European Training and Education for Medical Physics Experts in Radiology (EUTEMPE-RX)

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I. Facts leading to EUTEMPE-net

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

European Teaching and Education for Medical Physics Experts in (diagnostic and interventional) Radiology

It started as an EU supported project. Now it is a network of motivated teachers, the EUTEMPE-net, running EUTEMPE-RX courses (without EU support)
<table>
<thead>
<tr>
<th>Knowledge (facts, principles, theories, practices)</th>
<th>Skills (cognitive and practical)</th>
<th>Competence (responsibility and autonomy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>K1. Explain statutory and institutional requirements for Medical Physics Services in Diagnostic and Interventional Radiology with respect to Scientific Problem Solving Service.</td>
<td>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.</td>
<td>C1. Take responsibility for statutory and institutional requirements for Medical Physics Services in Diagnostic and Interventional Radiology with respect to Scientific Problem Solving Service.</td>
</tr>
<tr>
<td>K2. Explain the common imaging modalities (general projection x-ray imaging (CDR, 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, stereolactic 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.</td>
<td>S2. For each modality predict the effect on image quality and diagnostic accuracy when changing scanning and reconstruction parameters.</td>
<td>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.</td>
</tr>
<tr>
<td>K3. Discuss the advantages and disadvantages of imaging as a means of displaying spatially dependent signals and variables.</td>
<td>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.</td>
<td></td>
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<tr>
<td>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 (using Rose model, Wagner's taxonomy, CNR, relation to dose, NEQ, DQE, NPS etc).</td>
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<tr>
<td>K5. Explain inverse problem mathematical techniques used in image reconstruction (including both convolution and iterative methods and the advantages and disadvantages of each).</td>
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<tr>
<td>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.</td>
<td></td>
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<tr>
<td>K7. Explain in detail the way that acquisition data is processed to facilitate the extraction of information.</td>
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<td>K8. Explain the principles and role of image post-processing including knowledge based image and pattern theory, deterministic image processing and feature enhancement, image segmentation, image registration and co-registration.</td>
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<tr>
<td>K9. Discuss the limitations of image post-processing.</td>
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</tbody>
</table>
Our project application was convincing:

- We can increase nuclear safety in RX with MPEs
- Doses in X-ray imaging can be considerable (risks)
- Radiology is important (business)
- None of the EU Member States has the required (complete) training programs for medical radiation physics at EQF level 8
- We can realize borderless, life long learning, with e-learning and other modern teaching methods
- Yes, there is excellence in Europe

-> Cherry-picking!
## II. Objectives

1. Provide a modular training scheme for the MP in Radiology to bring him to EQF level 8

<table>
<thead>
<tr>
<th>EDUCATION</th>
<th>CLINICAL TRAINING</th>
<th>ADVANCED EXPERIENCE and CPD</th>
<th>RECOGNITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>EQF Level 6</td>
<td>Clinical Certification in Medical Physics Specialty</td>
<td>EQF Level 8 in Medical Physics Specialty</td>
<td>By Competent Authorities as MPE in Medical Physics specialty (i)</td>
</tr>
<tr>
<td>(e.g., Bachelor</td>
<td>[v]</td>
<td>[vi]</td>
<td></td>
</tr>
<tr>
<td>with 180 - 240</td>
<td>Structured accredited clinical training residency in the specialty of Medical</td>
<td>Structured accredited advanced experience and CPD in the specialty of Medical Physics in</td>
<td></td>
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<tr>
<td>ECTS) (ii)</td>
<td>Physics in which the candidate seeks clinical certification. The duration should</td>
<td>which the candidate seeks certification as MPE. The duration would be an additional</td>
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<tr>
<td></td>
<td>be typically two full-time year equivalents**</td>
<td>minimum of two full-time year equivalents**</td>
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<tr>
<td></td>
<td>(vi)</td>
<td>(vii)</td>
<td></td>
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<tr>
<td>Physics or</td>
<td></td>
<td>(viii)</td>
<td></td>
</tr>
<tr>
<td>equivalent (ii)</td>
<td></td>
<td>(ix)</td>
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</tr>
<tr>
<td>Medical Physics*</td>
<td></td>
<td>(x)</td>
<td></td>
</tr>
<tr>
<td>or equivalent (iv)</td>
<td></td>
<td>(xi)</td>
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</tbody>
</table>

