EUTEMPE-RX

combining e-learning and face-to-face training to build expert knowledge, skills and competences for medical physicists in radiology

Hilde Bosmans

AAPM Annual Meeting 2016, Washington

EUTEMPE-RX

EUropean Teaching and Education
for Medical Physics Experts in RX

www.eutempe-RX.eu

Overview

- History
- EUTEMPE-RX methods
- Quality
- Sustainability
- A warm welcome to all of you !

How we got started (1)

6.5.2008 EN Official Journal of the European Union C 111/1

I

(Resolutions, recommendations and opinions)

RECOMMENDATIONS

EUROPEAN PARLIAMENT

COUNCIL

RECOMMENDATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 23 April 2008

on the establishment of the European Qualifications Framework for lifelong learning

(Text with EEA relevance)

(2008/C 111/01)

ANNEX II

Descriptors defining levels in the European Qualifications Framework (EQF)

Each of the 8 levels is defined by a set of descriptors indicating the learning outcomes relevant to qualifications at that level in any system of qualifications

	Knowledge	Skills	Competence
	In the context of EQF, knowledge is described as theoretical and/or factual	In the context of EQF, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) and practical (involving manual dexterity and the use of methods, materials, tools and instruments)	In the context of EQF, competence is described in terms of responsibility and autonomy
Level 1 The learning outcomes relevant to Level 1 are	basic general knowledge	basic skills required to carry out simple tasks	work or study under direct supervision in a structured context
Level 2 The learning outcomes relevant to Level 2 are	basic factual knowledge of a field of work or study	basic cognitive and practical skills required to use relevant information in order to carry out tasks and to solve routine problems using simple rules and tools	work or study under supervision with some autonomy
Level 3 The learning outcomes relevant to Level 3 are	knowledge of facts, principles, processes and general concepts, in a field of work or study	a range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information	take responsibility for completion of tasks in work or study adapt own behaviour to circumstances in solving problems
Level 4 The learning outcomes relevant to Level 4 are	factual and theoretical knowledge in broad contexts within a field of work or study	a range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study	exercise self-management within the guidelines of work or study contexts that are usually predictable, but are subject to change supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities
Level 5 (*) The learning outcomes relevant to Level 5 are	comprehensive, specialised, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge	a comprehensive range of cognitive and practical skills required to develop creative solutions to abstract problems	exercise management and supervision in contexts of work or study activities where there is unpredictable change review and develop performance of self and others

Level 6 (**) The learning outcomes relevant to Level 6 are	advanced knowledge of a field of work or study, involving a critical understanding of theories and principles	advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialised field of work or study	manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work or study contexts take responsibility for managing professional development of individuals and groups
Level 7 (***) The learning outcomes relevant to Level 7 are	highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research critical awareness of knowledge issues in a field and at the interface between different fields	specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields	manage and transform work or study contexts that are complex, unpredictable and require new strategic approaches take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams
Level 8 (****) The learning outcomes relevant to Level 8 are	knowledge at the most advanced frontier of a field of work or study and at the interface between fields	the most advanced and specialised skills and techniques, including synthesis and evaluation, required to solve critical problems in research and/or innovation and to extend and redefine existing knowledge or professional practice	demonstrate substantial authority, innovation, autonomy, scholarly and professional integrity and sustained commitment to the development of new ideas or processes at the forefront of work or study contexts including research

Compatibility with the Framework for Qualifications of the European Higher Education Area

The Framework for Qualifications of the European Higher Education Area provides descriptors for cycles.

Each cycle descriptor offers a generic statement of typical expectations of achievements and abilities associated with qualifications that represent the end of that cycle.

(*) The descriptor for the higher education short cycle (within or linked to the first cycle), developed by the Joint Quality Initiative as part of the Bologna process, corresponds to the learning outcomes for EQF level 5.

(**) The descriptor for the first cycle in the Framework for Qualifications of the European Higher Education Area agreed by the ministers responsible for higher education at their meeting in Bergen in May 2005 in the framework of the Bologna process corresponds to the learning outcomes for EQF level 6.

(***) The descriptor for the second cycle in the Framework for Qualifications of the European Higher Education Area agreed by the ministers responsible for higher education at their meeting in Bergen in May 2005 in the framework of the Bologna process corresponds to the learning outcomes for EQF level 7.

(****) The descriptor for the third cycle in the Framework for Qualifications of the European Higher Education Area agreed by the ministers responsible for higher education at their meeting in Bergen in May 2005 in the framework of the Bologna process corresponds to the learning outcomes for EQF level 8.

How we got started (2)

RADIATION PROTECTION NO 174

EUROPEAN GUIDELINES ON MEDICAL PHYSICS EXPERT

Directorate-General for Energy
Directorate D — Nuclear Safety & Fuel Cycle
Unit D.3 — Radiation Protection
2014

Qualification Framework for the Medical Physics Expert (MPE) in Europe

MPE: "An individual having the knowledge, training and experience to act or give advice on matters relating to radiation physics applied to medical exposure, whose competence to act is recognized by the Competent Authorities" (Revised BSS)

The Qualifications Framework is based on the European Qualifications Framework (EQF). In the EQF learning outcomes are defined in terms of Knowledge, Skills, Competences (KSC) (European Parliament and Council 2008/C 111/01)

EDUCATION

EQF Level 6
(e.g., Bachelor with 180 - 240 ECTS)
(i)

Physics or equivalent
(ii)

EQF Level 7
(e.g., Master with 90 - 120 ECTS)
(iii)

Medical Physics* or equivalent
(iv)

CLINICAL TRAINING

Clinical Certification in Medical Physics Specialty
(v)

Structured accredited clinical training residency in the specialty of Medical Physics in which the candidate seeks clinical certification. The duration should be typically two full-time year equivalents**
(vi)

ADVANCED EXPERIENCE and CPD

EQF Level 8 in Medical Physics Specialty
(vii)

Structured accredited advanced experience and CPD in the specialty of Medical Physics in which the candidate seeks certification as MPE. The duration would be an additional *minimum* of two full-time year equivalents***
(viii)

RECOGNITION

By Competent Authorities as MPE in Medical Physics specialty
(ix)

