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EFOMP policy statement 18: Medical physics education for the non-physics healthcare professions

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ABSTRACT

Although Medical Physics educators have historically contributed to the education of the non-physics healthcare professions, their role was not studied in a systematic manner. In 2009, EFOMP set up a group to research the issue. In their first paper, the group carried out an extensive literature review regarding physics teaching for the non-physics healthcare professions. Their second paper reported the results of a pan-European survey of physics curricula delivered to the healthcare professions and a Strengths-Weaknesses-Opportunities-Threats (SWOT) audit of the role. The group's third paper presented a strategic development model for the role, based on the SWOT data. A comprehensive curriculum development model was subsequently published, whilst plans were laid to develop the present policy statement. This policy statement presents mission and vision statements for Medical Physicists teaching non-physics users of medical devices and physical agents, best practices for teaching non-physics healthcare professionals, a stepwise process for curriculum development (content, method of delivery and assessment), and summary recommendations based on the aforementioned research studies.

1. Introduction

Although Medical Physics educators[1] have historically contributed to the education of the non-physics healthcare professions,[2] their role was not studied in a systematic manner. In 2009, EFOMP set up a group to research the issue. In their first paper, the group carried out an extensive literature review regarding physics teaching for the non-physics healthcare professions [1]. Their second paper reported the results of a pan-European survey of physics curricula delivered to the healthcare professions and a Strengths-Weaknesses-Opportunities-Threats (SWOT) audit of the role to assess its actual state in Europe [2]. The group's third paper presented a strategic development model for the role, based on the SWOT data. Critical components of the strategic development model were updated modern mission and vision

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[1] The title 'Medical Physics educator' in this policy statement includes any academic or clinical physicist offering teaching and/or training to non-physics healthcare professionals. This will include not only Medical Physicists, but also Biomedical Physicists, Biophysicists, Medical Biophysicists, Clinical Physicists, Radiological Physicists and similar others.

[2] The term 'Non-physics healthcare professions' refers to medicine and surgery, dentistry, pharmacy, nursing, midwifery, radiography, physiotherapy etc and their specialties and subspecialties (e.g., radiology, cardiology, neurology, critical-care nursing, oncology nursing etc).

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statements for the role, and an emphasis on the need for the construction of a curriculum development model to guide role holders in improving the relevance and effectiveness of their teaching. The publication of a corresponding policy statement by EFOMP was also considered critical to ensure a harmonized pan-European approach [3]. A curriculum development model was subsequently published [4], whilst plans were laid by the Education & Training and Professional Matters committees of EFOMP to develop the present policy statement. To be appropriate and useful, it is vital that policy statements be based on systematic and comprehensive research; this policy statement is therefore based on the research results of the aforementioned articles.

2. Medical physicists teaching non-physics healthcare professionals

To strengthen the role and ensure its future relevance, Medical Physics educators should focus their teaching on those areas in which their own competency is strongest. Medical Physicists should perceive their role as having a bridging function, spanning the ever-widening gap between the physics knowledge and skills underpinning the effective, safe and economical use of **medical devices (including stand-alone software devices)** and associated **physical agents**[3] and the practice-oriented curricula of the healthcare professions [3]. Medical devices and physical agents are well-defined legal terms and our association with these areas is strong and incontestable. *Medical Physicists are now involving themselves in all medical devices and all physical agents (*i.e.*, not only the radiological devices and ionising radiations within the scope of 2013/59/EURATOM).* This expanded role of the Medical Physicist is increasingly being cemented in EFOMP policy [5–8]. Medical Physicists teaching healthcare professionals are increasingly being requested to teach not only the physics of ionising and non-ionising radiation based medical devices but the physics of *all* medical devices ranging from the various forms of microscopy, to spectrophotometry, physiotherapy and medical nanodevices and including any associated human biophysics.