RE-CERTIFICATION
5 year CPD cycle (x)
II. Objectives

1. Set up a multicampus education combining online with face-to-face learning
2. Serve as a model for harmonised courses
3. Get accredited (by EFOMP) (now EBAMP)
4. To achieve excellence in:
   – module content (RP174) and organization
   – fulfillment of quality objectives
   – participant and stakeholder satisfaction
III. Methods

- Different expert teams were selected to organize a module
  - Excellent publication record or excellent teachers
  - Geographical spread / gender
    - Belgium, Malta (Czech Republic), Italy, Spain, Bulgaria, UK, The Netherlands, Swiss, Greece, Germany
    - Hilde, Virginia, Annalisa, Kristina, Federica, Saartje, Sofie
  - Website
  - Common e-learning platform
III. Methods

• Quality manual describing all the procedures & forms
  – Module abstract in the required format.
  – CVs of course leader(s)
  – Appropriate aims of the modules
  – Sufficiently comprehensive list of learning outcomes (10 – 15 learning outcomes) and at EQF level 8
  – EFOMP accreditation achieved
Module MPE01: Development of the profession and the challenges for the MPE (D&IR) in Europe

ABSTRACT

Title: Development of the profession and the challenges for the MPE (Diagnostic and Interventional Radiology) in Europe

Module Code: MPE01

Module Level: EQF level 6

Aims: This module aims to help the future MPE acquire the knowledge, skills and competences needed to address the development of the role of the MPE (Diagnostic and Interventional Radiology). Participants will have the opportunity to update their knowledge in line with the latest EU directives, guidelines and local protocols.

Learning Outcomes: At the end of this module, participants will be able to:

- Take responsibility for the development of roles and responsibilities within the MPE (Diagnostic and Interventional Radiology) department
- Evaluate the various models of management suitable for the MPE (Diagnostic and Interventional Radiology) role
- Take responsibility for researching, evaluating, leading, and implementing service quality and clinical governance in MPE (Diagnostic and Interventional Radiology)
- Take responsibility for ethical issues in the area of radiology
- Discuss the role of the MPE (Diagnostic and Interventional Radiology) in health technologies
- Research, develop and lead the development of the MPE (Diagnostic and Interventional Radiology) role
- Manage inter-professional issues in MPE (Diagnostic and Interventional Radiology)
- Manage priorities regarding radiation protection research
- Participate in networks for research and development

Module Leaders:

Prof. Carmel J. Caruana (carmel.caruana@felhasznalo.elte.hu)
Past EFOMP Chair for E&T and education
Chairman of the Committee on radiation protection, medical data protection and development of the role definition in MEDRAPET
He also represents Hungary in the EFOMP's executive council
Prof. Eliseo Vano (eliseov@med.unam.mx)
Full Professor of Medical Physics, Health for radiation protection, Chairman of the Committee on radiation protection

Faculty: Carmel J. Caruana, Eliseo Vano

Delivery of the module: The module will be mostly asynchronous (10-15 learning outcomes which provide an overview of the KCS addressed in the module).

Total participant effort time: 80 hours

Assessment Mode: The assessment mode will be mostly asynchronous (10-15 learning outcomes which provide an overview of the KCS addressed in the module). Participants are expected to demonstrate their knowledge and competence during the course.
III. Methods

• consortium meetings with educational workshops:
  • the use of e-learning tools
  • the creation of e-learning material
  • activation of the audience
  • assessment methods at the expert level
  • teaching methods
• sharing teaching experiences, hints & tricks
• feed-back by professionals in education
III. Methods

