of RO professionals
- establishes national education and training **programmes**
- regional courses for **continuous professional development**
- supports also **national group training**

**continue IAEA's on-going activities** in helping many countries with the establishment of education programmes

# role of the different organisations

## *ICEC*



**Partnerships** institutions in ‘centers of excellence’ and those in rural/underserved regions or LMIC, to **foster education** in radiation oncology

ICEC provides a **knowledgeable workforce** of diverse backgrounds and specialities

# role of the different organisations

## *MPWB*

- **partnering**, at the grassroots level, with individuals, institutions, organizations
- develop the **professional capacity** of Medical Physicist
- enhance the **level and accessibility of Cancer care** in LMIC's
- send individuals to participate in **theoretic and practical training programs**
- **partner with individual** clinics in support of existing staff (commissioning, new technologies)
- partner in the development of **new and improved QA programs**

- identify and help recruit **professionals** to contribute to programs in LMIC
- engage in activities that address **Individualized** education/training/mentoring
- coordinate and complement **ongoing activities** in education and training, with
- advise and collaborate with other professionals on the **Physics and Technology aspects of Cancer treatment**
- combine **on-site visits** with on-going **electronic communication**
- **partner** with individuals in local centers and with other organizations in open communication.

# major challenges

| | AAPM | ASTRO | ESTRO | IAEA | ICEC | MPWB |
|---|---|---|---|---|---|---|
| ***Trainers*** | | | | | | |
| Lack of dedicated time to devote to education | | | | | x | x |
| Lack of trainers to sustain local education | | | x | x | | x |
| ***Educational material and equipment*** | | | | | | |
| Content to be tailored to the needs of the audience | | x | | | x | |
| Materials to be adapted the audience (e.g. language) | | | | | x | |
| Lack of resources (donation of equipment) | x | x | | | | x |
| ***Educational program*** | | | | | | |
| Lack of long-term educational exchanges | x | | | | | x |
| Lack of educational programs | | | | | | x |
| Lack of focus on skills and practical training | | | x | | | x |
| Clear need for outside support | | | | | | x |
| ***Trainees*** | | | | | | |
| Low general academic level of postgraduates | | | | x | | |
| Cost of education abroad | | | x | | | |
| Brain drain (low salaries, no retention policies) | x | | x | x | | x |
| ***Accreditation - recognition*** | | | | | | |
| Lack of official professional recognition (MP) | | | | x | | |
| Lack of certification process | | | | x | | |

# approaches to sustainable training

| | AAPM | ASTRO | ESTRO | IAEA | ICEC | MPWB |
|---|---|---|---|---|---|---|
| ***Trainers*** | | | | | | |
| Take opportunity to send out recent graduates | x | | | | | |
| ***Collaborations*** | | | | | | |
| Teach the Teachers, educate local trainers | | | | | x | x |
| Create long-term relationships | | | | | x | |
| Partnership-agreements with big institutions | | | x | | | |
| Support individual clinics/univ. (Centres of Excellence') | | | | | | x |
| Collaboration with large organisations | | | x | | | |
| ***Educational approaches*** | | | | | | |
| Blended learning activities | | | | | | |
| Online courses (delineation courses) | | x | x | | | |
| Online tumor boards | | | x | | | |
| Licencing 'Best of ASTRO' | | x | | | | |
| ***Efforts at country-level*** | | | | | | |
| Regional and national educational programmes | | | | x | | |
| Promote proper recognition | | | | | | x |
| Promote correct compensation | | | | | | x |