RE-CERTIFICATION

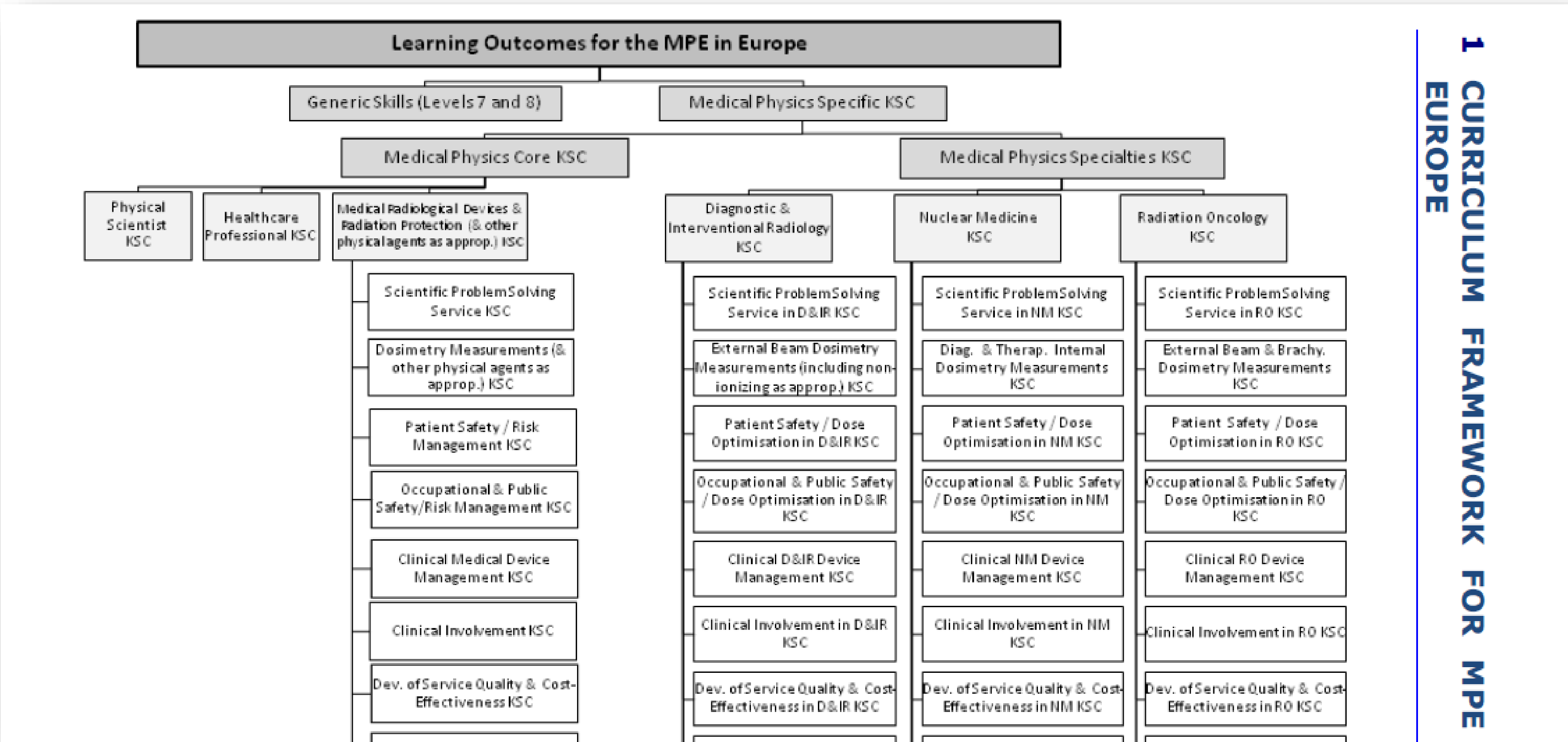
5 year CPD cycle
(x)

* Should include, as a minimum, the educational components of the Core KSC of Medical Physics and the educational components of the KSC of the specialty of Medical Physics (i.e., Diagnostic & Interventional Radiology or Nuclear Medicine or Radiation Oncology) for which the candidate seeks clinical certification. When this element of specialization is not included it must be included in the residency.

** The EQF level of the residency is intermediate between EQF levels 7 and 8.

*** In countries where the MPE is required to be certified in more than one specialty of Medical Physics the number of years would need to be extended such that the MPE will achieve level 8 in each Specialty.

How we got started (2)



	Knowledge (facts, principles, theories, practices)	Skills (cognitive and practical)	Competence (responsibility and autonomy)
Scientific Problem Solving Service	K1. Explain statutory and institutional requirements for Medical Physics Services in Diagnostic and Interventional Radiology with respect to Scientific Problem Solving Service. K2. Explain the common imaging modalities (general projection x-ray imaging (DDR, CR and film-screen where this is still valid), chest systems, mammography, dental systems (intra-oral, OPG, cephalometric systems), mobile, flat panel / image intensifier fluoroscopes including C-arms, interventional systems, tomosynthesis, paediatric systems, radiostereometric (RSA) systems, stereotactic systems, dual energy X-ray absorptiometry (DXA), axial and helical mode CT, cone-beam CT, MRI, ultrasound) and explain their function as instruments for the measurement, mapping and imaging of the spatial distribution of different physical variables within the human body. Each imaging modality/dedicated device has its utility in the various applications of medical imaging i.e., diagnosis, population screening, patient monitoring, intervention and specialised use such as paediatric. K3. Discuss the advantages and disadvantages of imaging as a means of displaying spatially dependent signals and variables. K4. Explain in detail the principles of image quality measurement: linear systems theory, types of contrast (subject, image and display), unsharpness (LSR, PSF, LSF, MTF), lag, noise (including sources, noise power spectra, effect of lag on noise, noise propagation in image subtraction), SNR (including Rose model, Wagner's taxonomy, CNR, relation to dose, NEQ, DQE, NPS etc). K5. Explain inverse problem mathematical techniques used in image reconstruction (including both convolution and iterative methods and the advantages and disadvantages of each). K6. Explain at an advanced level the following: temporal / frequency domain representation of signals, Fourier transform, statistical description of signals, power spectral density, autocorrelation function, sampled (discrete) signals, delta function and its Fourier transform, Fourier transform of aperiodic discrete signal (DFT), the FFT, the effects of finite sample intervals, linear processors, impulse response, convolution integral and theorem, various types of filters used in the processing of medical signals. K7. Explain in detail the way that acquisition data is processed to facilitate the extraction of informatio[illegible] K8. Explain the principles and r[illegible] of image post-processing including knowledge based image an[illegible]pattern theory, deterministic image processing and feature enh[illegible]ent, image segmentation, image registration and co-registra[illegible]ion. K9. Discuss the limitations of in[illegible]st-processing.	S1. For each modality, operate imaging devices at the level necessary for give advice on optimization of imaging protocols, quality control, image quality manipulation, and carry out research when the available evidence for advice is not sufficient. S2. For each modality predict the effect on image quality and diagnostic accuracy when changing scanning and reconstruction parameters. S3. Manipulate acquisition parameters for all forms of projection x-ray imaging devices (e.g., kV, filtration, mAs, sensitivity ('speed'), collimation, magnification, SID, SSD, frame rate, screening time, manual/AED modes, compression), explain the effect on image quality and relevant patient dose quantities (and occupational dose particularly when this is correlated with patient dose) and relevance to specific clinical studies.	C1. Take responsibility for statutory and institutional requirements for Medical Physics Services in Diagnostic and Interventional Radiology with respect to Scientific Problem Solving Service. C2. Carry out or supervise as appropriate the measurement of physical quantities relevant to the effective, safe and economical use of medical devices / ionizing radiations and other physical agents in Diagnostic and Interventional Radiology.

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43

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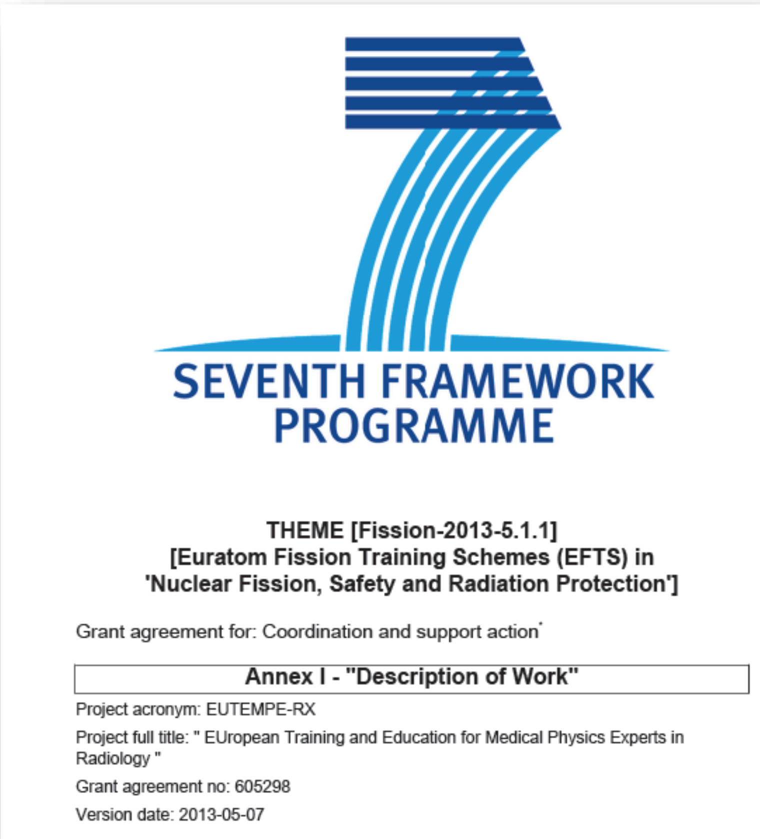
Suddenly,
the EU EURATOM asked for projects
on Teaching and Education
to increase **nuclear** safety ….