• ‘My’ lessons learned
  – We learned a lot from teaching experts. Enthusiasm is at the core of success
  – What can be taught with a power point presentation, should be taught upfront, online
  – Group work / group discussion is appreciated most by our participants
  – The use of different teaching methods is appreciated
  – Videos should be maximally 5min long
  – No multiple choice exams for EQF level 8
Characteristics EUTEMPE-RX modules

• Half of the effort in the online platform
• On site, small group (nearly individual) teaching in particular skills and competences
  • knowledge is more covered online
• An enthusiastic team of teachers
• Important ‘social program’
• Very different from attending a conference:
  • Learn by doing
  • Different topics. Example: it is not perse about innovation, but how to embrace it in the practice
Results: Example of e-learning material
Example of e-learning teaching

In the 3D imaging part of the course stereoscopic imaging, breast tomosynthesis and breast CT will be discussed. The emphasis of this part of the course will be on tomosynthesis: the technologies employed by different manufacturers will be discussed, some basics will be explained about image reconstruction and some information on recent developments like synthetic 3D views and stapling of focal planes will be given.

Further reading

If you have questions or would like a skype meeting for clarification, mail to: EUTEMPE@leicbd.nl
Upfront introduction of the teachers

ANNALISA TRIANNI

trianni.annalisa@eaud.sanita.fvg.it

- Medical Physicist – Medical Physics Department University Hospital 1. Maria delle Misericordia of Udine
- Present activities:
  - Chair of EPMIC DICOM WG6. Working on a White Report to review Patient Dosimetry in Diagnostic Imaging
  - Member of AAPM/5/10 DICOM/ECG Coordination
  - Member of EURADOS WG12 Chair of SG2 on “Patient Radiation Dosimetry in Diagnostic and Interventional Procedures”. Working on the development and implementation of Trigger Levels for Interventional procedures and on skin dosimetry
  - Coordinator of AIP/making groups on Digital Radiology. Working on an allocation protocol for Quality Controls and Performance Assessment of Equipment to be used in Interventional Procedures
  - ISO-AGMA project. Work on optimization in Interventional radiology and cardiology

Teachers Making a Difference
Think...

- Could you try to guess possible pros and cons of the two types of computational phantom descriptions and design approaches?

<table>
<thead>
<tr>
<th>Solid Geometry (Pros)</th>
<th>Voxel based (Pros)</th>
</tr>
</thead>
<tbody>
<tr>
<td>best suited for surface deformation</td>
<td></td>
</tr>
<tr>
<td>no discretisation error</td>
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<tr>
<td>realistic shapes</td>
<td></td>
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<tr>
<td>low resolution</td>
<td></td>
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<tr>
<td>memory demanding</td>
<td></td>
</tr>
<tr>
<td>patient specific</td>
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</tbody>
</table>
Example of Module 6 in Leuven

“From basic to advanced QA: why & how”

