

[Title]

Validation of a competence profile for MR radiographers using a formal research process.

[Aims and objectives]

In the European Qualifications Framework (EQF) competence is defined in terms of 'responsibility and autonomy'. Thus a competence profile can be defined as a list of key responsibilities or activities for a given class of health care professionals. The Higher Education Network for Radiography in Europe (HENRE) has developed an inventory of agreed generic and subject specific competences for the first cycle of Radiography (diagnostic and therapy) education [1] and generic competences for the 2nd cycle. However, no competence inventory that can be applied to magnetic resonance (MR) and spanning the range of expertise from entry to expert level has been developed. The first cycle HENRE inventory indicates that it is highly unlikely that entry level radiographers would have received formal education for carrying out investigations carried out in a MR unit. Studies in MR education show concern regarding the insufficient education of MR practitioners and indeed most of the training carried out in MR clinical settings is informal, delivered in-house and rarely assessed[2-4].

Competence profiles are valuable to students, faculty, and employers. Such profiles help students form accurate perceptions of, and to be motivated to pursue a field of study. Faculty can use profiles to clarify practices in their disciplines, design appropriate educational materials and instruction, and link other disciplines to their own. Employers can use these profiles to communicate their expectations to educators and to guide professional development for employees. Program evaluators can use competence profiles to link learning outcomes to long-term skills and behaviours[5].

An initial literature search indicated that no agreed pan European competence profile for MR has yet been developed. The only publication we have come across that provides specific competences at the level of higher education that may be applied to MR is that of Caruana and Plasek [6], but this is limited to the imaging physics component only and the competences though cross-modality in nature were applied to CT scanning and not MR. Canada, USA and New Zealand each have a national MR competence profile however none of these are written in the knowledge-skills-competence format required by the European

Qualifications Framework or address the novice to expert continuum as suggested by Dreyfus[7, 8] , Benner[9] and Yields[10].

Owing to the limited time for CPD available and hence the impossibility of covering all the knowledge, skills and competences required for the full range of MR techniques available today, it's important that competence profiles are context specific. This study therefore sought to develop and validate a context specific competence profile for MR radiographers that would be necessary and sufficient to deliver the MR service portfolio and care pathway in Malta. The study forms part of a wider study on continuous professional development for MR radiographers in Malta. The research question underpinning the focus of the study is what competences do MR radiographers need to have in order to carry out the MR procedures to be delivered by 2020 in Malta in an effective, safe and efficient way?

[Methods and materials]

The development of the competence profile was preceded by three subsidiary studies the results of which fed into the development of the profile:

1. A forecasted national MR service portfolio for year 2020 was developed[11],
2. The national MR care pathway was optimized[12], and
3. A qualitative documentary analysis of MR qualification and certification frameworks in the major English speaking countries was carried out to identify any existent competence profiles and elements of best practice relevant to the development of a competence profile (submitted for publication and under review).

The results of the studies above were utilized to develop the competence profile. During the write up of the competence profile care was taken to ensure that criteria for a quality profile as discussed by Davis and Beyerlein [13] were adhered to. These characteristics are:

Comprehensive – addresses all key areas important to the profession or discipline

Conciseness – provides a snapshot of key responsibilities

Distinctness – statements are non-overlapping

Organized – statements are ordered or grouped for deeper meaning

Action Orientation – statements identify observable actions

Compelling – elements inspire development and respect.

An initial blueprint of the MR competence profile was reviewed by a small group of subject matter experts which included an MR radiographer, a consultant radiologist and medical physicist. The group had both clinical and pedagogical expertise. The resulting competence profile was then validated with a panel of MR stakeholders using a Delphi process. The list of MR competences with an attached 6-level Likert scale was piloted by two additional radiographers who practice MR imaging (one Maltese and one non-Maltese) and who are in possession of a higher qualification in MR imaging at EQF level 7. The remit was to assess each statement for appropriateness and accuracy, for any overlapping with other statements and for a level of content detail that was meaningful even to an outside reviewer. The final list included 43 competence statements grouped under 7 key activities (Table 1 in results section).

The Delphi technique which is used when expert judgement is required was then used to validate the blueprint by an MR expert group. The web-based Delphi method chosen for this study made it possible for a panel of busy MR experts to contribute to the optimization and validation of the competences. Although a face-to-face nominal group technique would also have been suitable, resource and time constraints precluded the possibility of this option. In addition, the Delphi method has the advantage that it promotes panel member contributions free of the influences of personal style and status impacting face-to-face techniques. A disadvantage of this method is that the researcher relies upon his personal interpretation without the opportunity for clarification that might occur in a face-to-face meeting. This disadvantage was reduced by carrying out email discussions between phase 1 and phase 2 of the Delphi technique. This produced additional qualitative data that enhanced the development of the competence profile.

7 participants representing the radiographers' and radiology society, the public and private sector radiology departments, the faculty of health sciences of the University of Malta, and medical physics were invited to participate. The intention was to create a balanced representation of the stakeholders (with different professional backgrounds in clinical, management, academic, and professional society) who are involved and collaborate in magnetic resonance imaging.

