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A Chief Resident-Driven Curriculum Designed to Improve Core Exam Performance at a Small Community Radiology Residency Program

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Introduction

Changes in the American Board of Radiology (ABR) board certification structure in 2014 necessitated alterations in the way residency programs deliver content, as the final ABR exam issued in residency shifted from the end of the fifth postgraduate year (PGY) to the end of the fourth PGY (PGY-4). Lesson plans formerly designed to cover a span of 4 years became condensed to 3 years, and the shift away from an oral examination and toward image-based and physics-relevant multiple-choice items compelled radiology programs to reinvent the way resident education is delivered. Performance on medical licensing exams among medical students matching in radiology continued to rise from 2009 to 2016 in the face of declining medical student interest in radiology,[1,2] and these match classes became the first medical students to eventually take the new Core Exam. Considering that small program size correlated with lower fill rates in the residency match over these years,[3] small programs were more likely to need to take residents outside the match in order to fill. These became residents who would eventually take the Core Exam in its initial cycles. It thus came as no surprise that the first chief resident survey to address the new Core Exam showed that small programs failed it at a higher rate than larger programs.[4]

While many larger academic programs traditionally employ a diverse faculty with multiple fellowship-trained subspecialty radiologists in each of their respective divisions, smaller programs may face relative disadvantages.[5] The first semester of diagnostic radiology residency can represent a steep learning curve for new residents. While many textbook-oriented "clubs" have been a relatively common method of bringing new residents to a minimum level of competency, it may take several cycles before program faculty become aware to what extent these textbooks successfully prepare residents for the new board exams. This study assesses a resident-driven first semester curriculum for new radiology residents with successful results. The program described in his paper was one of the smallest in the United States with only 3 residents per class when the Core Exam was launched, and the program had only a 50% first-time Core Exam pass rate after the first 2 administrations of the exam.

Intervention

All members of the diagnostic radiology residency were surveyed regarding the utility of different learning activities available in the first semester of residency. An additional resident was added to each of 2 consecutive classes after the first 2 classes of residents affected by the Core Exam such that there were 3 PGY-2 residents, 4 PGY-3 residents, 4 PGY-4 residents, and 3 PGY-5 residents surveyed ($n = 14$). The residents were asked which of the following activities were considered helpful in the first semester of residency: providing some sort of structured curriculum, new residents should be left alone to develop their own curriculum, providing structured reading assignments, specified learning objectives, standardized quizzes administered by the program director, standardized quizzes administered by the chief resident, first year resident "hot seat" conferences, examination given prior to the in-training examination, physics modules provided by the Radiological Society of North America (RSNA), and increased clinical responsibilities. Of note, these responses were conjectural, as not all of these activities had been offered by the residency program at the time of the survey.

The results of the survey are provided in Figure 1. Most residents (79%) valued some type of structured curriculum, and none of the respondents suggested that new residents should be left to study on their own (0%). The difference between a chief-resident-administered quiz structure (64%) and program-director-administered quizzes (29%) highlighted the importance of respecting resident autonomy in the early stages of diagnostic radiology education. More than half of respondents (57%) recommended a structured examination administered prior to the first In-Training examination. A minority of the residents (43%) validated R1 hot seats as a valuable learning modality during the first semester, and only (36%) endorsed the RSNA physics modules. None of the respondents (0%) agreed that additional clinical responsibilities would be valuable during the first semester of residency.

A structured curriculum was then implemented to augment the textbook "club" that had already been a staple of the first-year curriculum. New residents were first given their first reading assignment, Chapter 1 of Brant and Helms[6] at orientation with an exam administered the following week. An objective set prepared by the chief resident which emphasized basic concepts from the chapter (eg, radiation dose, image artifacts, introductory physics, etc.) was provided to each new resident along with the reading assignment. As the new residents then undertook their individual rotations, objective sets (5-15 objectives per chapter) were provided along with module

