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Need for Competency-Based Radiation Oncology Education in Developing Countries

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Abstract

Although not a new concept in itself, competency-based education has set the trend for the globally accepted standard norm for education and training of medical professionals including postgraduate education in radiation oncology. Societal needs demand from radiation oncologists that they be not only competent in the knowledge and skills relevant to their specific discipline, but that they also display competencies such as professionalism, scholarship, health advocacy, management/leadership, collaboration and communication. The realities of developing countries, in particular low and middle income countries (LMICs) set different priorities than in high income countries. A large proportion of cancer patients do not have access to adequate radiotherapy services. Resource constraints determine limitations in equipment, accessories, and dosimetry. Lower than standard staffing levels and limited quality education and training also contribute to substandard care and clinical outcomes. In this environment, the addition and assessment of competency-based elements to training programmes can be challenging. On the other hand, it is precisely in these countries, where competencies such as the ones listed above are highly needed in the radiation oncology profession. Implementation of competency-based medical education in the education of radiation oncologists in LMICs is both a need and a challenge. The available frameworks and competencies, despite being very relevant to the realities faced by radiation oncologists in LMICs, will still need to be adapted in order to ensure effective implementation at the national/regional level. Radiation oncologists need to employ effective change-management strategies to ensure

that the changes which are introduced can remain sustainable within the context of national healthcare, education and political systems.

Keywords

Competency-Based, Medical Education, Radiation Oncology

1. Introduction

Modern developments in radiation oncology require specialists who are able to meet the associated growing challenges. This can be achieved by providing the knowledge, skills and attitudes which underpin defined competencies in areas including communication, collaboration, social actions, organization and management. Knowledge and skills necessary for the application of certain techniques in specific fields of oncology have been recognized and underlined as the major driving forces for education and training in the past, which included implicitly the ability to carry out specific activities. A new explicit paradigm "competency" expresses the knowledge, skills and attitude in a way that ensures professionals in current and future oncology-related disciplines are educated appropriately and comprehensively in order to meet the growing demands of more complex patient management approaches.

Competency-based radiation oncology education is well established in North America and some European countries, Australia, Malaysia and other countries. This article discusses the need and implications of promoting and sustaining a competency-based radiation oncology training programme in countries with limited resources.

2. The Unmet Needs of Low- and Middle-Income Countries (LMICs) in Radiotherapy and Trained Medical Professionals

Radiotherapy is an important component of cancer management worldwide. According to a recent analysis in several European countries (Borras et al., 2015) and developing countries in Asia and Africa (Rosenblatt et al., 2015), more than 50% of cancer patients require radiotherapy for curative and/or palliative indications.

However, the availability and distribution of radiotherapy facilities, equipment and personnel vary widely between and even within regions (Zubizarreta et al., 2015), with a very strong correlation between national income and availability (Levin & Tatsuzaki, 2002). Despite having 80% of the global cancer burden, low and middle income countries have access to only 32% of the total available resources (Atun et al., 2015). With more than two-thirds of the world population being served by only a third of the world pool of radiotherapy machines (Datta et al., 2014), radiotherapy is unfortunately far less accessible in the countries where it is most needed. This and other healthcare system limitations, inevitably result in a higher mortality from cancer in low and middle income countries (Batouli et al., 2014).

Further complicating the matter, radiotherapy as a clinical modality requires not only equipment but also trained medical professionals (Atun et al., 2015; Izewska, 2008). Unfortunately, radiation oncology education is still non-existent in many countries (Morhason-Bello et al., 2013; Abdel-Wahab et al., 2013), resulting in the need to send trainees to academic centres in developed countries. This is not only resource-demanding but also brings along the risk of "brain drain" caused by exodus of human capital, as these individuals, faced with the prospect of poor academic and financial resources in their home countries, might decide to settle in developed countries instead (Agbiboa, 2012).

It is therefore important that education initiatives be started, at least at the regional level and preferably nationally, in order to train professionals who are able to work effectively within the healthcare system and are sensitive to the local needs faced by the population while preventing a drain of intellectual capital from countries which are already facing a shortage.

3. Competency-Based Medical Education in Radiation Oncology

3.1. Competency-Based Medical Education

Competency-based medical education is an approach to preparing physicians for practice that is fundamentally oriented to graduate outcome abilities and organized around competencies derived from an analysis of societal and patient needs. It deemphasizes time-based training and promises greater accountability, flexibility, and learner centredness (Frank, Mungroo et al., 2010).