A link to the web based Delphi survey was sent to each of the experts. The participants were asked to register their level of agreement/ disagreement regarding the importance of each

competence statement using the following Likert scale: 1 = completely disagree, 2 = generally disagree, 3 = disagree, 4 = agree, 5 = generally agree, 6 = completely agree. No neutral ('neither agree nor disagree') point was used as suggested by Beaudin [14] but each participant was given the option to comment on or modify the statement. The measures of level of agreement/disagreement with the competence statement and level of consensus among the participants were the median and IQR respectively [15, 16]. Email correspondence was carried out between rounds to discuss further modifications to statements that either achieved too low a median level (4 and less), or too low consensus (IQR higher than 1) or where the comments from the participants showed that the statements could be improved further. In such cases attempts were made to improve the competence statements or to increase the level of acceptance with the proviso that the level of consensus did not become unacceptably low (i.e., IQR was never allowed to exceed 1.0). Ethical approval was received from the ethics committee of the University of Malta.

[Results]

All participants agreed to participate in the study. The tool for the validation of the competence profile and corresponding results of the first and second round of the Delphi are shown in Table 1. Modifications in competence statements in the second round designed to improve the competence statements or increase the level of acceptance and consensus are shown in italics.

No	Statement	Median1	IQR1	Median2	IQR2
Image Acquisition refers to the use of knowledge of anatomy, pathology and physics to produce images of high diagnostic effectiveness. The MR radiographer uses devices and optimizes imaging parameters to acquire the best possible images for interpretation.					
IA1.	Assumes responsibility for the planning and execution of Neurology MR including Diffusion Weighted Imaging, Magnetic Resonance Angiography, MR tractography, MR Neurography. <i>Planning for Deep Brain Stimulation is carried out under neurosurgeon's supervision</i>	5.0	0.5	6.0	1.0
IA2.	Assumes responsibility for the planning and execution of Body MR including Diffusion Weighted Imaging, Magnetic Resonance Angiography and MR Enterography.	5.0	0.5		
IA3.	Assumes responsibility for the planning and execution of Breast MR. <i>MR guided biopsy of the breast is planned under supervision of breast specialist.</i>	4.0	1.0	6.0	0.0
IA4.	Assumes responsibility for the planning and execution of Musculoskeletal MR including MR arthrography and e.g., patellar tracking).	5.0	0.0		
IA5.	Assumes responsibility for the planning and execution of MR Cholangiopancreatography (MRCP), MR Liver, MR Pancreas and MR Liver Elastography.	5.0	0.5		
IA6.	Assumes responsibility for the planning and execution of MR male pelvis including prostate and rectum.	5.0	0.5		
IA7.	Assumes responsibility for the planning and execution of MR female pelvis	5.0	0.5		

	including uterus, cervix, and ovaries.				
IA8.	Assumes responsibility for the planning and execution of Paediatric MR.	5.0	0.5		
IA9.	<i>Shares responsibility</i> for the planning and execution of MR sequences requested for the assessment of change in tumour burden as a measure of treatment response or tumour progression.	5.0	0.0	6.0	0.5
IA10.	<i>Shares responsibility</i> for the planning and execution of MR Cardiac procedures <i>under supervision of a cardiac specialist.</i>	5.0	1.0	5.0	1.0
IA11.	Assumes responsibility for the planning and execution of vascular MR.	5.0	0.5		
IA12.	Assumes responsibility for the planning and execution of MR carried out under general anaesthesia.	5.0	1.0		
IA13.	Assumes responsibility for the operation of MRIMR equipment at 1.5T and 3T.	6.0	1.0		
IA14.	Participates in oncology planning with MR-PET fusion imaging.	5.0	0.0		
IA15.	Assumes responsibility for the MR component of image acquisition in MR-PET.	5.0	1.0		
IA16.	<i>Discuss with radiologist</i> contraindications and psychological and / or somatic issues before patients attend the scan.	5.0	1.5	5.0	1.5
IA17.	Assumes responsibility for the evaluation of patient compatibility with MR procedure and imaging requirements.	6.0	1.0		
IA18.	Assumes responsibility for consulting with other MR stakeholders as necessary on issues related to the pathway including flagging of incidental findings to Radiologist and QA abnormal results to Medical Physicist.	6.0	1.0		
IA19.	Applies appropriateness criteria for MR referrals <i>following discussion with consultant radiologist.</i>	5.0	1.5	6.0	1.0
IA20.	<i>Applies prioritization guidelines following discussion with consultant radiologist.</i>	5.0	2.0	6.0	1.5
<p>Education - The MR radiographer participates in the education of patients, public and health care professionals about procedures, devices, facilities, current services, safety and legislation. The radiographer contributes to quality healthcare professional education by participating in the education of medical imaging students and organization of medical imaging educational programmes.</p>					
E1.	Assumes responsibility for providing information to patients before scanning and obtain informed consent.	6.0	1.0		
E2.	Participates in providing information on the diagnostic utility of different techniques and associated pulse sequences in the various areas of MR to healthcare professionals and specialty trainees.	5.0	1.0		
E3.	Participates in <i>multi professional</i> educational programmes aimed at ensuring that all MR stakeholders are informed about the various components of the MR Care Pathway (e.g., referral guidelines)	6.0	1.5	6.0	1.5
E4.	Participates in the provision of information about the strengths, limitations and safety of other stakeholders including the general public.	6.0	0.5		
E5.	Participates in the development of quality assured MR courses to MD and Non-MD Healthcare professionals.	6.0	0.0		
E6.	Assumes responsibility for mentoring student radiographers, and for participation in the education and training of student medical physicists and radiology trainees during their clinical placements	6.0	0.5		
<p>Quality assurance ensures that high standards are maintained and includes quality control procedures carried out in a systematic and reliable manner. This means that all healthcare professionals and patients are satisfied with the quality and consistency of the MR examination. QA means consistent, effective, safe and efficient MR Care Pathway. For patients, QA nurtures confidence in consistently receiving a quality MR examination that meets the requirements of the procedure. The radiographer participates in QC programmes, documents and analyses the results and liaises with Medical Physicists when QC values are out of acceptance levels</p>					
QA1.	Participates in the establishment of objective quality criteria for the evaluation and monitoring of quality criteria at all stages of the care pathway.	6.0	1.0		
QA2.	Assumes responsibility for preparing and documenting a controlled radiographer's technical report for each scan. (Technical report	6.0	0.5		