Our project application was convincing:

- We can increase nuclear safety in RX with MPEs
- None of the EU Member States has the required training programs at EQF level 8
- We can realize borderless, life long learning, with e-learning and other modern teaching methods
- Radiology is important (business)
- Yes, there is excellence in Europe

-> Cherry-picking !

History


SEVENTH FRAMEWORK PROGRAMME

THEME [Fission-2013-5.1.1]
[Euratom Fission Training Schemes (EFTS) in
'Nuclear Fission, Safety and Radiation Protection']

Grant agreement for: Coordination and support action*

Annex I - "Description of Work"

Project acronym: EUTEMPE-RX

Project full title: " EUropean Training and Education for Medical Physics Experts in Radiology "

Grant agreement no: 605298

Version date: 2013-05-07

- Successful application for a Euratom ‘Fission Training Scheme’
- EU support: 1.7M€
- Timing:
  01/08/2013 - 31/07/2016

Objectives

- Provide a modular training scheme for the MP in Radiology at EQF level 8
- Set up a multicampus education combining online with face-to-face learning
- Serve as a model for harmonised courses
- Get accredited (by EFOMP)
- To achieve excellence in:
  - module content (RP174) and organization
  - fulfillment of quality objectives
  - participant and stakeholder satisfaction

Course modules

Number	Title	Lead
1	Development of the profession and the challenges for the MPE (D&IR) in Europe	C. Caruana & E. Vano
2	Radiation biology for medical physicists in radiology	A. Ottolenghi & K Trott
3	Monte Carlo simulation of X-ray imaging and dosimetry	J. Sempau
4	Advanced X-ray physics for imaging devices and user protocol innovation in D &IR	M. Gambaccini, A T.aibi
5	Antropomorphic phantoms	K. Bliznakova
6	The development of advanced QA protocols	H. Bosmans, N Marshall & E. Vano

Course modules

Number	Title	Lead
7	Advanced measurements of the performance of X-ray imaging systems & optimization	K. Young & A. MacKenzie
8	Model Observers: theory and application for CT optimization	F. Verdun & F Bochud
9	Achieving quality in diagnostic and screening mammography	R. van Engen, W. Veldkamp & I. Sechopoulos
10	High dose X-ray procedures in Interventional Radiology and Cardiology	A. Trianni, R. Padovani & E. Vano
11	Radiation dose management of pregnant patients, pregnant staff and children in diagnostic and interventional radiology	J. Damilakis
12	Personnel dosimetry: Techniques and Applications	M. Borowski & M. Fiebich

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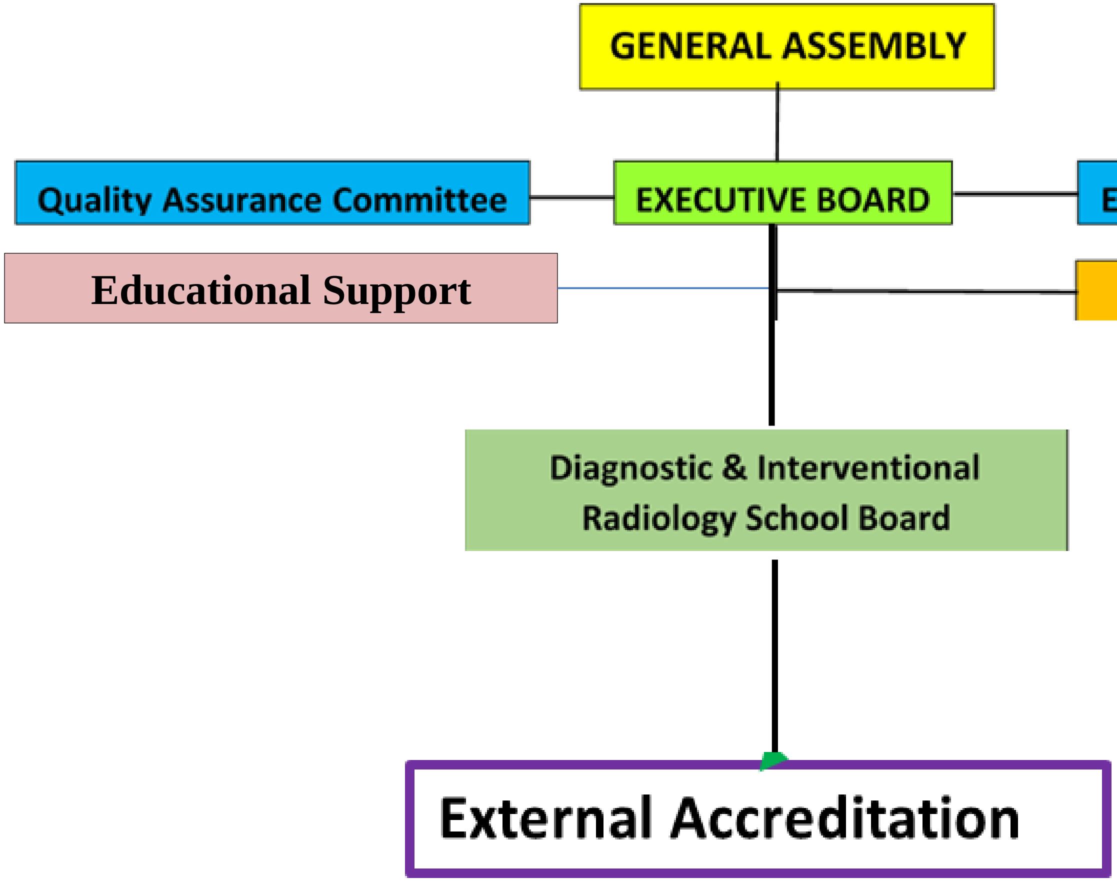
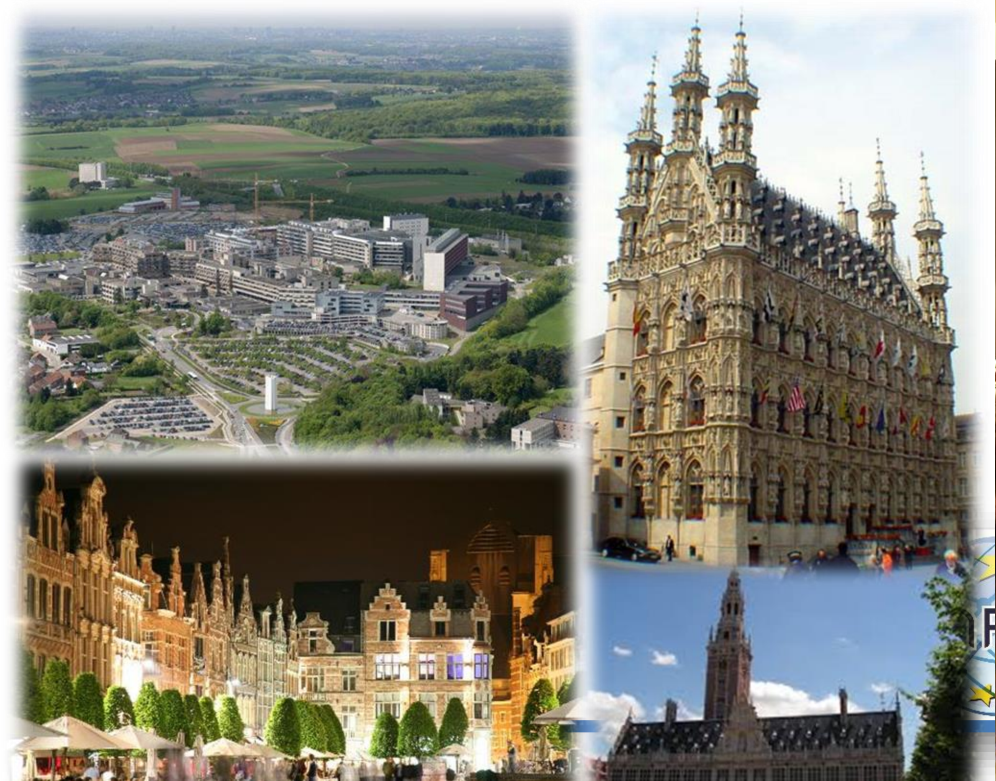
EUTEMPE-RX method