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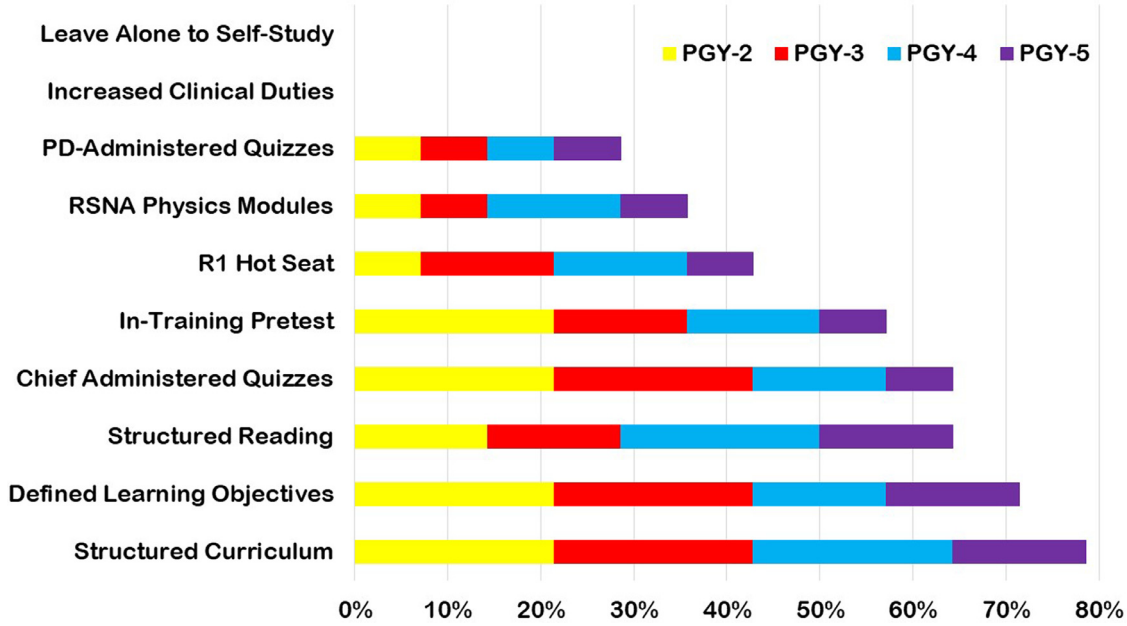

FIG 1. Percentage of residents answering that the specified elements would be helpful during the first semester of residency training.

or reading assignments specific to the material from their individual clinical rotations. For example, a new resident who started on thoracic imaging was given the objective sets for the relevant chapters in Brant and Helms at the onset of the rotation. A resident assigned to body computed tomography was given a different relevant reading assignment and thus different objective sets. A quiz was then given with one question per objective as the resident completed the assigned chapter. Each quiz question was a standard 4-option multiple choice item. All residents completed the same 6 4-week rotations at the beginning of training, albeit in different sequences. The chief resident personally reviewed the quiz results with the individual residents shortly after each quiz was taken.

With the compaction of the curriculum, the chief resident was able to steer new residents toward the items most relevant to call responsibilities, concepts deemed important to faculty, and themes addressed by the In-Training exam and board exams according to the chief resident's experience. Residents were provided an electronic tablet with access to electronic textbooks including Brant and Helms. Free-source material such as the RSNA physics modules was also regularly referenced in the learning objectives. Examples of objective sets and quiz questions are provided in Table 1 and 2, respectively.

This self-paced curriculum eventually culminated in a comprehensive exam administered by the chief resident approximately 20 weeks into the first semester of training in which lesser understood concepts (underperformed objectives) were emphasized. The chief resident underscored that the best way residents can successfully "compete" with each other is to complete the reading assignments and complete as many quizzes as possible in preparation for both call responsibilities and the In-Training examination.

TABLE 1
Example objective set

Vascular Ultrasound
Reading Assignment: Brant and Helms Chapter 39
1. Know the Doppler equation.
2. Define the terms high resistance and low resistance waveforms.
3. Know the equation for resistive index.
4. Understand the concepts of color flow Doppler and power Doppler.
5. Describe the origin and appearance of typical artifacts encountered in vascular ultrasound.
6. Describe how to eliminate artifacts in vascular ultrasound.
7. Memorize the NASCET criteria for carotid stenosis.
8. Understand how ultrasound is used in the diagnosis of subclavian steal syndrome.
9. Describe Doppler patterns that result from valvular disease and contralateral carotid disease.
10. Know the Doppler indications of TIPS malfunction.
11. Recognize the characteristics of a pseudoaneurysm and know how it is treated.
12. Understand the characteristics and properties of deep vein thrombosis including the anatomy of the superficial and deep vein systems in the upper and lower extremities.