Although not a new concept in itself, competency-based education has set the trend for the globally accepted standard norm for education and training of medical professionals including postgraduate medical education (World Federation for Medical Education, 2003). Multiple definitions exist for competency-based medical education (Frank, Snell et al., 2010). Common themes shared by the various definitions include competencies constructed from societal needs, the use of competencies as the basis for constructing applicable and observable outcome abilities towards which the education process is oriented, and a shift of focus towards developmental progression instead of training duration. All these result in the learner, instead of the teacher, becoming the centre of the system (Frank, Mungroo et al., 2010; Frank, Snell et al., 2010). It is "competency by design" (Iobst et al., 2010), requiring education programmes to focus their efforts and resources towards the achievement and assessment of desired competencies, with less reliance on opportunistic learning.

3.2. Defining Competencies: The Three-Circle Model

The Three-Circle Model (**Figure 1**) (Harden, 1999) was initially developed in the context of undergraduate medical education to create "competent and reflective medical practitioners". This model illustrates the interconnected nature among technical competencies which constitute the inner circle (performance of tasks), attitudes with which the technical competencies are done which constitute the

Figure 1. The three-circle model diagram for outcome-based education. The Dundee three-circle model for considering the learning outcomes in medicine offers a practical and user-friendly method to encouraging a holistic approach to medical practice.

middle circle (approach to task), and personal/professional developments which constitute the outer circle (professionalism). The Three-Circle Model is further elaborated into seven learning outcomes in the inner circle, three learning outcomes in the middle circle, and two learning outcomes in the outer circle. This model and its learning outcomes formed the basis for the development of The Scottish Doctor framework by The Scottish Deans' Medical Curriculum Group (Simpson et al., 2002; Simpson et al., 2015).

Despite its initial context, the three-dimensional view of the model as slices representing areas of medical practice (specialty) enables it to provide tighter integration and cohesion not only among medical specialties but also between undergraduate and postgraduate medical education, in an attempt to break the "silo mentality" in which different phases and areas of medical education are developed in isolation of each other. The "silo mentality" refers to the reality in which the different phases or stages of education (medical school, postgraduate training, internship, continuing medical education) are considered in isolation with different organizations responsible for their implementation, regulation and funding (Harden, 2006).

It is the intuitive nature of this model and its flexibility in perspective that makes it a promising model for application as a future unified model not only for undergraduate but also postgraduate medical education.

4. Competency Framework: The Canadian Medical Education Directives for Specialists (CanMEDS)

The CanMEDS initiative was initiated in the 1990s in Canada in response to the concerns raised by the Fellows of the Royal College of Physicians and Surgeons of Canada (RCPSC) regarding the tremendous change in medical practice (Frank, 2005). From this, a working group was created to identify the core competencies which were required by all physicians to undertake their role and be able to meet societal needs. The first publication of the framework in 1996 described the seven essential physician competencies: Medical Expert, Professional, Scholar, Health Advocate, Manager, Collaborator and Communicator. Follow-

ing its adoption as the standard for training within all postgraduate medical specialties in Canada, subsequent development took place looking at pilot studies, implementation and faculty development. In 2005 the CanMEDS diagram ("flower") (**Figure 2**) was revised to reflect the overlap and interconnected nature of the seven roles. The "Medical Expert" role is acknowledged as central within the framework but also draws significantly from the competencies of the other six roles, often described together as the non-medical expert (NME) roles. This arrangement signifies the goal of creating competent physicians possessing not only biomedical expertise but also additional NME skills who will be able to serve patients and society as a whole. In addition, to assist implementation at the program level, competencies and objectives are defined and arranged in a taxonomy consisting of eight levels starting from the framework construct (level 1) to instructional-event specific objectives (level 8) (Frank, 2005). Extensive guides on pertinent aspects from design to assessment have been published (Sherbino & Frank, 2011; Bandiera et al., 2006).

Ongoing review of the effectiveness of the CanMEDS framework to deliver the "competent and socially accountable physician" is taking place in Canada as part of the "Future of Medical Education in Canada Postgraduate Project (FMEC PG)". Notable changes to the CanMEDS framework include refinement of the description for each Role, a name change of the Role "Manager" into "Leader", and the adoption of the concept of competency milestones (Frank, Snell et al., 2014; Frank, Snell et al., 2015).

As Leaders, physicians should develop a vision of a high-quality health care system and, in collaboration with other health care leaders, take responsibility for effecting change to move the system toward the achievement of that vision.

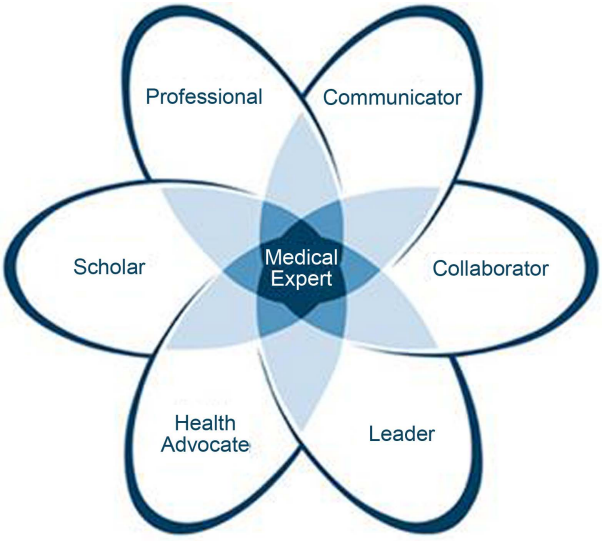

Figure 2. The CanMEDS diagram. Updated in 2015, the CanMEDS diagram highlights the central role of being a medical expert, but also the partially overlapping nature of other competencies. The "leader"role is a new addition.