EUTEMPE-RX method

- Common platform, common structure, …
- 6 monthly consortium meetings with educational workshops:
    - the use of e-learning tools
    - the creation of e-learning material
    - assessment methods at the expert level
    - teaching methods
- Room for sharing teaching experiences, hints & tricks



Example of e-learning material

4 Documents for further reading

- Introduction
- European documents
- International documents
- Conclusion

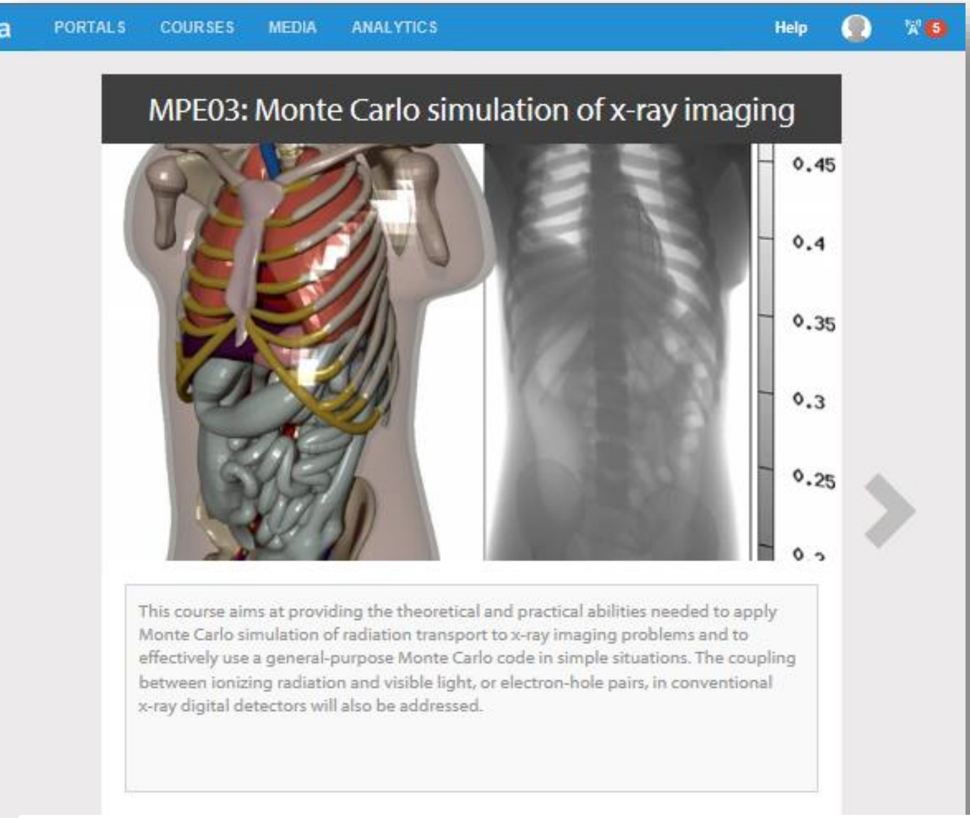
8 Phantoms for QA

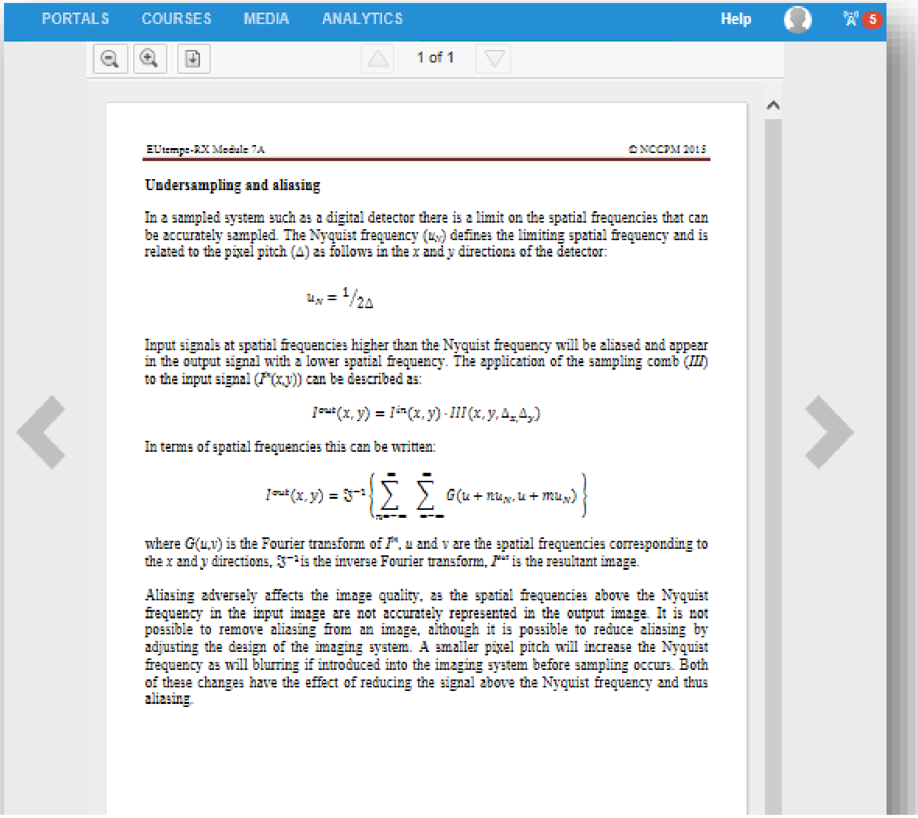
- Introduction
- Types of phantoms
- Mammography - CDMAM
- General Radiography/Fluoroscopy - CDRAD
- Fluoroscopy - TOR18FG
- Fluoroscopy - TO20
- Compu
- Compu
- Compu
- (Cone
- Dental
- Dental
- Conclu