Outcome

There was excellent compliance with the curriculum as each new resident completed the reading assignments and quizzes over the course of the 5 rotation blocks (4 months) leading up to supervised call responsibilities. All residents scored above the 90th percentile on the In-Training Exam. Following this pilot year, the program director incorporated the system into the first-year training experience and transferred coordination of the curriculum to the program coordinator. After this transition took place, the first-time Core exam pass rate rose to 100%.

Discussion

The path to becoming a diagnostic radiologist has never been more arduous or exciting than it is today. The burgeoning of technology, both in the realm of medical diagnostics and in the arena of educational software, has created a climate unlike that ever witnessed

TABLE 2
Example quiz item

Using the NASCET criteria, choose the correct item that describes an ICA which has 50-70% stenosis:
a. Peak systolic velocity in the ICA of 110 cm/sec with end diastolic velocity of 35 cm/sec.
b. Peak systolic velocity in the ICA of 125 cm/sec and peak systolic velocity in the CCA of 52 cm/sec.
c. Peak systolic velocity in the ICA of 120 cm/sec and peak systolic velocity in the CCA of 75 cm/sec.
d. Peak systolic velocity in the ICA of 235 cm/sec with end diastolic velocity of 110 cm/sec.

before in our field. As the ACR and ABR have begun to map out the blueprint of the future of our profession,[7] it is incumbent upon us as educators to adapt to the shift in the caliber of the new radiology resident pool and to the modifications of the board certification structure which will define the new radiologist.

The approach described here offers several benefits to new radiology residents. By having the chief resident guide content, comradery among residents is promoted, and the survey results presented here suggest that new residents may prefer chief-resident-derived quizzes to more traditional program-director-based testing. The rapid evolution of technology and potential changes to noninterpretive skills testing yield potential fodder for exam material to adapt on a year-to-year basis, and these changes are most acutely seen by recent examinees. This study supports the notion that residents prefer a structured approach to learning.

In 2008, 71% of surveyed residents reported spending 60%-100% of studying on recalled exam items in preparation for the written examination.[8] The practice of providing previously-administered ABR exam questions to future examinees is now more formally prohibited,[9] and it must be stated that residents should not provide known ABR questions to new trainees. Addressing topics covered on the exam, however, is permissible.[9]

There are several barriers to successful implementation of a curriculum such as this one. The first of these stems from the fact that the curriculum is self-driven. The decision in our case to allow residents to negotiate complete the readings and quizzes on their own schedules proved to be successful, however, it could be the case that programs with lesser-motivated residents could suffer from lack of voluntary participation. In such cases, it could be necessary to apply intervention from program officials or move toward scheduled quizzing. The ability of radiology to recruit strong applicants[1] hopefully implies that this gifted pool is comprised of self-motivated individuals who strive to complete their assignments before the completion of each rotation.

The second possible impediment to success is the lack of active participation by chief (or senior) residents. The new structure of the board certification process lends itself to structured PGY-5 “mini-fellowships” which may serve to consume the time or interest of the senior residents. With the Core Exam taking place at the end of the third year of residency training, programs run the risk of a PGY-5 class that could succumb to so-called “senioritis” or may simply shift its PGY-5 residents away from a comprehensive generalist curriculum and toward subspecialty rotations. While it should be argued that strong leadership demands the teaching of younger residents, the new structure lends itself to faster subspecialization and more complete training in a subspecialty of interest. The challenge to balance general diagnostic radiology with subspecialty training will manifest in the new era, and programs will have to further alter their missions in order to keep PGY-5 residents engaged.

Physics instruction continues to be an element of radiology education that is irregularly delivered throughout the country. While physicists and radiation safety officers are unvaryingly omnipresent throughout diagnostic radiology departments, radiology residents continue to avail themselves of nationally-available resources as primary source material. The RSNA physics modules, when paired with vigorous participation in the acquisition of images throughout all modalities during residency training, are an excellent starting point for the first-year radiology resident.

This innovative approach to new resident teaching serves as a means that smaller programs can utilize to prevent new residents from getting lost in the pack. This method shows promise in providing a comprehensive and high-yield means to provide the framework necessary to succeed in the changing climate.

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