Society has explicitly identified management and leadership abilities as core requirements for the practice of medicine. Physicians and others exercise collaborative leadership within the complex health care systems that form their specific work environments. At a system level, physicians contribute to the development and delivery of continuously-improving health care and engage others to work with them toward this vision. Physicians must balance their personal lives with their responsibilities as leaders and managers in their everyday clinical, administrative, research, and teaching activities. They function as individual care providers, as members of teams or groups, and as participants and leaders in the health care system locally, regionally, nationally, and globally. The CanMEDS Leader Role describes the active engagement of all physicians as leaders and managers in decision-making in the operation and ongoing evolution of the health care system.

This leadership role is particularly important and a high priority for radiation oncologists in low-middle income countries. In this environment it makes a significant difference the presence of a person or persons who have and put in practice leadership skills to develop services, organize processes, hire staff, successfully occupy managerial positions and partner with donors and international organization to move projects forward.

5. Assessment Milestones: Accreditation Council for Graduate Medical Education (ACGME)

The Accreditation Council for Graduate Medical Education (ACGME) is the primary organization responsible for overseeing physician residency education in the United States. Together with the American Board of Medical Specialties (ABMS), it implemented what are currently referred to as the Six Core Competencies, which include Medical Knowledge, Patient care, Professionalism, Interpersonal and Communication Skills, Practice-Based Learning and Improvement, and Systems-Based Practice. These six competencies are expected to be achieved through medical education and training and ultimately demonstrated and maintained in their daily practice.

In March of 2014 the ACGME generated a set of milestones that define the behavioural attributes essential to be demonstrated in each competency before a resident moves on to the next level or graduates. These Milestones were arranged into numbered levels from Level 1 to Level 5, which is synonymous with moving from novice to expert and do not correspond with post-graduate year of education. Level 4 is designed as the graduation target, while level 5 typically involves research. A toolbox of methods has also been provided for use in the assessment of these milestones (Green & Holmboe, 2010).

Viewed as a whole, efforts to successfully address all of the Competencies and Milestones can be viewed as opportunities for programmatic synergism. The ACGME Competencies and Milestones have been implemented in all residency programs in the United States, including radiation oncology, as part of their accreditation requirements.

6. Regional Initiatives: The ESTRO Core Curriculum

The European Society for Radiotherapy and Oncology (ESTRO) faces a unique challenge as compared to the United States and Canada. European professional societies including ESTRO, are in no position to issue region-wide regulations concerning the education and training of medical professionals in individual countries. However, it is possible and necessary for ESTRO to facilitate agreement on core concepts and common systems to be endorsed by national authorities (Leer et al., 1991), since the right of mobility for medical professionals across Europe has been guaranteed by the European law (European Union, 1993).

With the aim of harmonizing the education and training of radiation oncologists, for more than two decades ESTRO has developed core curricula for the education and training of radiation oncologists in Europe. Two versions of the core curriculum have been produced in 1991 (Leer et al., 1991) and 2004 (Baumann et al., 2004), consisting of areas in which trainees have to demonstrate their ability in patient management, and topics which they should have knowledge of. The first version of the core curriculum was endorsed by 22 European member countries in 1991, while the second version in 2004 was endorsed by 35 member countries (Eriksen et al., 2012).

In 2007, ESTRO refined its approach towards Competency-Based Medical Education and initiated a major revision of its core curriculum (Eriksen et al., 2012). This third revision is based on the seven general competencies described in the CanMEDS system. Realizing the limitations of the classic way of resident evaluation, ESTRO advocates that new approaches for evaluation of competencies be introduced in radiation oncology training programs. These new approaches, including formal supervision, direct observations in practical situations, mini-CEX, 360-degree evaluation, delineation tools and tests, and portfolio including a log-book, are expected to not only provide a more structured and transparent assessment of developmental progression of the residents but also to promote learning.

ESTRO changed its original training logbook (Hunter et al., 2004) into a web-based portfolio, which could serve as a "European passport" for graduates in radiation oncology demonstrating the achieved skills and knowledge during the training. ESTRO opened the way to the use of an electronic logbook during residency training, which was subsequently replaced by national electronic logbooks that follow national priorities.