- Invited: Industrial rep. & President of article 31 group: ‘what is QA?’
- Invited speaker: ‘create QA from the start’
- Practical sessions showing how QA is done in Leuven & discussion
- Case study: normal QA protocols, but what is missing?
- Show case: phantoms, reading studies, dosimetry
- Group work: compile a new QA protocol – discuss – report to all
- Advanced QA science by local expert: ‘Digital opportunities and measurements of digital systems explained’, Q& A.
- Hints and tricks competition
- Assessment: make the outline for a task based QA protocol
<table>
<thead>
<tr>
<th>Time</th>
<th>Monday, 13 Nov 2023</th>
<th>Tuesday, 14 Nov 2023</th>
<th>Wednesday, 15 Nov 2023</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.30 - 10.30</td>
<td>Wake Up Poll: Hello world! Do you need advanced QA protocols? We surely do. Guess why !</td>
<td>Wake Up Poll: &quot;Help, this purchase request is special.&quot; Can we help with MPE advice/input?</td>
<td>Wake Up Poll: We have systems with many protocols. Which type of protocol management could help?</td>
</tr>
<tr>
<td>10.30 - 11.00</td>
<td>Coffee break</td>
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<tr>
<td>11.00 - 12.30</td>
<td>Example QA reports from Leuven and all, of systems without problems</td>
<td>Example phantoms for several applications.</td>
<td>What you always wanted to know on MTF, NNPS and DQE</td>
</tr>
<tr>
<td>11.00 - 12.30</td>
<td>Example QA reports: find the problems. How could testing be improved?</td>
<td>Bring in your experience with phantoms. Hints and tricks competition !</td>
<td>DQE workshop or repeat of Monday's QA database or Contrast Detail workshop</td>
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<tr>
<td>12.30 - 13.00</td>
<td>Lunch break</td>
<td></td>
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<tr>
<td>13.30 - 15.00</td>
<td>Introduction to patient dose monitoring systems - J. Binst</td>
<td>Introduction to dual energy CT and photon counting detectors (PCCT) - J. Vignero</td>
<td>Introduction to digital breast tomosynthesis (DBT) and Synt. Mammo - K Houbrechts</td>
</tr>
<tr>
<td>13.30 - 15.00</td>
<td>Introduction to task based testing and figures of merit - N. Marshall</td>
<td>Introduction to (dental) Cone Beam CT (CBCT) - K. Merken</td>
<td>Introduction to contrast enhanced mammography - L. Cockmartin</td>
</tr>
<tr>
<td>15.00 - 17.00</td>
<td>Choose one practical:</td>
<td>Choose one practical:</td>
<td>Choose one practical:</td>
</tr>
<tr>
<td>15.00 - 17.00</td>
<td>1. The use of QA data bases</td>
<td>1. Review of annual CT testing</td>
<td>1. Review of digital breast tomo testing</td>
</tr>
<tr>
<td>15.00 - 17.00</td>
<td>2. Patient dose monitoring: a tool for MPEs</td>
<td>2. Create protocol outline for PCCT</td>
<td>2. Create protocol outline for CE Mammo</td>
</tr>
<tr>
<td>15.00 - 17.00</td>
<td>3. Contrast detail analysis and 4AFC</td>
<td>3. Create protocol outline for CBCT</td>
<td>3. Create protocol outline for CAD algor.</td>
</tr>
<tr>
<td>17.00 - 17.30</td>
<td>Working groups report to all</td>
<td>Working groups report to all</td>
<td>Working groups report to all</td>
</tr>
<tr>
<td>18.00 - 19.00</td>
<td>Tour of the radiology department</td>
<td>Hands-on testing of the PCCT</td>
<td>Hands-on testing of CE mammo</td>
</tr>
<tr>
<td>Facultative</td>
<td>Tour to the proton therapy center</td>
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<tr>
<td>Facultative</td>
<td>Tour of the Medical Physics lab</td>
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<tr>
<td>19.30 - ...</td>
<td>Social Program with all in Leuven</td>
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</tbody>
</table>
EUTEMPE characteristics

• Unique opportunities & encounters
  – with the local MPEs showing how they solve their challenges
  – with the team of teachers
  – with medical doctors
  – in modern hospitals
  – in top screening organisation
  – visit a synchrotron facility
  – visit a calibration lab, ...

• Social events are an integral part of the module. (Most courses take place in nice historical cities)

• Registration fees covering the costs of organizing the module by the module leader
Why attend EUTEMPE-RX modules?

• You learn to defend medical physics in front of medical boards
• You set up your Monte Carlo simulation platform and you run your simulation
• You can make your task specific QA protocols
• You formulate and run an optimization plan of your choice
• You use a simulation platform and truly understand breast imaging
• You get organized for your individualized dose calculations (patients and personnel)(pregnant patients and CT in general)
• You become an expert, in diagnostic and interventional radiology
Why attend EUTEMPE-RX modules?

EUTEMPE-RX is all about skills and competences. You learn to do something very interesting for your profession that you did not do before.
IV. Sustainability (2016)

• Memorandum of Understanding: let’s replicate the effort!
• Creation of the EUTEMPE-net, to repeat the modules
• The consortium plans to go on with yearly meetings
  – for harmonization
  – for feedback and follow-up
  – to plan, learn about and explore new teaching methods
• Modules have to be self-supporting, from the registration fees
• Coordination by prof. H. Bosmans
• We reached out to several organisations for support but that part of the work failed
IV. Sustainability (2016)
The 1st repetition of the modules
Module 12: communication of risks and RP

Also for RPE

Lead: prof. Martin Fiebich & Markus Borowski, PhD

Content: Focus on dosimetry and methods to assess dose to the personnel. A visit to a calibration lab in Berlin is included.
2nd repetition of the modules

Program 2019-2020

11 modules in 2019-2020, 11 opportunities to boost your career!

