

Radiology Education in Medical School and Residency: The Views and Needs of Program Directors

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Rationale and Objectives: The authors of this study used the perspectives of residency program directors (PDs) nationally to explore whether trainees are adequately prepared to utilize and interpret medical imaging as interns, to identify the types of imaging skills most important for residency, and to begin to address current shortcomings in radiology education.

Materials and Methods: The authors created a survey using a modified version of Accreditation Council for Graduate Medical Education radiology milestones and sent it to 100 randomly selected PDs each in pediatrics, internal medicine, obstetrics and gynecology, and general surgery. The survey asked PDs to assess the actual and desired imaging skills of their incoming interns, the incoming interns' variability of skill level upon matriculation, and which imaging skills were most important from the PDs' perspective.

Results: PDs from all specialties identified a significant shortcoming relative to their expectations for both image interpretation and utilization skills. Additionally, PDs identified a significant variability in imaging skills, and described that variability as a hindrance to their programs. All of the potential imaging skills were rated as highly important with little clinically relevant difference between them.

Discussion: This multidisciplinary national survey found a deficiency in imaging education among interns across specialties and substantiates calls for formalized and improved radiology education in undergraduate medical education. Additionally, PDs had difficulty distinguishing which skills were most important, suggesting an unclear understanding of imaging ability needs for interns in respective specialties. More specific needs assessments are warranted on a national level.

Key Words: Radiology; education; undergraduate medical education; graduate medical education.

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INTRODUCTION

Medical imaging has become increasingly integral to the practice of medicine (1–3) and, accordingly, increasingly emphasized in undergraduate medical education (UME) (1). However, there are variations in how much is taught in medical school, ranging from no formal imaging education to required radiology clerkships (2,4,5). Additionally, there are large variations in what is taught to medical students (1), despite the existence of published curriculum

recommendations (6). Prior studies report that graduate medical education (GME) trainees, medical school deans, and radiology chairs desire a concerted effort to strengthen imaging skills in the UME curriculum (2,7). Importantly, some major specialties, such as internal medicine, fail to include even one imaging milestone in their standardized assessments (8), currently leaving formal development and assessment of imaging skills solely to the UME curriculum.

Considering these existing shortcomings, it seems unlikely that current UME in the United States is sufficiently providing the imaging skills most useful for intern year. In fact, a national study of interns recently reported a lack of confidence in a variety of important imaging skills, including determining normal from abnormal in basic imaging modalities, indications for various imaging tests, and when to consult radiologists (7). A convenience sample survey of program directors (PDs) from a variety of specialties identified that interns were generally adequately prepared (9); however, this early study had a limited sampling frame and did not account for variation between specialties. Thus, the question remains whether UME is sufficiently preparing students for clinical practice as interns.

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To address this, we targeted residency PDs nationally in pediatrics, internal medicine, obstetrics and gynecology, and general surgery to complete a milestone-based survey. Our purpose was to perform the first full-scale national exploration of the perspective of residency PDs regarding the effectiveness of UME in preparing trainees to use medical imaging as interns as well as the types of imaging skills most important for residency.

MATERIALS AND METHODS

Questionnaire

A questionnaire consisting of 12 items, a mix of narrative response, and 4- and 5-point Likert-type items was developed from a literature review of topics in medical school radiology curricula (10–20) (Appendix S1). Questions were written using REDCap software (REDCap, Nashville, TN) in accordance with published questionnaire methods (21–26) and focused on three broad topics: (1) the level of imaging skills interns (a) are expected to possess and (b) actually possess on day 1 of intern year; (2) the amount of variability in imaging skills that exists among incoming trainees; and (3) which skills PDs find most essential for day 1 interns to have.

Previously published competency-based milestones from the Accreditation Council for Graduate Medical Education (ACGME) (27) were adapted to ask PDs about the imaging interpretation and utilization competencies of incoming trainees (20). These milestones are the current gold standard for assessing GME trainee clinical skills and as such provide a consistent, familiar method for PDs to evaluate trainees in our survey. They were modified to include additional levels *below* what levels were already present as many interns may not even qualify as a level 1 (Table 1 and Table 2). Remaining questions focused on the disparity in imaging skills among incoming trainees as well as the relative importance of specific image-related skills. Questions offered a 5-point set of response options: “none,” “little,” “some,” “quite a bit,” and “substantial” (Appendix S1), which corresponded to numerical values of “1” through “5,” respectively, for data analysis.

The instrument underwent rigorous testing before executing it at the national level. First, questions were informed by interviews and focus groups of attendings and residents in various specialties (pediatrics, internal medicine, obstetrics-gynecology, general surgery, emergency medicine, and radiology). The instrument was evaluated for construct validity by education experts, radiologists, and assistant PDs from several specialties. Three assistant PDs (one in internal medicine, two in pediatrics) provided think-aloud testing to further evaluate construct validity. Test-retest reliability was evaluated among assistant PDs and education experts at our institution not involved in previous testing (an assistant PD of internal medicine; a director of undergraduate clinical skills education; a director of student education and assistant PD of emergency medicine; an assistant PD of pediatrics; an assistant PD of radiology; a director of student education and

associate professor of radiology). We then conducted a full pilot test of all 20 PDs at a single institution and further evaluated reliability of the internal structure.

Questionnaire Paradata

National Data

Four hundred residency PDs from across the United States were randomly surveyed from four core medical specialties: pediatrics, internal medicine (IM), obstetrics and gynecology (ObGyn), and general surgery (surgery). We opted to sample 100 PDs from each of the specialties to provide equivalent representation for comparison analysis. Although this would lead to a higher proportional representation of specialties with fewer programs, and vice versa, the improved statistical comparison capability from having similar sample sizes, as well as preventing the larger specialties from skewing the data and resulting recommendations, were determined to be more important at this early stage of exploration. The 100 PDs were randomly selected by applying a random number generator (SPSS v24, IBM Corporation, Armonk, NY) without repeating values to the entire list of PDs in each specialty and selecting the first 100. Nationally, there were 207 total pediatric residency programs accredited by ACGME, 469 IM, 269 ObGyn, and 278 surgery at the time of this study (28).

Program location, specialty, and contact addresses were obtained through public access from the ACGME website (28). PDs received prenotification and two invitations to participate by e-mail. This series of e-mails was followed by one mailing of a hard copy of the survey. Returned hard copies were entered by hand into REDCap software and double-entered to ensure accurate transcription.

Analyses

The scores were exported from REDCap to Microsoft Excel 2011 (Microsoft Corporation, Redmond, WA) and analyzed using SPSS v24 (IBM Corporation). Messick's framework was used to assess validity (which includes reliability as a measure of validity) (29). Test-retest reliability was assessed using the intraclass correlation coefficient and standard error of the mean (30). The internal structure evidence was difficult to assess without replicating the entire milestones scales for imaging skills. Additionally, there are no data published to date evaluating the validity and reliability of the radiology milestones. Our instrument evaluated multiple aspects of imaging evaluation and did not lend itself to a theoretically cohesive analysis by Cronbach's α . The conceptual difference in expected vs actual abilities also created theoretical additional domains, limiting the ability of Cronbach's α to evaluate such a small number of items (31,32). Response rate was calculated using field standards (33).

Chi-squared power analyses assumed moderate effect size ($\omega = 0.3$ and $\alpha = 0.05$). Because competence is a continuous measurement, we opted to approach the imaging interpretation and utilization competency level responses as a continuous scale allowing for more informative analyses than

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