	would include information about patient assessment; image quality; SAR levels; clinical indications; sequence optimization, incidental findings or patient assessment).				
QA3.	Participates in the development, distribution, collection, analysis and reporting of patient satisfaction surveys.	6.0	0.0		
QA4.	<i>Participates in multi professional group</i> in auditing of the Care Pathway against national and local quality benchmarks (e.g appropriateness of referrals, patient satisfaction, radiographer technical report).	6.0	0.5	6.0	1.0
QA5	<i>Participates in multi professional group</i> in the auditing of the effectiveness of the MR service against target patient management outcomes.	5.0	1.0	6.0	0.5
Safety and Risk Management relates to the overall safe care of the patient and/or their guardians, public and other workers. It involves the collection of data about the patient and procedure. The radiographer participates in the determination of the most appropriate action plan that results in enhanced safety to patient and others. The radiographer shares participation in the monitoring of MR and related devices, evaluation of clinical protocols to ensure the on-going protection of patients, and persons from the deleterious effects of physical agents and development of risk assessment tools (e.g safety screening forms, patient experience surveys).					
SRM1.	Assumes responsibility for risk assessment and the provision for the physical and psychological needs of patients before, during and after the scan.	6.0	0.5		
SRM2.	Assumes responsibility <i>for the application of standard safety operating procedures</i> in maintaining a working environment safe from hazards that could arise from chemical, physical and biological agents.	6.0	0.5	6.0	1.0
Service Unit Management encompasses the performance or management of business operations and the making of any decisions to meet the goals of the organisation and the goals of the examination. It includes the day-to-day tasks of organising patient data and records, the management of staff, and resources.					
SUM1.	Participates in the delivery of information on and application of MR legislation.	6.0	1.0		
SUM2.	Participates in the update of local MR departmental regulations and procedures to any EU legislation and documentation.	6.0	1.0		
SUM3.	Participates in the use referral guidelines in order to prioritize accessibility to services.	6.0	1.0		
SUM4.	Participates in the development of Standard Operating Procedures (e.g., regulating non-MD referrals if these are implemented).	6.0	1.0		
Facility Management – Radiographers participates in the specification and selection of medical devices in accordance with the latest published European or International recommendations. The MR radiographer provides advice on the development of quality management systems. Provides advice on the human factors and ergonomics of MR equipment, accessories and room design. Advise policy makers on initiatives that address waiting list and productivity. Participates in health technology assessment activities.					
FM1.	Assumes responsibility for the provision of on call services on a 24/7 basis.	6.0	0.5		
FM2.	Assumes responsibility for the offer of advice on the management of resources including waiting list initiatives.	6.0	0.5		
FM3.	Participates <i>in a multi professional group</i> in the development of referral guidelines and the certification of MR referrers in order to grant referring privileges.	6.0	1.5	5.0	1.0
FM4.	Participates in activities for ensuring that quality and safety of MR services are ISO assured.	6.0	0.5		
FM5.	Participates in the procurement of MR scanners and associated medical devices.	6.0	1.0		
Research ensures that all activities will be based on current best evidence or own scientific research when the available evidence is not sufficient.					
RES1.	Takes responsibility for independent research or with other healthcare professionals.	6.0	0.5		

Table 1 – Competence statements with corresponding median and IQR values. Modifications in competence statements for the second round of the Delphi are shown in italics.