14 Literature search: Elements for consolidating and improving QA in X-ray imaging

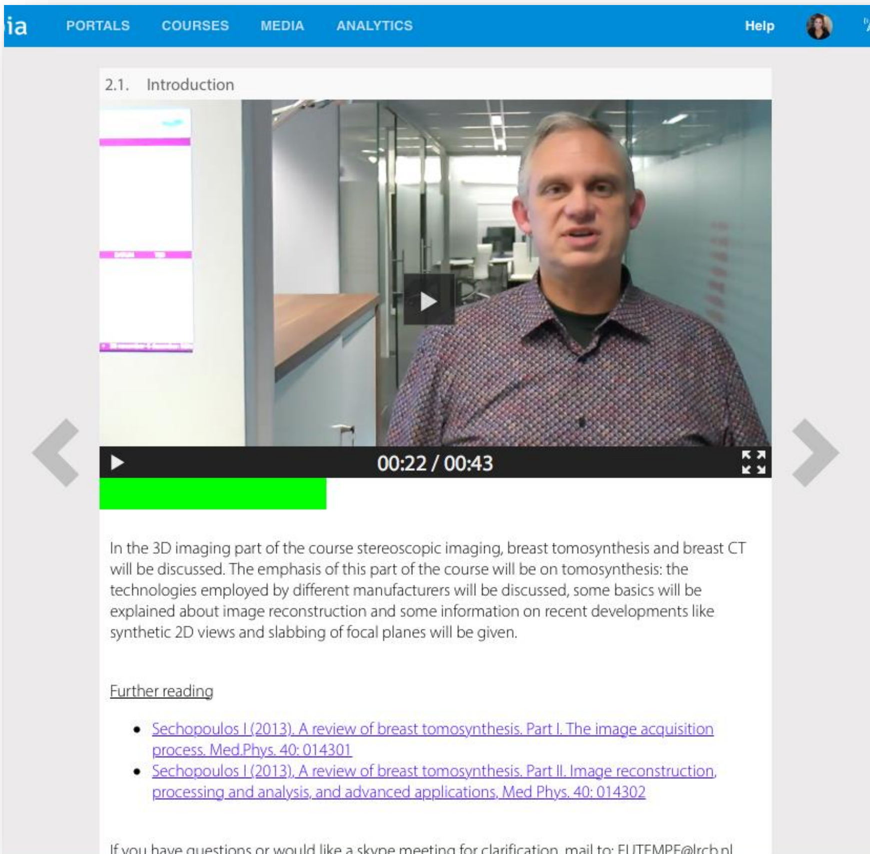
- Introduction: Literature surve on QA in diagnostic radiology
- QA means being organized and ambitious
- New phantoms (often task based) and new QC procedures
- New methods to automate QC data analysis
- Conclusion

