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Determining an Imaging Literacy Curriculum for Radiation Oncologists: An International Delphi Study

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Summary

The purpose of this study was to develop an entry-to-practice imaging literacy competency profile for radiation oncology (RO). An international 2-round Delphi process was conducted with experts in RO. Thirty-two participants representing 24 centers in 6 countries participated. Of the 97 items ranked in round 1, 84 were included in the final competency profile. This profile could form the basis of training standards for RO residency programs.

Purpose: Rapid evolution of imaging technologies and their integration into radiation therapy practice demands that radiation oncology (RO) training curricula be updated. The purpose of this study was to develop an entry-to-practice image literacy competency profile.

Methods and Materials: A list of 263 potential imaging competency items were assembled from international objectives of training. Expert panel eliminated redundant or irrelevant items to create a list of 97 unique potential competency items. An international 2-round Delphi process was conducted with experts in RO. In round 1, all experts scored, on a 9-point Likert scale, the degree to which they agreed an item should be included in the competency profile. Items with a mean score ≥ 7 were included, those 4 to 6 were reviewed in round 2, and items scored <4 were excluded. In round 2, items were discussed and subsequently ranked for inclusion or exclusion in the competency profile. Items with $>75\%$ voting for inclusion were included in the final competency profile.

Results: Forty-nine radiation oncologists were invited to participate in round 1, and 32 (65%) did so. Participants represented 24 centers in 6 countries. Of the 97 items ranked in round 1, 80 had a mean score ≥ 7, 1 item had a score <4, and 16 items with a mean score of 4 to 6 were reviewed and rescored in round 2. In round 2, 4 items had $>75\%$ of participants voting for inclusion and were included; the remaining 12 were excluded. The final list of 84 items formed the final competency profile. The 84 enabling competency items were aggregated into the following 4 thematic groups of key competencies: (*1*) imaging fundamentals (42 items); (*2*) clinical application (27 items); (*3*) clinical management (5 items); and (*4*) professional practice (10 items).

Conclusions: We present an imaging literacy competency profile which could constitute the minimum training standards in radiation oncology residency programs.

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Introduction

Medical imaging plays a fundamental role in the practice of radiation oncology (RO). It is critical for accurate staging, target and organ-at-risk delineation, and image guidance for radiation treatment. Technological advances in imaging science have always provoked radical changes in nearly every aspect of RO (1-3). Radiation oncologists currently have new imaging techniques and tools at their disposal that combine anatomic and functional imaging for staging, planning, treatment delivery, and follow-up (4). Advances in imaging have allowed for more conformal radiation treatments and have facilitated dose escalation while maintaining a favorable impact on normal tissue tolerances (5). The effective use of multiple imaging modalities has resulted in significant improvements in patient outcomes (6, 7).

New knowledge, skills, and attitudes are needed to optimize the application of medical imaging in modern RO practice (8). Elsewhere, we define "imaging literacy" in RO as being competent in a diverse set of skills including image acquisition, image optimization, and application to patient specific situations (9). While some residency programs are beginning to understand the need for including comprehensive imaging components in their curricula (10, 11), there are no accepted competency profiles that fully address the training needs of RO residents and practicing physicians (12). A review of international requirements for RO (13-15), along with a review of published literature (16-18), further emphasizes a widening gap between the need for updated imaging competency among radiation oncologists and the lack of appropriate educational guidelines.

The CanMEDS medical education framework defines the national postgraduate medical education standards in Canada (19). This framework articulates an educational taxonomy of competency groupings that, taken together, guide the essential abilities that physicians require (20). Individual competency items are formed from the best available evidence. These essential "key" competencies are broad abilities that form the grounding on which program-level objectives may be built. Subordinate abilities, referred to as "enabling" competencies, are the specific "ingredient" abilities (knowledge, skills, and attitudes) required to attain each key competency. The viability of any new competency framework depends on the completeness, accuracy, and applicability of both key and enabling competencies to the practice setting. The purpose of this study was to develop a viable entry-to-practice competency profile in imaging literacy for RO based on international consensus.

Methods and Materials

Competency list generation

From September 2012 to December 2012, a review of the published literature, published objectives of training, and program-specific curricula was conducted to generate an inclusive preliminary list of potential imaging competency items. Most of these sources were readily available to investigators through academic departments or online through professional organizations such as the Royal College of Physicians and Surgeons of Canada and the American Board of Radiology. Permission was requested from residency programs for access to unpublished competency profiles. Competencies were also drawn from a thematic analysis of a focus group series conducted previously for the purpose of generating consensus on imaging competencies (9). Relevant competency items relating to imaging literacy were reviewed and categorized. This produced an initial list of potential competency items. This comprehensive list was reviewed by the study investigators, and redundant items were removed, combined, or restructured, resulting in a refined list of enabling competency items for inclusion in the Delphi process. Research ethics board approval was obtained for this study.

Study population

Radiation oncologists from international centers of excellence, considered to be experts in imaging and/or RO residency education who were able to speak and read English were invited to participate in this study. There was no consensus as to the optimal number of participants in a Delphi process (21). For consensus to be feasible, Delphi panels generally include <50 participants (22). For this study, we anticipated that 25 to 40 members would be optimal, based on other similar studies (23). Anticipating a 50% response rate to our request for participation, we approached 49 individuals for inclusion.

Delphi process

Forty-nine radiation oncologists were contacted by email with the request to participate. In an attached spreadsheet file, they were asked to score each of the potential competency items on a Likert scale for the degree to which they believed each item should be included in an RO residency competency profile (where $1 =$ strongly disagree to $9 =$ strongly agree). Participants were also given the opportunity to suggest new competencies for inclusion in subsequent rounds of the Delphi process. Items that received a mean score of between 7 and 9 were automatically included in the final competency list, those with a mean score of 1 to 3 were automatically excluded, and those with a mean score between 4 and 6 were revisited in a second Delphi round. A 1-time reminder was sent to those who had not responded to the invitation within the first 2 weeks.

Participants in the first Delphi round were invited to join a website conference hosted by investigators to discuss the items identified in round 1 that had a mean score between 4 and 6. Considerations for inclusion and exclusion from a competency profile were discussed. Participants were then asked to rescore these items as either to be included ("yes") or excluded ("no") from the profile. In Delphi studies, consensus agreements are generally defined as not less than 55% agreement and in some cases up to 100% agreement (21). In our study, items voted to be included by $>75\%$ of round-2 participants were included in the final profile. This is consistent with previous studies (23).

The final competency items were aggregated and refined by investigators and placed into 4 thematic groups of key competencies: (*1*) imaging fundamentals; (*2*) clinical application; (*3*) clinical management; and (*4*) professional practice, to generate a final competency profile structure.

Results

Competency list refinement

An initial list of 263 potential enabling competency items was compiled from 14 sources including University of Toronto,