7. Curriculum Development: The Royal Australian and New Zealand College of Radiologists

The Royal Australia and New Zealand College of Radiologists (RANZCR) Faculty of Radiation Oncology training program curriculum (RANZCR, 2012) was developed as a response to the need to increase the transparency of all aspects of training, by adopting modern evidence-based educational and adult-learning concepts. The curriculum is built around the seven roles as described in the

CanMEDS framework relevant to radiation oncology. The RANZCR further expands the key roles by the use of role statements, which is further illustrated with learning outcomes that describe the competencies necessary for completion of training. In order to assist implementation, the learning objectives for the "Medical Expert" role are structured as the Oncology Sciences, the Radiation Oncology Central Knowledge and Skills Summary (ROCKSS) and the Medical Expert Supplement (MES). The Oncology Sciences comprise subjects that require knowledge at a foundation level for further attainment of skills and knowledge in clinical applications. The ROCKSS provides an overview of the clinical competencies that are not tied to a specific site or clinical situation but form the core requirements for achievement of site-specific learning outcomes. MES, on the other hand, provides a list that organizes learning outcomes for each tumour site. It is further organized as sites of major focus and lesser focus depending on the expected role of radiation oncologists in their care and management.

The RANZCR also includes an assessment blueprint in the curriculum document, delineating the roles and the various assessment tools which may be used to provide evidence of achievement. The assessment tools include Mini-Clinical Evaluation Exercise (Mini-CEX), Clinical Supervisor Assessments (CSAs), Director of Training (DOT) Assessments, Trainee Assessment of Training Site (TATS), Multi-Source Feedback Assessment (MSF), Clinical Assignments, Practical Oncology Experience, Examinations, Case Reports, Research Requirement and Statistical Methods, evidence Appraisal and Research for Trainees (SMART) point accrual.

The RANZCR Curriculum has been successfully implemented in Australia and New Zealand. A recent evaluation (Turner et al., 2015) showed positive views from trainees, supervisors and directors of training, with a significant majority agreeing that in addition to providing direction, it also promoted periodic and meaningful interaction between trainees and their supervisors and improved readiness for practice.

8. Oncology Training in a Middle-Income Country: The Malaysian Model

Prior to the new millennium, the Malaysian Government has traditionally sent clinicians to the UK for post-graduate training in Clinical Oncology. While this provided an opportunity for trainees' exposure to treatment facilities and techniques in a developed country, it also proved to be a costly practice. In addition, most of the training occurred outside the context of the local culture and pattern of malignancies frequent in Malaysia.

In 2000, there were only 30 practising oncologists in Malaysia to serve a population of 20 million, which was significantly lower than the ratio recommended by the World Health Organisation. With rising incidence of cancer in Malaysia, it was decided that a local university-based programme was required to train oncologists locally to provide the necessary non-surgical cancer services

for a growing population. Due to resource constraints and the need for versatility, the "clinical oncology" model was preferred to training either medical or radiation oncologists separately.

The following year, a steering committee was set up with the remit of developing a structured training programme for a Master of Clinical Oncology degree under the auspices of the University of Malaya. The aim was to produce "generalist" clinical oncologists who are able to safely and competently manage a broad range of malignancies with both chemotherapy and radiotherapy.

This clinical master programme was finally launched in November 2002. It is a 4-year programme which covers basic oncology sciences, clinical training in all aspects of non-surgical management of cancers with emphasis on radiation oncology and the use of systemic therapy. The syllabus was initially based on the Royal College of Radiologists of the UK higher specialist training programme for Clinical Oncology, with some modification to suit local context and pattern of malignancies including the addition of a research component. The main entry requirements include the possession of a recognised medical degree, a minimum of two years post-registration clinical experience in specified disciplines and satisfactory performance in an entrance evaluation set by the specialty committee.

Lectures and tutorials are provided by academic and clinical staff to prepare trainees for the two-part written and clinical exams. There was close cooperation and collaboration between the clinical oncologists from the universities and the Ministry of Health. Basic sciences teaching is well supported by other departments including medical physics, pathology and statistics. In addition, the International Atomic Energy Agency (IAEA) provided educational support in the form of a visiting lecturer, internet-based distance learning and a "train-the-trainers" course during the early years of the implementation of this training programme. Trainees rotate through several accredited public cancer centres in Kuala Lumpur to maximise their learning opportunities. During this time they are supervised by designated clinicians appointed by University of Malaya according to set criteria.

In 2010, the Ministry of Higher Education in Malaysia introduced the Malaysian Qualification Framework (MQF) which is a series of guidelines outlining a competency-based curriculum for medical education. This framework has already been in place for basic medical degree programme few years prior and has now been extended to include postgraduate medical training. Seven competency domains have been identified, similar to the CanMEDS system.