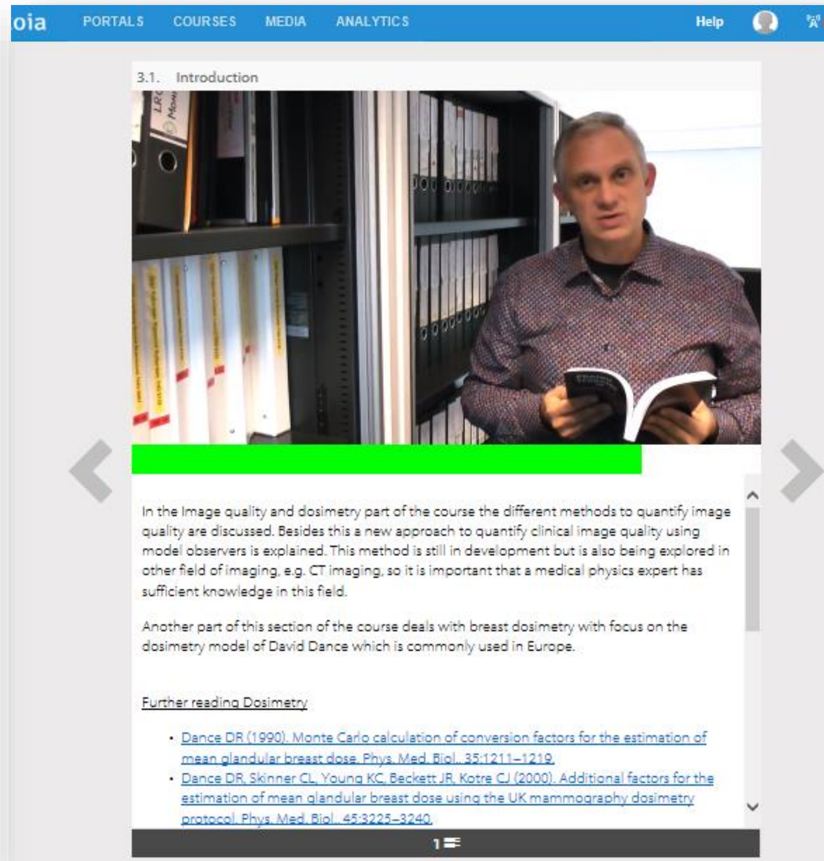
Science on the e-learning platform



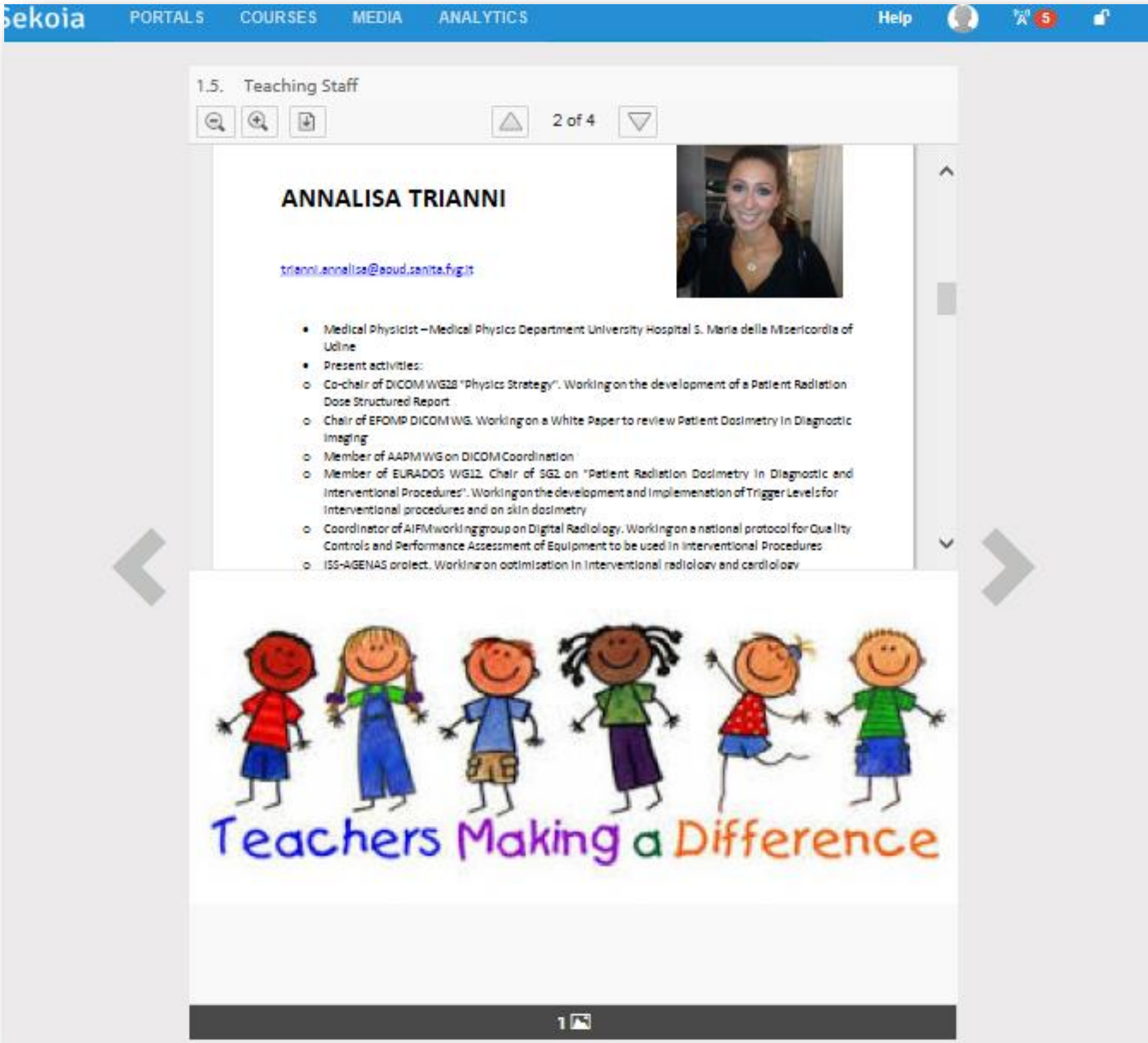


Example of e-learning teaching

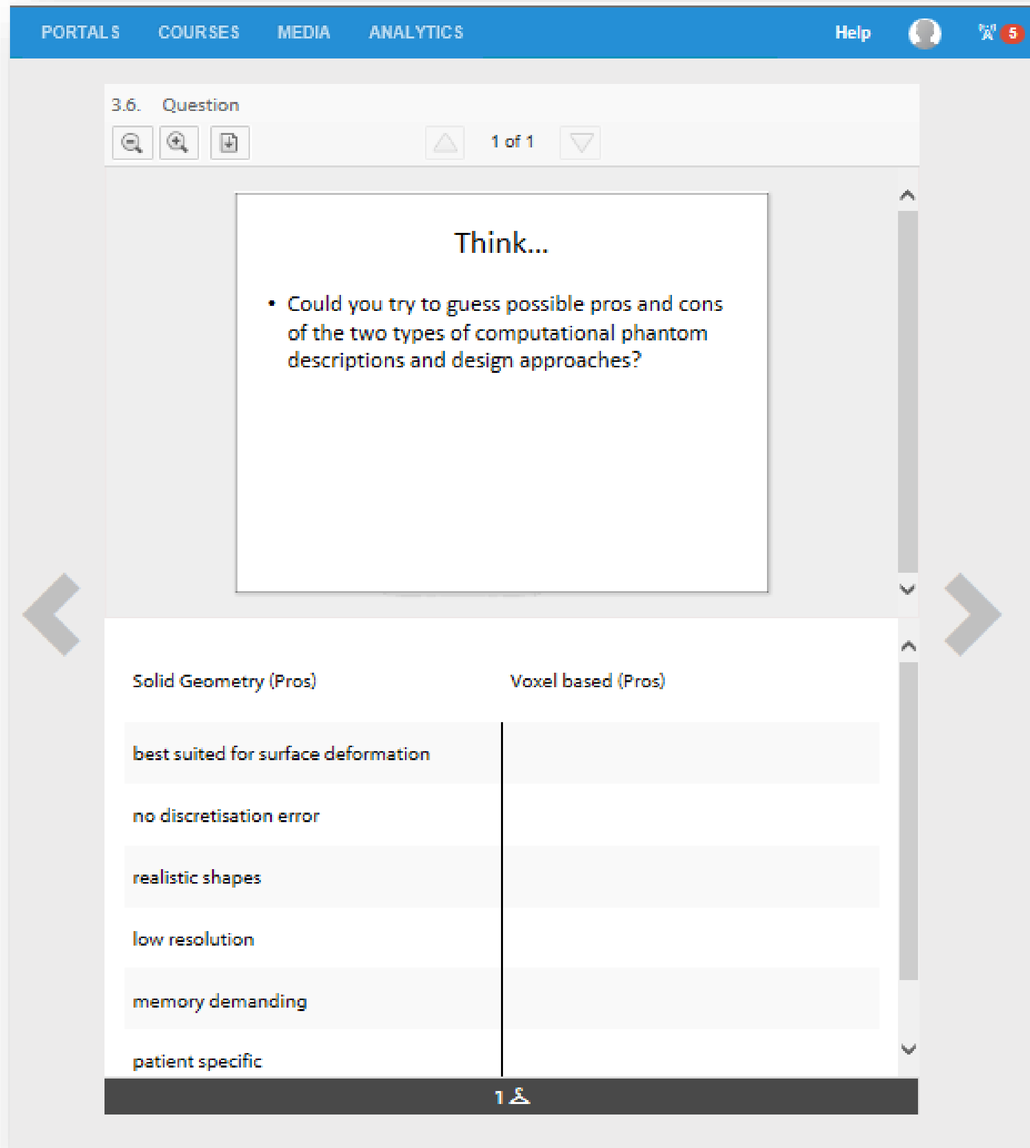




Upfront introduction of the teachers



Interaction



Example of face-to-face course Module on Advanced QA

- Industrial partner & President of article 31 group: what is QA?
- Have 2 group leaders share how QA is being organized
- Practical sessions showing how QA is done in Leuven
- Go from basic QA to advanced (task based) QA: how and why
- Group work: how to compile a new QA protocol – do it - report
- Digital opportunities and measurements of digital systems explained
- Hints and tricks !
- Testing the overlooked components
- Assessment = make the outline for a task based QA protocol

Teaching methods in practice

- **Unique achievements**
  - case studies in medical physics leadership
  - Monte Carlo simulation of a complete x-ray imaging chain
  - task specific QA protocols
  - new optimization plans
  - simulation with anthropomorphic breast models
  - individualized dose calculation

Teaching methods in practice

- **Unique opportunities & encounters**
  - with the team of teachers
  - with medical doctors
  - modern hospitals
  - top screening organization
  - a synchrotron facility
  - a calibration lab, …

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Teachers' reflections

- Extremely, positively motivated groups of participants
- Every new group = a new team of (young) medical physicists
- Group tasks were most appreciated
- Social events are a necessary part. Most courses take place in nice historical cities


Opportunities
Design
Inspiration
Information
Evolution
Progress
Imagination

Quality of the project

- **Criteria described in the Quality manual**
  - Knowledge skills and competences listed
  - Courses accreditated by EFOMP
  - Quality survey sent to participants
  - Follow up web conference with module leaders & educational team