A cursory look at university undergraduate prospectuses, confirms, that entry requirements in physics for healthcare professional undergraduate degrees are decreasing in many countries in Europe. On the other hand, the number and sophistication of medical technology are increasing rapidly. To compensate for any insufficiency in physics knowledge and skills, Medical Physicists must, in the interest of patients, workers and the general public, increase their involvement in the education of the healthcare professions at all levels. Otherwise, healthcare systems are more likely to end up staffed by healthcare professionals with an unsatisfactory understanding of the medical devices and physical agents that they use on a daily basis. It is also important to keep in mind that effective Medical Physics teaching should be based on evidence from educational research. Medical Physics educators must ask themselves such fundamental questions as:

- What Medical Physics content do the specific healthcare professionals that I am presently servicing need most?
- What are their backgrounds and previous knowledge of physics?
- How best to communicate successfully with these healthcare professionals and what pedagogical tools would be most effective?

Such questions can only be answered through quality, publishable research.

3. Mission and vision statements for physicists teaching non-physics users of medical devices and physical agents

The following constitutes an updated comprehensive mission statement for physicists teaching healthcare professionals:

"We will make a key contribution to quality healthcare professional education through knowledge transfer activities concerning the techno-scientific knowledge, skills and competences supporting the clinically-effective, evidence-based and economical use of medical devices and safety issues concerning associated physical agents. Our efforts will be guided by an appreciation of the value of the healthcare professions and underpinned by research-based curriculum development" [3].

A corresponding future-oriented *vision statement* that would provide guidance for role holders is:

"*The medical physics educator will be recognized by the educational leaders of all healthcare professions across Europe as the educator of first call with respect to the techno-scientific knowledge, skills and competences underpinning the clinically-effective, evidence-based and economical use of medical devices and safety issues concerning associated physical agents and be perceived as providing a practice-oriented, learning-outcomes based, well-integrated, research-based, internationally harmonized, ethically and inter-professionally oriented, contribution to the education of the healthcare professions*" [3].

4. Best practices for teaching non-physics healthcare professionals

Medical Physicists teaching non-physics healthcare professionals should base their curricula (i.e., curricular content, method of teaching and assessment) on the following principles [4]:

(a) Study the backgrounds of the participants in your courses: What is the healthcare profession? What is its role and at what professional development level would you be teaching (in terms of the European Qualifications Framework (EQF) [9], whether pre- or post-qualification, specialisation or sub-specialisation levels)?
(b) Study the clinical procedures and perform a risk analysis to identify the specific physics knowledge and skills required by the participants of your courses in order to be safe practitioners. It is important to consult the relevant manufacturers' recommendations and any published national and international guidelines for safe use.
(c) Keep in mind that, owing to the rapid expansion of healthcare there are increasing pressures on teaching time for both the healthcare curriculum in general and the physics component; hence, only those physics learning outcomes specifically required by the learning needs of the particular healthcare profession and educational level should be included. Use any published curricula of the healthcare professions and other documents to guide you. Examples abound in the literature; however, keep in mind that given the ever-increasing pace of development of medical device technology, many such curricula become outdated very quickly and may therefore need updating.
(d) Owing to the immediate need for employability of First Cycle graduates (EQF terminology for the Bachelor level), curricular content necessary for the effective and safe use of medical devices at entry level to the particular profession should be included and solidified at the early stages.
(e) The physics curriculum should allow for the fact that the roles of many healthcare professionals today encompass the use of an ever-widening range of medical devices, however the *proficiency*

[3] 'Physical agents' is the legal term for all physical sources of energy including the entire electromagnetic spectrum, sound and ultrasound, radioactive materials, particle beams, vibration, heat and cold.

level[4] in the use of any specific device varies by profession and country.

(f) The physics knowledge and skills should be formulated in precise, scientific, up-to-date, yet understandable terminology and in a way that promotes a consistent and harmonized use of physics terminology across devices and professions - this would guarantee an integrated approach to medical devices and the avoidance of communication errors in multi-professional healthcare teams.