Thus in 2010 and 2011, a major curriculum review was undertaken by all clinical specialties in Malaysia. It is since mandatory for all postgraduate medical curricula to be implemented according to the MQF for national accreditation purposes. While a competency-based curriculum provides explicit learning outcomes with the aim of producing all rounded clinicians, it is not without its own set of challenges. One of the main challenges with the introduction of a competency-based curriculum is the inevitable rigorous assessment and evaluation required, especially in a middle-income country where there is lack of manpower

and resources.

9. Implementing Competency-Based Medical Education in LMICs

9.1. The Needs

The shortage of trained professionals is a major factor hindering nation-wide expansion of radiation oncology services. Under a conservative assumption, it is estimated that by the year 2020 at least 9100 treatment units will be needed by 84 countries classified as LMICs, accompanied by the need for at least 12,000 radiation oncologists (Datta et al., 2014). A recent report by the Lancet Oncology Commission (Atun et al., 2015) predicted that overcoming the current shortage in equipment and personnel in LMICs will produce significant health, economic and social benefits globally over the next twenty years. Although international fellowship programs for education and training enable transfer of expertise, the current capacity is far from adequate to be depended upon as the only means of producing trained professionals.

Initiating a radiation oncology education program at the national level goes a long way in ensuring sustainable national radiotherapy services. It allows radiation oncologists to be trained locally within the unique context of the national healthcare system, achieving competencies that relate closely with society needs. The existence of an education program at the national level also enables better alignment of the quantity and competencies of graduates with the plans and priorities set in the national cancer control plan.

9.2. Unique Challenges

Radiation oncologists in LMICs commonly face different challenges to their counterparts in more affluent countries. They often need to operate as a sole practitioner in a single centre or in the only centre in a country. In addition to performing clinical duties expected from radiation oncologists, local needs will often put them in situations in which they are expected to deliver chemotherapy, advocate for cancer control and develop and manage their cancer service. A large workload often limits their opportunity to undertake continuing professional development or clinical research, while their shortage in number makes site-specialization difficult.

Limitation of resources and the overall poor health and nutritional status of patient populations in LMIC also pose unique challenges. Difficult access to care combined with the absence of prevention and early detection programmes, social stigma and cultural beliefs often result in advanced disease at presentation and multiple comorbidities. The lack of equipment and facilities, on the other hand, forces radiation oncologists in LMICs to optimally utilize the equipment they have available to them while keeping themselves aware of clinical and technological advances so that they can advise on service development pathways when resources become available.

Radiation oncologists in LMICs will need to act as experts, leaders, as well as

advocates for the improvement of cancer management in their countries, while maintaining collaboration with other disciplines to ensure synergy across disciplines in both patient care and cancer advocacy.

Unfortunately, the same situation that brings these additional requirements for radiation oncology education in LMICs also poses challenges for implementing education programmes. Lack of access to content experts, educational resources and activities, and even time commitment of staffs for teaching can pose a significant challenge which is difficult to overcome. While the issue of excessive resident working hours is still being debated in affluent countries (Treuhaft, 2003; Landrigan et al., 2008, Deshpande et al., 2012), it is already an unavoidable part of everyday life within radiation oncology education in LMICs (Ashkar et al., 2015).

It is therefore clear that it is not enough to focus only on essential skills as end-outcomes in radiation oncology education in LMICs. On the contrary, a comprehensive view of competency frameworks which include adapted forms of the CanMEDS NME roles (e.g., Health Advocate, Manager/Leader, and Collaborator) are of even greater relevance in LMICs given the challenges faced in these countries.

9.3. Fitting Best Practices into the Local Picture

Implementation of Competency-Based Medical Education is a major and complex undertaking (Jippes, 2012). It cannot be done separately from the nationwide education, healthcare, cultural and political systems. However, it is common for LMICs to seek international expertise in reforming their education systems, either directly through capacity-building programmes or indirectly through the literature, with the resulting need for consolidation and adjustments to maintain balance between maintaining local relevance and achieving global competitiveness (Burgis-Kasthala et al., 2012). Maintaining this delicate balance is certainly not a trivial task as it requires choices and sacrifices to be made. Blind adoption of a curriculum or framework, although might seem easier initially, will likely be counterproductive as it can result in an educational programme that lacks relevance, is ineffective, and exacerbates brain drain (Nair & Webster, 2012). On the other hand, experiences from both high-income (Jippes, 2012) and low-income (Burgis-Kasthala et al., 2012) countries have shown that such elements as full stakeholder involvement (which include not only professional societies, teaching staffs, and programme directors, but also consumers, residents, government and the society), upfront establishment of clear goals and priorities and effective change management strategies are key success factors which can accelerate the implementation process.

