Module MPE09: Achieving quality in diagnostic and screening mammography

ABSTRACT

Title: Achieving quality in diagnostic and screening mammography

Module Code: MPE09

Module Level: EQF level 8

Aims: This module aims to help the future MPE acquire the knowledge, skills and competences necessary *to* exercise a leadership role within diagnostic and screening mammography in his own country and in Europe. The content of the module would address all aspects of diagnostic and screening mammography, including radiological and epidemiological issues and provide the knowledge to assess (screening) quality and to perform high level trouble shooting. *In the face-to-face phase participants will have the opportunity to discuss the major issues directly with the present European leaders of the profession. The participants would also be updated with the latest EU directives, guidelines and activities impacting the role to ensure they are at the forefront of these developments.*

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

MPE09.01	Interpret the principles of breast cancer screening, including epidemiology, radiological issues of mammography and controversies of screening.
MPE09.02	Interpret the process of reading of radiological images by radiologists and identify related physical parameters.
MPE09.03	Take responsibility for the specification, selection, acceptance testing and commissioning of breast imaging systems.
MPE09.04	Research, develop, implement and manage a state-of-the-art QC programme for mammography and new breast imaging technology based on a multi-professional approach.
MPE09.05	Take responsibility for high level troubleshooting in technical and physical aspects of breast imaging screening.
MPE09.06	Take responsibility for ethical issues in the area of radiation protection in diagnostic and screening mammography and apply them in practice.
MPE09.07	Take responsibility for ethical issues in the area of (breast cancer) screening.
MPE09.08	Assess, evaluate and optimise diagnostic effectiveness and patient dose for clinical protocols for diagnostic and screening mammography.

Date and Location of Face-to-Face Component: Nijmegen **18-22 January 2016**

Module Leaders:

Ruben van Engen (r.vanengen@lrcb.nl)
Head of the physicists at the Dutch Reference Center For Screening (LRCB). He is member of the European Reference Organisation for Quality Assured Breast Screening and Diagnostic Services (EUREF), the American Association of Physicists in Medicine tomosynthesis subcommittee and chairman of the mammography QC committee of the Dutch medical physicists association. He has extensive experience in leading consensus meetings on development of new QA protocols. He represents the group at public meetings and in numerous discussions with manufacturers. Teaching activities are linked to this role.

Wouter Veldkamp (w.j.h.veldkamp@lumc.nl)
Medical physicist and research advisor at the LRCB. He did his PhD thesis on computer aided characterization of microcalcifications in mammograms and was chairman of the dose reference levels committee in the Netherlands. His research focus is on medical image processing and image quality assessment in computed tomography and conventional x-ray imaging including mammography. He is involved in teaching in radiation protection and physics of medical imaging courses for students, residents, medical doctors and medical physicists.

Faculty: W.J.H. Veldkamp, R van Engen, R. Pijnappel, M.J.M. Broeders, N. Karssemeijer, R.W. Bouwman (provisional)

Delivery of the module: The module will achieve its learning objectives using a combination of online and face-to-face readings, fora, presentations and discussions. The online phase will be mostly asynchronous so that participants would not need to take time off their clinical duties and there will not be a problem with time zones. If any synchronous learning is required this would be in the evening or weekend. The face-to-face component will be over a period of 1 week (3 days learning, 1 day exercises, 1 day for assessment).

Total participant effort time: 88 hours

Assessment Mode: The assessment will consist of an open book examination and solving several practical problem cases. In the examination and problem solving candidates must show that they have sufficient in dept knowledge and are able to apply this knowledge in developing QC programmes and in high level troubleshooting.

MODULE DATA	
Module Homepage	www.eutempe-rx.eu
Module Code	MPE 09
Module Leader/s Please limit CV to a max of 250 words and to what is relevant to this module.	Ruben van Engen LRCB r.vanengen@lrcb.nl +31-24-3655155 Head of the physicists at the LRCB. He is member of EUREF, the American Association of Physicists in Medicine tomosynthesis subcommittee and chairman of the mammography QC committee of the Dutch medical physicists association. He has extensive experience in leading consensus meetings on development of new QA protocols. He represents the group at public meetings and in numerous discussions with manufacturers. Teaching activities are linked to this role. Wouter Veldkamp LRCB/LUMC w.j.h.veldkamp@lumc.nl Medical physicist and research advisor at the LRCB. He did his PhD thesis on computer aided characterization of microcalcifications in mammograms and is chairman of the dose reference levels committee of the NCS. His research focus is on medical image processing and image quality assessment in computed tomography and conventional x-ray imaging including mammography. He is involved in teaching in radiation protection and physics of medical imaging courses for students, residents, medical doctors and medical physicists.
Teaching Staff Teaching staff should be either recognised MPEs or in possession of a PhD. If not please contact the Secretary of the QAC.	(Provisional) R. van Engen: Module leader W. Veldkamp PhD: Module leader R. Pijnappel PhD, LRCB/University Medical Centre Utrecht M. Broeders, PhD, LRCB/Radboud University Nijmegen Prof. N. Karssemeijer PhD, head of Image Quality Group Radboud University R. Bouwman, researcher LRCB