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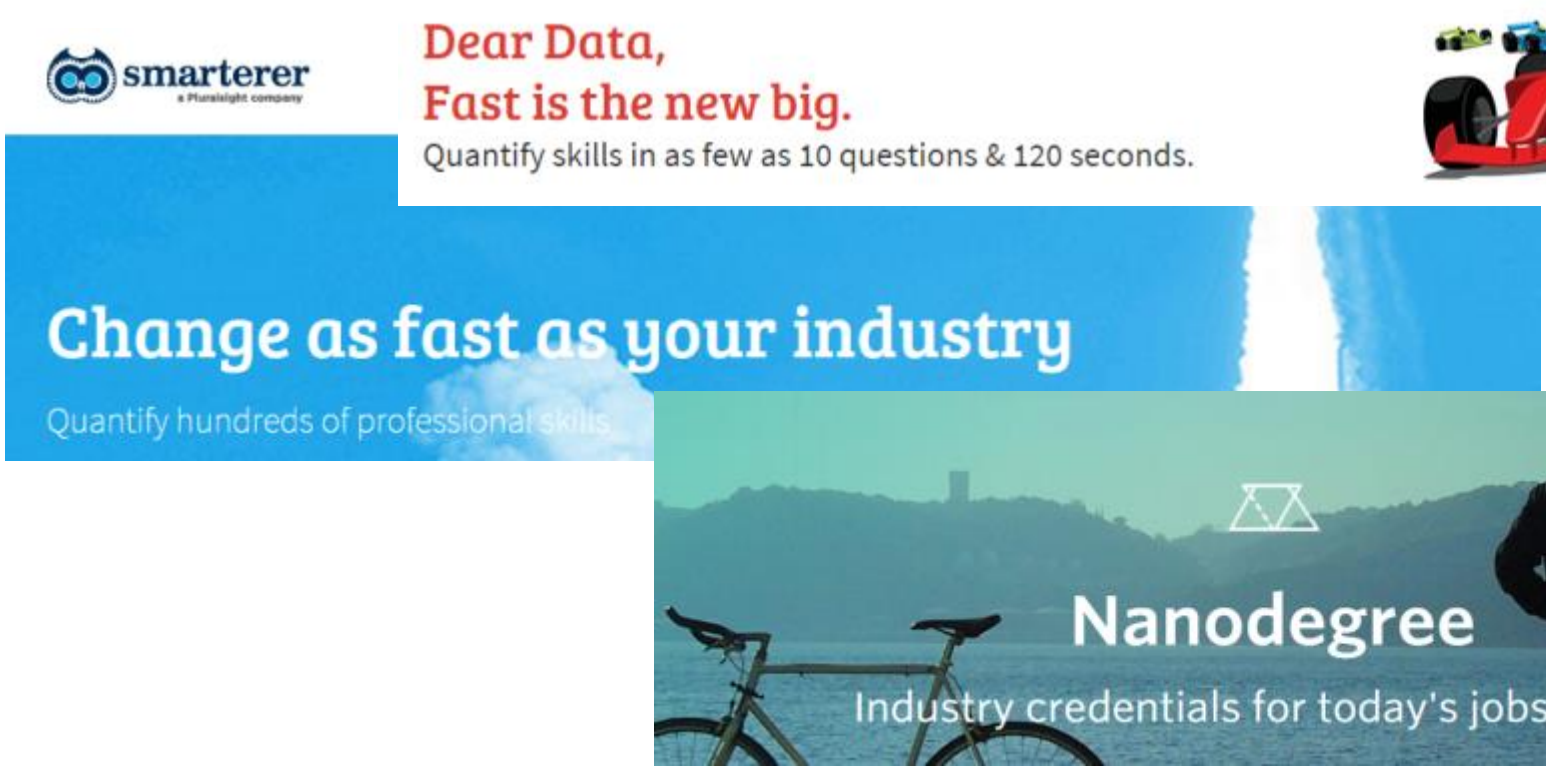
## Vertual - Innovative Tools for Training and Education.

# Educational Innovations: Competency

- New methods to assess skills and measure individual progress, competency-based learning, and ultimately ROI.




http://www.inc.com/aaron-skonnard/5-top-trends-in-education-technology-2015.html

# Educational Innovations: Integrated

- ‘Cloudification’ Trend
  - EMRs + LMS + TPS
  - Moodle - an open source LMS – OpenSaaS integration with Cloud-based applications.
- API integration
  - Allow systems to share data and provide integrated services (e.g. Twitter feed on any website).
  - Education support is *inside* the EMR system.