The IAEA has developed a wealth of resources that can certainly aid countries establish education programmes in the various professions related to radiotherapy. A series of syllabi for the training of radiation oncologists, medical physicists, radiation therapists, radiation oncology nurses and radiation biologists has been published. Some of them highlight the importance of competency-based

medical education. A website specifically developed for radiation medicine professionals ("Human Health Campus"—https://humanhealth.iaea.org/hhw/) provides resources and learning materials. The IAEA's Applied Sciences of Oncology (ASO) distance learning course (http://elearning.iaea.org/m2/course/index.php?categoryid=45), provides modules on subjects for which there may be limited local expertise such as radiobiology.

The IAEA has also established a teleconference network of consultation in radiation oncology for Anglophone African countries (AFRONET). This discussion platform has as its main purpose assisting in the process of decision-making of individual patients. Local radiation oncology residents are encouraged to participate, present the cases and learn the importance of multidisciplinary decision making ("collaboration") in this discipline.

10. The Way Forward

Various models and best practices are already available to assist implementation of competency-based education in radiation oncology, making it unnecessary to re-invent them. However, it will be necessary for radiation oncologists in charge of education and training in LMICs to review and adapt them in accordance to the realities faced in their countries. It is strongly recommended that this initiative be aligned with the larger picture of nation-wide changes in medical education that might already be in motion, or in the absence of such changes, to involve major stakeholders to play an active role in the process. Effective change-management strategies will need to be applied throughout the implementation process, while keeping a focus on a clearly defined goal. In order to provide these goals and milestones, prior assessment involving key stakeholders will be an indispensable first step that must be taken in order to enable informed decisions to be made during the course of implementation.

Outcomes, contents, approaches in instructional methods, learning opportunities and assessment of competencies will need to be wisely chosen, developed and adapted within the context of local needs and available resources to ensure effective implementation. Fortunately, most of the workplace-based assessment methods have been made with time constraints in mind, which should make their implementation more manageable. The utilization of information technology, while requiring a certain amount of commitment and upfront investment, will assist in the management of the significant amount of assessment data that will be produced.

Since 2009, the Division of Human Health of IAEA has adopted a pragmatic approach to planning, developing, implementing and evaluating education and training programs. This approach emphasizes that more attention should be paid to actionable components of the process: mapping the curriculum, writing measurable learning outcomes, designing and planning relevant courses, selecting effective approaches to learning and assessment, and ensuring continuous development through program evaluation (Ros & Chhem, 2013). The IAEA can

certainly assist its Member States in the process of devising and implementing a competency-based radiation oncology education programme.

11. Conclusion

Implementation of competency-based medical education in radiation oncology in LMICs is both a need and a challenge. The available frameworks and competencies, despite being very relevant to the realities faced by radiation oncologists in LMICs, will still need to be adapted in order to ensure effective implementation at the national/regional level. Radiation oncologists need to employ effective change-management strategies to ensure that the changes which are introduced can remain sustainable within the context of national healthcare, education and political systems.

References

Abdel-Wahab, M., Bourque, J.-M., Pynda, Y., Iżewska, J., Van der Merwe, D., Zubizarreta, E. et al. (2013). Status of Radiotherapy Resources in Africa: An International Atomic Energy Agency Analysis. *The Lancet Oncology, 14,* e168-e175. https://doi.org/10.1016/S1470-2045(12)70532-6

Agbiboa, D. E. (2012). Offsetting the Development Costs? Brain Drain and the Role of Training and Remittances. *Third World Quarterly, 33,* 1669-1683. https://doi.org/10.1080/01436597.2012.720847

Ashkar, K., Romani, M., Musharrafieh, U., & Chaaya, M. (2015). Prevalence of Burnout Syndrome among Medical Residents: Experience of a Developing Country. *Postgraduate Medical Journal, 86,* 266-271. https://doi.org/10.1136/pgmj.2009.092106

Atun, R., Jaffray, D. A., Barton, M. B., Bray, F., Baumann, M., Vikram, B. et al. (2015). Expanding Global Access to Radiotherapy. *The Lancet Oncology, 16,* 1153-1186. https://doi.org/10.1016/S1470-2045(15)00222-3

Bandiera, G., Sherbino, J., & Frank, J. R. (2006). *The CanMEDS Assessment Tools Handbook. An Introductory Guide to Assessment Methods for the CanMEDS Competencies*. 1st editio. Ottawa: The Royal College of Physicians and Surgeons of Canada.