- Expert teachers
- Prepare online
- Meet and learn onsite (opt. exam for extra EBAMP credits)
- Travel to various cities in Europe
- Many countries eligible for reduced fees (check website)

Information & Registration
www.eutempe-net.eu

Course fees and dates may still be subject to change
V. During the Corona pandemic...

- educational webinars (1h each)
- master classes (2h each)

Unique approaches, polls, ... and very well attended 😊
<table>
<thead>
<tr>
<th>#</th>
<th>Date 1</th>
<th>Date 2</th>
<th>Topic</th>
<th>Presenter(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Oct 13</td>
<td>Oct 27</td>
<td>Tellin’ ain’t Teachin’</td>
<td>Danielle Dobbe</td>
</tr>
</tbody>
</table>
| 2  | Nov 10 | Nov 24   | Webinar: Building robust QC protocols for the assessment of medical x-ray imaging systems  
| 3  | Dec 8  | Dec 22   | Webinar: The philosophy of QC protocols  
Masterclass: Digging deeper: The why behind a quality control protocol and how to adapt to varying realities | Ruben van Engen                   |
|    |        |          |                                                                      | Ruben van Engen & Ioannis Sechopoulos |
| 4  | Jan 12 | Feb 2    | Webinar: An introduction to strategic and robust leadership in medical physics  
Masterclass: Medical physics leadership – real world case studies from the trenches | Carmel Caruana                    |
| 5  | Feb 23 | March 9  | Webinar: Personnel Dosimetry – a first step to radiation protection of the staff  
Masterclass: Personnel Dosimetry – two steps ahead | Markus Borowski                   |
| 6  | March 23 | X   | Webinar: A guided tour of x-ray CT through dosimetry and image quality assessment | John Damilakis                    |
| 7  | April 13 | April 27 |                                                                      | Paola Cardarelli                  |
| 8  | May 11 | May 25   | Webinar: Beyond X-ray tubes: Innovation in radiological imaging with monochromatic sources | Paolo Cardarelli                  |
VI. Sustainability (today)

- Help with practical aspects from the Nijmegen team (R. van Engen; D. Dobbe)
- Coordinator: H. Bosmans
- Registration via EFOMP’s website
- Hopefully included in EFOMP mailings
VI. Sustainability (today)

• We ran EUTEMPE ateliers in Dublin ECMPE conf. 2022
• Modules have restarted.
  – Successfully finished
    • Module RPE (Braunschweig, D)
    • Module Digital Mammography (Nijmegen, NL)
  – Planned
    • Module Digital measurements (Guildford, UK)
    • Module advanced QA protocols (Leuven, B)
  – Being reworked: Module 1, on Leadership, addressing also nuclear medicine and radiotherapy. New module leader – probably – P. Gilligan
VI. Sustainability (today)

• Strengths
  – Unique course content; small group teaching; efficient

• Opportunities
  – Growing number of (young) MPEs in radiology
  – Fast technological development
  – Reach out to nuclear medicine, radiotherapy, other

• Threats
  – Work by volunteers; some of them very busy/retire soon.
  – How to ensure we fill the needs of the ‘people out there’

• Weaknesses
  – There is no financial reserve; all effort went into keep registration fees low
  – Cannot financially support expansion of modules
Summary

• There are still a few places for the Module in Leuven
• The last 4 modules have been successful (number of participants; updated content; enthusiasm)
• If we can cope with the work load, we will continue. However, we have to plan the future (better)
• The EUTEMPE team is open for any offer to expand topics and to reach out better to the world of MPEs/RPEs (announcing the courses)