<table>
<tr><td rowspan="2">Candidate Assessment
(all assessments open book)</td><td colspan="2">Written Assessment (open book):</td><td>A 4-hour paper with 3 case-study questions. No choice is allowed.</td></tr>
<tr><td colspan="2">Practical Assessment (open book):</td><td>High level trouble shooting case</td></tr>
<tr><td rowspan="2">Module Duration

The TOTAL number of hours of participant effort should be about 80. (including lectures, reading of assigned compulsory texts, participation in online fora etc)</td><td>Online phase

Asynchronous methods should be used whenever possible so that participants would not need to take time off their clinical duties and there will not be a problem with time zones. However synchronous methods (evenings or weekends only) should be used when crucial.</td><td colspan="2">The online component will be spread over a period of approximately 3 - 4 weeks and would require approximately 56 hours of reading and effort by the participants. The online phase will be mostly asynchronous so that participants would not need to take time off their clinical duties and there will not be a problem with time zones. If any synchronous learning is required this would be in the evening or weekend.</td></tr>
<tr><td>Face-to-face phase

Must include 1 day for revision and 1 day for the assessment proper.</td><td colspan="2">5 days: 3 days content delivery (24 hours), 1 day for revision, 1 day for assessment.

All modules: All learning materials including presentations will be sent to the participants 2 weeks before the first day of the face-to-face phase.</td></tr>
<tr><td>Date and location of Face-to-Face</td><td colspan="3">Prague 18 – 22 January 2016</td></tr>
<tr><td>Date of Assessment
Normally last day of face-to-face phase.</td><td colspan="3">22 January 2016</td></tr>
<tr><td rowspan="4">Breakdown of participant effort time</td><td colspan="2">Module Component</td><td>Estimated Time</td></tr>
<tr><td colspan="2">Online lectures, seminars, tutorials, fora</td><td>15 hours</td></tr>
<tr><td colspan="2">Online compulsory reading and online module task</td><td>33 hours</td></tr>
<tr><td colspan="2">Face-to-face lectures, seminars, tutorials, fora</td><td>25 hours (over 3 days)</td></tr>
</table>

	Face-to-face technical demonstrations	5 hours
	Face-to-face laboratory/clinical exercises	10 hours
	Total participant effort time	**88 hours**
	Free day for exam preparation day (same for all modules)	**1 day**
	1 day for assessment (same for all modules)	**1 day**

PRE-REQUISITES FOR THE MODULE	
Minimum entry qualifications, training and years of experience for *all* modules Same for all modules	EQF Level 6 in Physics (BSc Physics or equivalent) EQF Level 7 in Medical Physics (MSc Medical Physics or equivalent) 2 year equivalent clinical training in D&IR for clinical Medical Physicists 2 year equivalent Industry/Radiation Authority experience for Industry/Radiation Authority personnel.
Assumed previous KSC for *all* modules from the 'Inventory of Learning Outcomes for the MPE in Europe' (Annex I of the 'European Guidelines on the MPE') Same for all modules	GENERIC SKILLS : Generic Skills Required at EQF level 7 KSC FOR THE MPE AS PHYSICAL SCIENTIST: All Knowledge learning outcomes to EQF level 7 KSC FOR THE MPE AS A HEALTHCARE PROFESSIONAL: All Knowledge learning outcomes to EQF level 7 KSC FOR THE MPE AS EXPERT IN CLINICAL MEDICAL RADIOLOGICAL DEVICES & RADIATION PROTECTION: All Knowledge learning outcomes to EQF level 7 KSC SPECIFIC FOR THE MPE IN DIAGNOSTIC & INTERVENTIONAL RADIOLOGY: All Knowledge learning outcomes to EQF level 7 The Skills and Competences included in the IAEA document 'Clinical Training of Medical Physicists Specializing in Diagnostic Radiology' (IAEA Training Course Series, 47, 2010) to EQF level 7.
Pre-requisite EUTEMPE-RX online summary modules for *all* modules	MPE01 Development of the profession and the challenges for the MPE (D&IR) in Europe (online summary version accessible to all participants in all courses)
Additional pre-requisite EUTEMPE-RX online summary modules for *this* module Different for each module.	None required