Batouli, A., Jahanshahi, P., Gross, C. P., Makarov, D. V., & Yu, J. B. (2014). The Global Cancer Divide: Relationships between National Healthcare Resources and Cancer Outcomes in High-Income vs. Middle- and Low-Income Countries. *Journal of Epidemiology and Global Health, 4,* 115-124. https://doi.org/10.1016/j.jegh.2013.10.004

Baumann, M., Leer, J. W. H., Dahl, O., De Neve, W., Hunter, R., Rampling, R. et al. (2004). Updated European Core Curriculum for Radiotherapists (Radiation Oncologists). Recommended Curriculum for the Specialist Training of Medical Practitioners in Radiotherapy (Radiation Oncology) within Europe. *Radiotherapy & Oncology, 70,* 107-113. https://doi.org/10.1016/j.radonc.2003.12.004

Borras, J. M., Lievens, Y., Dunscombe, P., Coffey, M., Malicki, J., Corral, J. et al. (2015). The Optimal Utilization Proportion of External Beam Radiotherapy in European Countries: An ESTRO-HERO Analysis. *Radiotherapy & Oncology, 116,* 38-44. https://doi.org/10.1016/j.radonc.2015.04.018

Burgis-Kasthala, S., Kamiza, S., & Bates, I. (2012). Managing National and International Priorities: A Framework for Low-Income Countries. *Medical Education, 46,* 748-756.

Datta, N. R., Samiei, M., & Bodis, S. (2014). Radiation Therapy Infrastructure and Human Resources in Low- and Middle-Income Countries: Present Status and Projections for 2020. *International Journal of Radiation Oncology, Biology, Physics, 89,* 448-457.

https://doi.org/10.1016/j.ijrobp.2014.03.002

Deshpande, G. A., Soejima, K., Ishida, Y., Takahashi, O., Jacobs, J. L., Heist, B. S., Obara, H., Nishigori, H., & Fukui, T. (2012). A Global Template for Reforming Residency without Work-Hours Restrictions: Decrease Caseloads, Increase Education. Findings of the Japan Resident Workload Study Group. *Medical Teacher, 34,* 232-239. https://doi.org/10.3109/0142159X.2012.652489

Eriksen, J. G., Beavis, A. W., Coffey, M. A., Leer, J. W. H., Magrini, S. M., Benstead, K. et al. (2012). The Updated ESTRO Core Curricula 2011 for Clinicians, Medical Physicists and RTTs in Radiotherapy/Radiation Oncology. *Radiotherapy & Oncology, 103,* 103-108. https://doi.org/10.1016/j.radonc.2012.02.007

European Union (1993). Council Directive 93/16/EEC of 5 April 1993 to Facilitate the Free Movement of Doctors and the Mutual Recognition of Their Diplomas, Certificates and Other Evidence of Formal Qualifications. *Official Journal of the European Communities, L165,* 1-24.

Frank, J. R. (2005). *The CanMEDS 2005 Physician Competency Framework: Better Standards, Better Physicians, Better Care*. Ottawa: The Royal College of Physicians and Surgeons of Canada.

Frank, J. R., Mungroo, R., Ahmad, Y., Wang, M., De Rossi, S., & Horsley, T. (2010). Toward a Definition of Competency-Based Education in Medicine: A Systematic Review of Published Definitions. *Medical Teacher, 32,* 631-637. https://doi.org/10.3109/0142159X.2010.500898

Frank, J. R., Snell, L. S., & Sherbino, J. (2014). *Draft CanMEDS 2015 Milestones Guide—September 2014*. Ottawa: The Royal College of Physicians and Surgeons of Canada.

Frank, J. R., Snell, L. S., Cate, O. T., Holmboe, E. S., Carraccio, C., Swing, S.R. et al. (2010). Competency-Based Medical Education: Theory to Practice. *Medical Teacher, 32,* 638-645. https://doi.org/10.3109/0142159X.2010.501190

Frank, J. R., Snell, L., Sherbino, J., & Bandiera, G. (2015). *Draft CanMEDS 2015 Physician Competency Framework—Series IV*. Ottawa: The Royal College of Physicians and Surgeons of Canada.

Green, M. L., & Holmboe, E. (2010). The ACGME Toolbox: Half Empty or Half Full? *Academic Medicine, 85,* 787-790. https://doi.org/10.1097/ACM.0b013e3181d737a6

Harden, R. M. (1999). AMEE Guide No. 14: Outcome-Based Education: Part 1—An Introduction to Outcome-Based Education. *Medical Teacher, 21,* 7-14. https://doi.org/10.1080/01421599979969

Harden, R. M. (2006). Trends and the Future of Postgraduate Medical Education. Emergency. *Medicine Journal, 23,* 798-802. https://doi.org/10.1136/emj.2005.033738

Hunter, R. D., Maciejewski, B., Leer, J. W., Kinay, M., & Heeren, G. (2004). Training Logbook for Radiotherapy. *Radiotherapy & Oncology, 70,* 117-121. https://doi.org/10.1016/j.radonc.2003.12.005

Iobst, W. F., Sherbino, J., Cate, O. T., Richardson, D. L., Dath, D., Swing, S. R. et al. (2010). Competency-Based Medical Education in Postgraduate Medical Education. *Medical Teacher, 32,* 651-656. https://doi.org/10.3109/0142159X.2010.500709

Izewska, J. (2008). *Setting up a Radiotherapy Programme: Clinical, Medical Physics, Radiation Protection and Safety Aspects*. Vienna: International Atomic Energy Agency.