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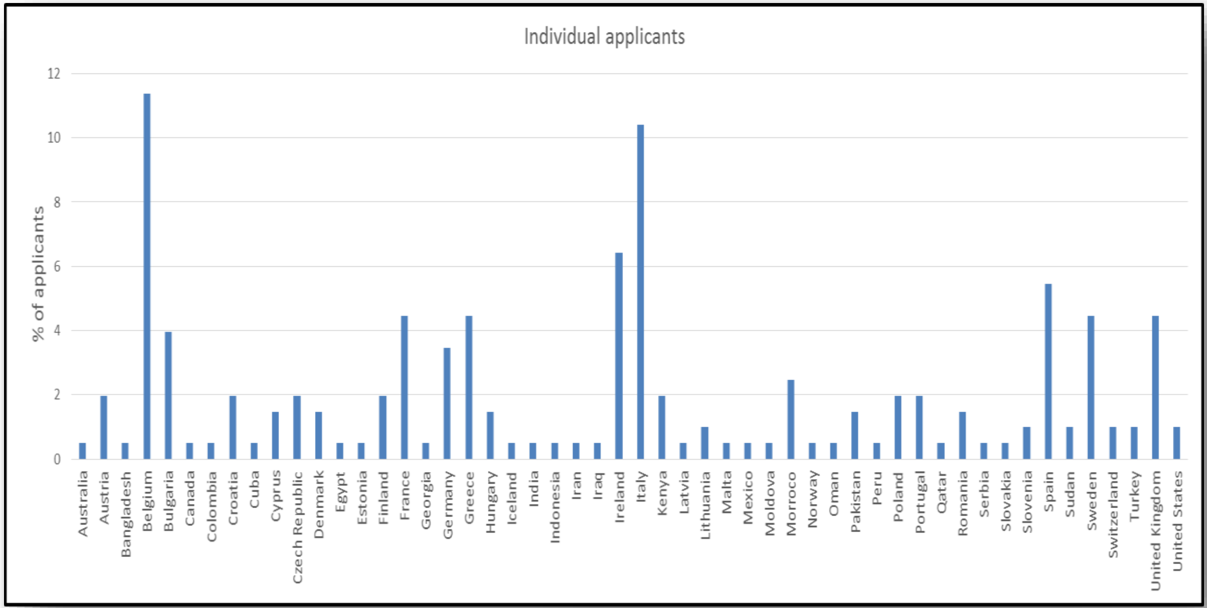
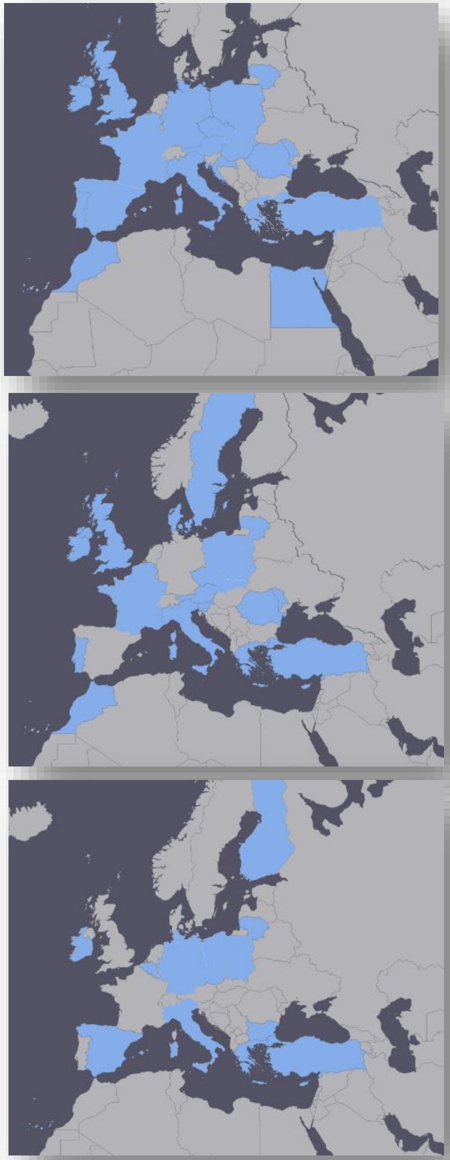
Quality

- Approx. 50 – 50 m/f
- Applicants from all over Europe and beyond





For more info: see quality manual

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Module MPE01: Development of the profession and the challenges for the MPE (D&IR) in Europe

ABSTRACT

Title: Development of the profession and the

Module Code: MPE01

Module Level: EQF level 8

Aims: This module aims to help the future MPE (
acquire the knowledge, skills and competences n
address the development of the role of the MPE
phase participants will have the opportunity to d
latest EU directives, guidelines and activities i

Learning Outcomes: At the end of the module

MPE01.01	Take responsibility for European and nation
MPE01.02	Implement and evalu
MPE01.03	Evaluate the various
MPE01.04	Take responsibility for and clinical governan
MPE01.05	Take responsibility fo
MPE01.06	Discuss the role of th
MPE01.07	Research, develop an professionals.
MPE01.08	Manage inter-profess
MPE01.09	Manage priorities reg
MPE01.10	Implement safety cul
MPE01.11	Participate in networ
MPE01.12	Take responsibility fo
MPE01.13	Interpret the signific

Date and Location of Face-to-Face Componen

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Module Leaders:

Prof. Carmel J. Caruana (carme
Past EFOMP Chair for E&T and
radiation protection, medical d
development of the role defini
in MEDRAPET. He also represe

Prof. Eliseo Vano (eliseov@me
Full Professor of Medical Phys
Health for radiation protectio
Chairman of the Committee on

Faculty: Carmel J. Caruana, Elis

Delivery of the module: The
phase will be mostly asynchro
learning is required this woul
assessment).

Total participant effort time: 8

Assessment Mode: The assess
are expected to demonstrate t
the profession. Participants ar
during the course.

MODULE CONTENT: AIM and SUMM		
Aim	This module will help the future MPE (Diagnostic and Interventional Ra department) acquire the knowledge, skills and competences necessary The content of the module would address the development of the role other modules. *In the face-to-face phase participants will have the op profession. The participants would also be updated with the latest E forefront of these developments.*	
Learning Outcomes (10 – 15 learning outcomes which provide an overview of the KSC addressed in the module)	MPE01.01	Take responsibility for researching, evaluating, leadin in the ambit of European and national legislation and
	MPE01.02	Implement and evaluate strategic solutions to the cha
	MPE01.03	Evaluate the various models of management suitable
	MPE01.04	Take responsibility for researching, evaluating, leadin service quality and clinical governance in D&IR.
	MPE01.05	Take responsibility for ethical issues in the area of rad
	MPE01.06	Discuss the role of the MPE (D&IR) in health technolog
	MPE01.07	Research, develop and lead the development of the other healthcare professionals.
	MPE01.08	Manage inter-professional issues in D&IR.
	MPE01.09	Manage priorities regarding radiation protection rese MPEs.
	MPE01.10	Implement safety culture in their management practic
	MPE01.11	Participate in networks for research and development