MODULE CONTENT: AIM and SUMMARY LEARNING OUTCOMES	
Aim	This module aims to help the future MPE acquire the knowledge, skills and competences necessary *to* exercise a leadership role within diagnostic and screening mammography in his own country and in Europe. The content of the module would address all aspects of diagnostic and screening mammography, including radiological and epidemiological issues and provide the knowledge to assess (screening) quality and to perform high level trouble shooting. *In the face-to-face phase participants will have the opportunity to discuss the major issues directly with the present European leaders of the profession. The participants would also be updated with the latest EU directives, guidelines and activities impacting the role to ensure they are at the forefront of these developments.*
Learning Outcomes (10 – 15 learning outcomes which provide an overview of the KSC addressed in the module)	MPE09.01 Interpret the principles of breast cancer screening, including epidemiology, radiological issues of mammography and controversies of screening. MPE09.02 Interpret the process of reading of radiological images by radiologists and identify related physical parameters. MPE09.03 Take responsibility for the specification, selection, acceptance testing and commissioning of breast imaging systems. MPE09.04 Research, develop, implement and manage a state-of-the-art QC programme for mammography and new breast imaging technology based on a multi-professional approach. MPE09.05 Take responsibility for high level troubleshooting in technical and physical aspects of breast imaging screening. MPE09.06 Take responsibility for ethical issues in the area of radiation protection in diagnostic and screening mammography and apply them in practice. MPE09.07 Take responsibility for ethical issues in the area of (breast cancer) screening. MPE09.08 Assess, evaluate and optimise diagnostic effectiveness and patient dose for clinical protocols for diagnostic and screening mammography.

MODULE CONTENT: TARGET KSC TO BE DEVELOPED TO EQF LEVEL 8 From the 'Inventory of Learning Outcomes for the MPE in Europe' (Annex I of the 'European Guidelines on the MPE')	
KSC targeted in *all* modules These learning outcomes are common to and permeate *all* modules, although to a varying degree according to the topic of the module.	GENERIC SKILLS : All 'Generic Skills Required at EQF level 8' KSC FOR THE MPE AS PHYSICAL SCIENTIST: All Skills and Competences to EQF level 8 KSC FOR THE MPE AS A HEALTHCARE PROFESSIONAL: All Skills and Competences to EQF level 8 KSC FOR THE MPE AS EXPERT IN CLINICAL MEDICAL RADIOLOGICAL DEVICES & RADIATION PROTECTION (AND OTHER PHYSICAL AGENTS AS APPROPRIATE): All KSC for Scientific Problem Solving Service to EQF level 8 KSC SPECIFIC FOR THE MPE IN DIAGNOSTIC & INTERVENTIONAL RADIOLOGY: All KSC for Scientific Problem Solving Service to EQF level 8
***PRIMARY KSC* targeted in *this* module** These are the KSC which would be developed to Level 8 during this module. These should be mostly Skills and Competences. However, Knowledge learning outcomes should also be included when the knowledge normally acquired during Level 7 programmes is insufficient for the development of the skills and competences to level 8. The KSC codes from the 'European Guidelines on the MPE' should be inserted for easy reference.	Primary KSCs: **Knowledge:** K21. For each breast imaging modality, explain in detail the operation, technical principles and geometry of imaging equipment. K24, For each breast imaging modality, explain strengths and limitations and their impact on image quality / diagnostic efficacy (including any artefacts). K110. Describe the institutional framework of QA activity and regulation in breast imaging medical physics practice. K109. Define quality objectives in breast imaging medical physics practice. K2. Use physics, concepts, principles and theories to describe in detail and quantitatively, the structure, functioning, characteristics, strengths and limitations and use of breast imaging devices. K89. Explain protocol optimization principles in breast imaging medical physics practice. K65. Describe and discuss the principles of medical device design with respect to clinical effectiveness and safety, including human-factors. K23. For each breast imaging modality, list and explain user controlled variables/settings and their impact on image quality/diagnostic efficacy and patient risk. K14. For each breast imaging modality, explain the relationship between target image quality outcomes and imaging device performance indicators. K97. For each breast imaging modality, list and explain target imaging outcomes (e.g., in terms of image quality criteria) relevant to diagnostic effectiveness. **Skills:**