Jippes, E., Van Luijk, S. J., Pols, J., Achterkamp, M. C., Brand, P. L. P., & Van Engelen, J. M. L. (2012). Facilitators and Barriers to a Nationwide Implementation of Competency-Based Postgraduate Medical Curricula: A Qualitative Study. *Medical Teacher, 34,* e589-e602. https://doi.org/10.3109/0142159X.2012.670325

Landrigan, C. P., Fahrenkopf, A. M., Lewin, D., Sharek, P. J., Barger, L. K., Eisner, M. et

al. (2008). Effects of the Accreditation Council for Graduate Medical Education Duty Hour Limits on Sleep, Work Hours, and Safety. *Pediatrics, 122,* 250-258. https://doi.org/10.1542/peds.2007-2306

Leer, J. W., Overgaard, J., & Heeren, G. (1991). The European Core Curriculum on Radiotherapy. *Radiotherapy & Oncology, 22,* 153-155. https://doi.org/10.1016/0167-8140(91)90016-A

Levin, V., & Tatsuzaki, H. (2002). Radiotherapy Services in Countries in Transition: Gross National Income Per Capita as a Significant Factor. *Radiotherapy & Oncology, 63,* 147-150. https://doi.org/10.1016/S0167-8140(02)00010-5

Morhason-Bello, I. O., Odedina, F., Rebbeck, T. R., Harford, J., Dangou, J.-M., Denny, L. et al. (2013). Challenges and Opportunities in Cancer Control in Africa: A Perspective from the African Organisation for Research and Training in Cancer. *Lancet Oncology, 14,* e142-e151. https://doi.org/10.1016/S1470-2045(12)70482-5

Nair, M., & Webster, P. (2012). Managing Priorities. *Medical Education, 46,* 733-735. https://doi.org/10.1111/j.1365-2923.2012.04308.x

RANZCR (2012). The Royal Australian and New Zealand College of Radiologists [Internet]. http://www.ranzcr.edu.au/training/radiology/current-training-program/curriculum

Ros, S., & Chhem, R. K. (2013). "Educating the Educators" Guidelines for Education in Radiation Medicine: A Pragmatic Approach at International Atomic Energy Agency. *Seminars in Nuclear Medicine, 43,* 202-207. https://doi.org/10.1053/j.semnuclmed.2012.11.011

Rosenblatt, E., Barton, M., Mackillop, W., Fidarova, E., Cordero, L., Yarney, J. et al. (2015). Optimal Radiotherapy Utilisation Rate in Developing Countries: An IAEA Study. *Radiotherapy & Oncology, 116,* 35-37. https://doi.org/10.1016/j.radonc.2015.06.012

Sherbino, J., & Frank, J. R. (2011). *Educational Design: A CanMEDS Guide for the Health Professions*. Ottawa: The Royal College of Physicians and Surgeons of Canada.

Simpson, J. G., Furnace, J., Crosby, J., Cumming, A. D., Evans, P. A., David, M. F. et al. (2015). The Scottish Doctor—Learning Outcomes for the Medical Undergraduate in Scotland: A Foundation for Competent and Reflective Practitioners. *Medical Teacher, 24,* 136-143. https://doi.org/10.1080/01421590220120713

Simpson, J. G., Furnace, J., Crosby, J., Cumming, A. D., Evans, P. A., Friedman Ben David, M. et al. (2002). The Scottish Doctor—Learning Outcomes for the Medical Undergraduate in Scotland: A Foundation for Competent and Reflective Practitioners. *Medical Teacher, 24,* 136-143. https://doi.org/10.1080/01421590220120713

Treuhaft, P. S. (2003). Perspective: The Debate over Residents' Work Hours. *Hastings Center Report, 33,* 53. https://doi.org/10.2307/3527825

Turner, S., Seel, M., & Berry, M. (2015). Radiation Oncology Training Program Curriculum Developments in Australia and New Zealand: Design, Implementation and Evaluation—What Next? *Journal of Medical Imaging and Radiation Oncology, 59,* 728-735. https://doi.org/10.1111/1754-9485.12337

World Federation for Medical Education (2003) *Postgraduate Medical Education: WFME Global Standards for Quality Improvement*. Copenhagen: WFME Office, University of Copenhagen.

Zubizarreta, E. H., Fidarova, E., Healy, B., & Rosenblatt, E. (2015). Need for Radiotherapy in Low and Middle Income Countries—The Silent Crisis Continues. *Clinical Oncology, 27,* 107-114. https://doi.org/10.1016/j.clon.2014.10.006