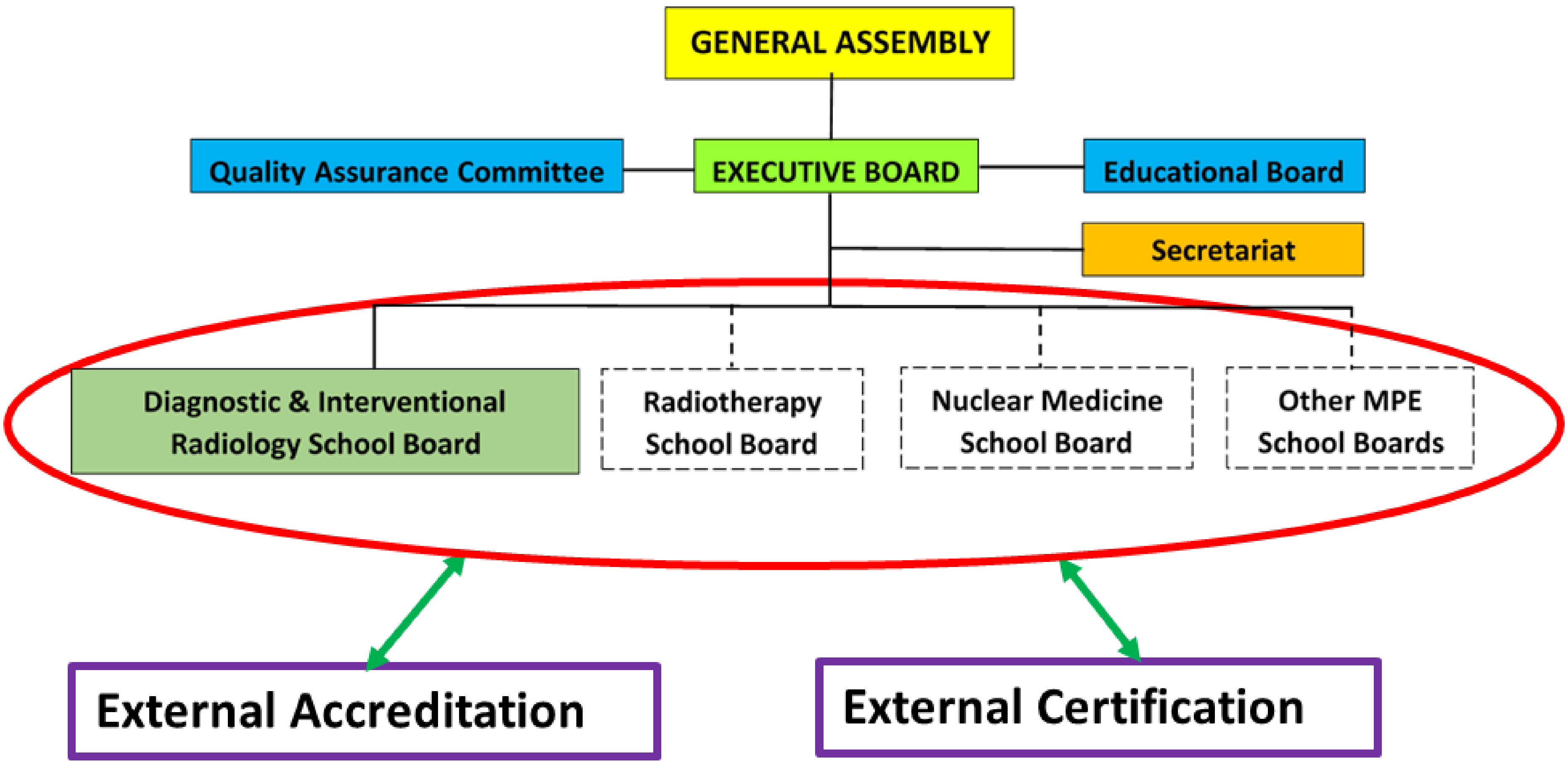
Quality survey results

Question	1	2	3	4	5
The learning goals of this module (found on the description page of the module) were clear to me.	0.6	1.9	6.5	35.1	55.9
This level of the module helped me achieve EQF level 8 in the areas covered by the module.	0.6	1.7	13.9	42.5	41.3
Participation in this module enabled me to develop learning goals relevant to my professional objectives.	1.0	2.2	8.5	30.8	57.5
The module leader(s) and presenters had a good command of the subject matter of the course.	0.0	0.0	4.2	21	74.8
The study materials (online work, articles, hand-outs, face-to-face presentations,…) were sufficient for me to master the learning goals.	0.5	2.4	12.8	34.2	50.1
The assessment (e.g. paper, examination, exercises, …) allowed me to show my level of achieved knowledge/skills/competences.	1.4	5.4	18.0	40.2	35.0
The knowledge, skills and competences supported by this module match with those expected by my employer.	1.7	3.0	17.0	39.6	38.7

Sustainability

- Creation of the EUTEMPE- net
- Modules will be repeated (at a fee from 500 – 900 €)
- The consortium will go on with yearly meetings
  - for harmonization
  - for feedback and follow-up
  - to plan and explore new teaching methods
- A new group of excellence will apply for the next EURATOM call, Oct 2016

Sustainability with the EUTEMPE-net



Sustainability plan

Deadline for application of 1 Nov 1st, 2016

	Module Topic	Leaders	Face-to-face Per[illegible]ocation
MPE01	Leadership in Medical Physics: Development of the profession and the challenges for the MPE (D&IR)	C. Caruana & V. Tsapaki	6-10 February 2017, Prague, Czech Republic
MPE02	Radiation biology for medical physicists in radiology	A. Ottolenghi, G.Baiocco	15-19 January 2018, Pavia, Italy
MPE03	Monte Carlo simulations of X-ray imaging and dosimetry	J. Sempau	19-23 June 2017(Provisional), Barcelona, Spain
MPE04	Innovation & Advanced X-ray physics for imaging devices in Diagnostic and Interventional Radiology	A. Taibi & M. Gambaccini	11-15 Sptember 2017, Ferrara, Italy
MPE05	Physical and virtual anthropomorphic phantoms for image quality and patient dose optimization	K. Bliznakova	22-26 May 2017, Varna, Bulgaria
MPE06	The development of advanced QA protocols for testing radiological devices	H. Bosmans, N. Marshall & E. Vano	13-17 November 2017, Leuven, Belgium
MPE07	Optimisation of X-ray imaging using standard and innovative techniques	A. Mackenzie & K. Young	9 - 11 Oct, 2017 with extensive e-learning part and possibility to register for the e-learning only, Guildford, UK
MPE08	Mathematical model observers developed and implemented for patient dose optimization in CT	F. Verdun & F. Bochud	12-16 March 2018, Lausanne, Switzerland
MPE09	Achieving quality in diagnostic and screening mammography	R. Van Engen, I. Sechopoulos & W. Veldkamp	27-31 March 2017, Nijmegen, the Netherlands
MPE10	High dose X-ray procedures in Interventional Radiology and Cardiology: establishment of robust protocols for patient and staff dose	A. Trianni, R. Padovani & E. Vano	25 - 29 June 2018 (to be confirmed), Udine, Italy
MPE11	Radiation dose management of pregnant patients, pregnant staff and paediatric patients in diagnostic and interventional radiology	J. Damilakis	21-25 May 2018, Iraklion (Crete), Greece
MPE12	Personnel dosimetry and techniques to communicate practical results to the users (tasks of the radiation protection expert, RPE)	M. Borowski & M. Fiebich	16-20 April 2018, Braunschweig, Germany

The challenge is this:

- We need more leaders in our profession.
- We aim to train them to the best level possible.
- We know how to train them.
- How to reach all?

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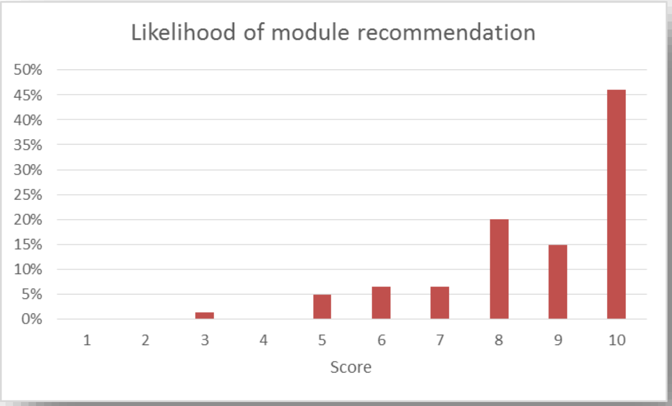
We welcome

also US participants

cooperation with AAPM

exchange of ideas…



For more information, visit our website: www.eutempe-RX.eu

You can register now: First come, first served.

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