	S34. Analyze breast imaging devices and investigate their design, functioning, associated signal / image processing, safety features, typical specifications and performance indicators. S29. Use appropriate physical / software test objects / phantoms, data acquisition protocols, data recording forms, national / European / international protocols to measure the performance indicators of breast imaging devices, assess deviations from acceptable values (as indicated by manufacturer and international / European / national standard setting bodies), evaluate the relevance of deviations for clinical practice and suggest actions for restoring default performance. S29. For each imaging modality, identify device malfunctioning and take appropriate action. **Competences:** C27. Take responsibility for the proper functioning of breast imaging devices (including software, information systems, PACS) management including planning, evaluation of clinical needs, specification for tender purposes, evaluation of tendered devices, acceptance testing, commissioning, constancy testing (including setting of warning and suspension levels), maintenance, decommissioning, installation design and surveillance, and service contract management. C3. Take responsibility for applying the general concepts, principles, theories and practices of physics to the solution of clinical problems concerning the optimal use of diagnostic and interventional radiology devices and management of risk from associated ionizing radiations and other physical agents. C33. Establish and plan QA/QC procedures in appropriate support of breast imaging devices activity, optimize breast imaging devices. C39. Decide if actions are required on a breast imaging device to restore default performance. C56. Participate in the design and implementation of QA systems for breast imaging devices.
***SECONDARY KSC* targeted in *this* module** (EQF Level 8) These are the KSC that are included in the module but would be given less attention owing to time constraints. Please insert the KSC code from the 'European Guidelines on the MPE' project KSC Inventory.	Secondary KSCs: **Knowledge:** K43. Explain the basic principles of modelling and simulation including statistical modelling based on Monte-Carlo techniques. K9. Describe and explain the European and national legal frameworks, regulations, guidelines and codes-of-practice impacting the role of the MPE K69. Describe and explain in detail the DICOM standard including its application to own area of medical physics practice. K138. Explain the importance of ongoing horizon scanning for new and emerging technologies. K13. For each breast imaging modality, list and define device performance indicators relevant to image quality outcomes (e.g., limiting spatial and contrast resolutions, SNR, geometric accuracy) including discussion of accuracy, precision and stability. K86. For each breast imaging modality, explain EU and national legislation, recommendations and regulations impacting the use of the modality. K16. Explain in detail the DICOM standard for all breast imaging modalities including the meaning of the terminology used in the DICOM header of images from the various modalities. K108. Describe the intentions and principles of QA systems and formal systems for external accreditation by expert/professional bodies.

	Skills: Generic Skill: Find, select and define problems of interest. S3. Use statistical techniques / tests and software to analyse measurement data and manage associated uncertainties. S7. Use statistical packages for the analysis of clinical and biomedical data. S52. Handle and analyze medical breast images including the extraction of parametric data / images. S31. Carry out acceptance testing, commissioning and constancy testing procedures in own area of medical physics practice. S30. Evaluate technical specifications of commercial devices in own area of medical physics practice. S38. Interpret and apply local occupational protection rules as applicable to medical device QC procedures. S53. Set up devices, experiments and protocols for the measurement of physical variables relevant to clinical practice. S40. Utilize PACS and DICOM in breast imaging medical physics practice. S41. Apply available systems resources (e.g., RIS, PACS, DICOM data) to QA data elaboration and record. S10. For each breast imaging modality elicit information from DICOM file headers. S28. Utilize PACS and DICOM in breast imaging. **Competences:** C40. Define warning and suspension levels for breast imaging devices.
***NEW KSC* which are NOT** INCLUDED in the 'Inventory of Learning Outcomes for the MPE in Europe'.	Liaise with the Radiation Protection Expert. Liaise with radiologists, radiographers and epidemiologists to solve (image quality) problems and optimize breast cancer screening multi-disciplinary.

OUTLINE TEACHING PLAN	
Online phase	The online component will consist of a series of sets of compulsory readings on the topics below. Each set will be accompanied by an asynchronous online forum for difficulties and prompting question/s to provoke reflection and discussion. An initial range of topics are: (provisional) SECTION 1: Introductory concepts (e-learning) - Advanced concepts of (mammography) screening. - Radiological and radiographical aspects of breast imaging. - Principles of breast imaging image formation (acquisition/processing/presentation) and assessment, including new technologies like tomosynthesis, CAD, breast density software - Controversies in breast cancer screening. - SECTION 2: Quantitative measurements (e-learning) - Image quality assessment: o Linear system theory metrics o Contrast-detail analysis o Model observers - Dosimetry in breast imaging: o Dance model o Other models/Dicom header dose? - Existing QC protocols in breast imaging - Principles/philosophy of Quality Control procedures and limiting values. SECTION 3: Optimisation and trouble shooting (e-learning) - Optimization of breast imaging systems - Image processing in mammography - Quality assessment of breast imaging systems, including image processing and new technologies like tomosynthesis, CAD and breast density software. - High level trouble shooting.

Face-to- Face Phase	SECTION 4: Face-to-face meeting - Clinical lessons in clinical mammography and pathology (hands-on?) - Overview lecture on quantitative measurements in breast imaging - Overview lecture on model observers in breast imaging - Quality control protocol (practical casus) - System optimization (practical casus) - High level trouble shooting (practical casus) - Observer studies - Students give short oral presentation on a specific practical casus - Open tutorial on all topics within course