Clinical Decision Support at the Point-of-Order Entry: An Education Simulation Pilot with Medical Students

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Rationale and Objectives: We have been called to reform radiology undergraduate medical education (UME) curricula. Clinically available clinical decision support provides an opportunity to improve education regarding appropriate imaging utilization, patient safety, and cost-effective care.

Material and Methods: We created an education simulation portal utilizing integrated clinical decision support. The portal was then piloted with 34 volunteer medical students at our institution in a blended learning environment. A program assessment was performed utilizing the results from a qualitative survey, pre-test, and post-test.

Results: The large majority of medical students felt this supplemental education resource should be included in our UME curriculum (85.29%). All students perceived value in the education simulation portal. The students performed significantly better on the post-test in multiple categories (overall $P < .0001$), including Choosing Wisely topics ($P = .0207$).

Conclusions: Based on our program assessment from this pilot program, we believe this innovative educational resource has significant potential to fill curricular gaps in radiology UME curricula. This platform is scalable and can be further customized to fill needs across the continuum of medical education.

Key Words: Simulation education; clinical decision support; appropriateness; utilization; medical imaging.

INTRODUCTION

Medical imaging is an integral component of medicine, spanning the continuum of care. The invention of imaging modalities such as computed tomography, magnetic resonance imaging, and molecular imaging has significantly increased the reliance on medical imaging in clinical practice during recent decades (1). Contemporaneously, complimentary advances in information technology, informatics, and analytics are evolving at a staggering rate. These changes are superimposed upon a backdrop of healthcare reform. Undergraduate medical education (UME) curricula typically are not reflective of the omnipresence of imaging in the modern clinical practice; traditional curricula have not kept pace with these rapid advancements in technology and do not fulfill the evolving educational needs of medical students.

A call to reform radiology UME curricula has been made by medical school and radiology leadership. The large majority of medical students (95%) will pursue specialties other than radiology; therefore, evidence-based imaging utilization, cost-effective care, appropriate use of intravenous contrast, and judicious exposure of patients to medical radiation are essential elements to include in UME curricula (2,3). Although the American College of Radiology Appropriateness Criteria (ACR-AC) is a long-standing resource designed and available to facilitate appropriate imaging utilization, utilization has been low among medical students. The lack of an easy-to-use electronic format has been likely a barrier to medical student usage of the ACR-AC (4).

We have not adequately prepared our future physicians to follow the mantra of ordering the "right test at the right time," which is of utmost importance during an era aimed at continuous quality improvement, bending the curve of rising healthcare cost, fostering a culture of safety and evidence-based medicine supplemented by resources such as clinical decision support (CDS). Simply stated, our profession has failed to provide radiology curricula and learning resources that will prepare our future physicians to succeed in our rapidly evolving healthcare system.

Education reform calls also include a national standardized radiology UME curriculum, readily available digital interactive education resources, and standardized assessment tools to

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motivate mastery of curriculum content and validate the importance of radiology education (2). General trends in medical student education include optimization of adult learning principles, quality improvement and patient safety (5), utilization of virtual patients (6), simulation (7), e-learning (8), and mobile health technologies (9). Technology is ubiquitous in the life of the current generation of technically savvy medical students making e-learning an effective option for medical student education. When integrated into a blended-learning strategy, e-learning allows educators to focus on facilitating learning and assessing competency, moving away from the traditional instructor-centered didactic distribution of content. The blended-learning approach is well aligned with a learner-centered approach to education. E-learning offers the additional benefits of standardized course content, decreasing the burden on educators in an era of increasing clinical demands, an opportunity for standardized assessment and cost-savings, which predominantly are realized by more efficient use of educators' time and decreased redundancy of education resources (8).

Our vision is to address national radiology curricular gaps and improve alignment with overall trends in medical education. We developed a supplemental education simulation portal with an aim to facilitate a blended learning environment that allows learners to hone their ability to appropriately select imaging studies, encourages a culture of safety, and provides important information regarding the cost of health care. This environment facilitates learning without compromising patient safety or unnecessary waste of medical resources at affiliated hospitals. We piloted the education simulation portal as a supplement to our UME radiology curriculum. At our institution, medical students do not have a required radiology rotation; therefore, our goal was to introduce our medical students to the ACR-AC and CDS at the beginning of their clinical rotations to improve awareness, facilitate learning beyond our traditional UME curriculum, and assess the students' perceived value of this education simulation portal. We are sharing our program assessment and experience implementing this novel educational approach at our institution. This platform is scalable and provides an opportunity for standardized education and competency-based assessment.

MATERIALS AND METHODS

Pilot Project

A pilot program was implemented for 34 volunteer second-year medical students (MS2) transitioning from their preclinical classes to clinical rotations. The pilot was offered at this point in their curriculum because all students had a relatively homogeneous educational experience thus far, and they had limited exposure to ingrained ordering patterns at our affiliated clinical institutions. Institutional review board approval was obtained for this project. The medical students participating in the pilot program were volunteers; this was not a required portion of their curriculum, and it did not affect their academic standing. Students were recruited by making two announcements prior to their regularly scheduled classes and a few emails, one sent on behalf of the investigators by an Associate Dean from our Office of Undergraduate Medical Education validating the project as a legitimate education opportunity. Participating students have been allowed to maintain access to the ACR Select CDS tool for their subsequent clinical rotations. The pilot program consisted of a hybrid classroom, blending a brief traditional classroom experience with a self-paced online learning module, summarized in Figure 1.

ACR Select

Although the ACR-AC is an extensive reference for appropriate image ordering, the information was not previously available in a practical, easily consumable manner to facilitate use in the clinical setting. ACR Select is a web service provided by National Decision Support Company that integrates the ACR-AC in a user friendly, consumable format to provide evidence-based, clinical point-of-order decision support for referring medical providers in selecting the most appropriate imaging evaluation for patients. In addition to appropriateness rankings for utilization of modalities based on the queried clinical scenario, the feedback also includes the relative radiation level and offers a relative cost scale derived from the global Centers for Medicare and Medicaid Services' relative value unit per exam in the feedback panel. If the user would like more information on the queried subject, the panel also provides a link to the relevant online ACR-AC. ACR Select is a commercially available product that can be integrated into existing electronic health record platforms (10). To our knowledge, prior to this project, ACR Select has been used solely as a CDS tool and not as a standardized education tool or conduit for learner self-assessment.

Education Portal

The education portal was utilized for the self-directed digital learning module. We built the module on the ACR's Radiology Curriculum Management System (RCMS) platform. Experts in various radiology subspecialties were recruited to author cases simulating common clinical scenarios from a primary care practice setting and representative of the available appropriateness categories within the ACR Select portal. Primary care was selected as the theme for the cases because at our institution the medical students have a longitudinal primary care clinical experience embedded in their traditional preclinical curriculum, thus ensuring the students had a clinical context and instructional scaffolding for the content of the pilot. Each case author was also asked to include question(s) regarding any Choosing Wisely topic that pertained to their section. Choosing Wisely is an initiative of the American Board of Internal Medicine to promote more effective use of healthcare resources. The cases were assigned a difficulty level (introductory, intermediate, and advanced) based on expected level of knowledge at the MS2 level and loaded into the RCMS. RCMS and ACR Select were integrated via