5. Stepwise process for curriculum development (content, method of delivery and assessment)

The main steps to take in the development of a curriculum suitable for teaching non-physics healthcare professionals are as follows:

(a) **RESEARCH** the learning needs of the particular healthcare profession to ensure relevancy of content. In particular, it is important that the physics curricular content for the healthcare professions not simply be a watered-down, non-mathematical version of the content for physicists. Every profession has own unique role and characteristics that should be respected. Healthcare professionals have a different attitude toward physical science and mathematics than physicists and this must be kept in mind if we are to be effective educators.

(b) **IDENTIFY** healthcare professional competences which include significant physics knowledge and skill learning outcomes. It is important to consult relevant EU, national and local documentation associated with the devices and physical agents and very importantly refer to the curricular documents of the healthcare professions. The outcome of this step of the process would be a list of medical devices used by the particular profession and an estimate of the proficiency level required for each device.

(c) **COMMUNICATE** your proposal to the educational programme leaders (European, national or local according to context) of the particular healthcare profession and ask for feedback. Revise your proposals according to the feedback and your own beliefs and iterate if necessary.

(d) **APPLY** the ***Generic (Bio)Medical Physics Learning Outcomes Inventory for the Non-physics Healthcare Professions*** found here ([4] Appendix) to identify the physics knowledge and skills necessary for the particular medical devices and physical agents and at the desired proficiency levels. The inventory is purposely generic to be applicable to all medical devices, physical agents and proficiency levels. These device-specific knowledge and skills learning outcomes will determine syllabus content.

(e) **EMPLOY** current preferred methods of curricular delivery in your educational or training organization (outcome-based, problem-centred, case-based etc.) and optimising weighting of breadth versus depth and sequencing of content, techniques for curriculum delivery (lecture-based, small group-based, eLearning, problem-based learning, inquiry-based learning, flipped learning and others) and assessment methods.

(f) **COLLECT** curricular resources and evaluate them objectively in terms of suitability.

(g) **QUALITY CONTROL** your teaching programme iteratively and in an ongoing manner. Solicit student feedback and set measurable programme key performance indicators for assessing the level of success or otherwise of your pedagogical techniques.

Further explanation and discussion of the above principles can be found in [4]. An example of a learning outcome inventory for a particular healthcare profession developed using the aforementioned perspectives can be found here [10].

[4] Operational definitions of Proficiency Levels appropriate for medical devices and physical agents can be found in reference [4] Table 1.

6. Summary recommendations

(a) As the level of physics knowledge and skills among non-physics healthcare professionals appears to have a downward trend, it is critical that Medical Physicists assist by increasing their involvement in the education and training of the healthcare professions.

(b) It is important to respect the uniqueness of every healthcare profession and tailor content to the specific learning needs of that particular profession; specifically, physics content should be developed following an analysis of the role of the particular healthcare profession, its future aspirations and educational and professional documentation related to the profession.

(c) All physics curricula should be expressed in terms of knowledge, skills and competences as required by the European Qualifications Framework (EQF) and be quality controlled in an ongoing manner.

(d) To ensure that learning outcomes are well designed, couched in up-to-date scientific and educational terminology and help promulgate a harmonised approach across Europe it is advisable to make good use of the **Generic (Bio)medical Physics Learning Outcomes Inventory for the Non-physics Healthcare Professions** found here ([4] Appendix).

(e) It is important that the level of detail of physics knowledge and skills taught to a particular healthcare profession corresponds to the legal clinical role of that particular healthcare profession and should not go beyond this. In order to avoid becoming inadvertently involved in inter-professional conflicts, one should focus only on the physics related to the specific role of the particular healthcare profession.

(f) Last but not least, it is important to publicise the role of the Medical Physicist as a member of the healthcare professional team in order to heighten awareness and appreciation of the role among the non-physics healthcare professions.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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