Integrating a Radiology Curriculum Into Clinical Clerkships Using Case Oriented Radiology Education

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Rationale and Objectives: In an effort to expose all medical students to a standardized radiology curriculum, the authors developed and used an online case-based teaching tool called Case Oriented Radiology Education (CORE) to teach medical students radiology during clinical clerkships. This paper discusses the authors' experience with the development and use of CORE as an educational tool.

Methods: The Alliance of Medical Student Educators in Radiology medical student curriculum was used as the foundation for CORE cases. CORE cases were published using the CASUS authoring system, incorporating text, interactive questions, hyperlinks, and multimedia in a Web-based format. CORE cases are presented as clinical scenarios introducing students to simulated patients who undergo various radiologic imaging procedures during the course of their diseases and complications.

Results: Since 2005, 14 cases have been published. CORE incorporates more than 75% of the Alliance of Medical Student Educators in Radiology curriculum, with cases covering chest imaging, pediatric radiology, abdominal imaging, women's imaging, neuroradiology, and musculoskeletal imaging. CORE cases are taken during medicine, surgery, obstetrics and gynecology, and neurology clerkships by third-year and fourth-year medical students. The majority of students surveyed agreed or strongly agreed that CORE cases made good use of their self-directed study time (84%), provided useful resources (73%), were appropriate for their level of training (86%), and expanded their knowledge and understanding of radiology (88%).

Conclusions: The integration of CORE cases into clinical clerkships provides medical students with the opportunity to learn a standardized radiology curriculum in an interactive, online, and case-based format tailored specifically for medical students. To date, 14 cases have been published and are used by students on clinical clerkships in their third and fourth years of medical school.

Key Words: Medical education, Web based, case based, radiology curriculum

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INTRODUCTION

Radiology plays an integral role in the practice of clinical medicine. With the technological advancements in medical imaging, radiologic studies guide many therapeutic decisions, enable clinicians to narrow differential diagnoses, and provide clinical answers. There are few medical disciplines that do not routinely use radiologic studies. Consequently, the overwhelming majority of graduating medical students, regardless of their chosen career paths, will need to interpret and understand radiologic studies at some level.

There are multiple reasons for the lack of a required radiology course in medical schools. Radiology educators are challenged to integrate radiology into a medical school curriculum that is already saturated with an evolving body of basic science and medical information. This saturated curriculum leaves little room for additional required courses. Furthermore, heavy radiologist workloads, administrative duties, resident training, and pressure to maintain productivity displace time and resources needed to teach medical students.

Although a required radiology course with one-on-one interaction between attending radiologists and students, use of PACS, interactive didactic lectures, and formal student evaluation is most desirable, we recognize that this may not be possible at many institutions. Computer

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and online learning may augment radiology education by integrating radiology teaching modalities into preexisting clinical clerkships. Indeed, teaching radiology during clerkships in this manner may have some advantages by learning imaging management and interpretive skills while encountering appropriate patient groups.

At our institution, we have radiology-anatomy instruction in the first year, 9 hours of instruction during the Scientific Basis of Medicine course in the second year, and a series of electives in the final year of medical school. Approximately 50% of Dartmouth medical students take a fourth-year radiology elective. In an effort to provide all medical students with some structured radiology education before graduation, we introduced a Web-based radiology educational tool called Case Oriented Radiology Education (CORE). Third-year and fourth-year medical students taking clinical clerkships use CORE. This article describes our experience developing and integrating CORE into medical school clerkships and discusses the potential benefits and drawbacks of teaching radiology in this format.

METHODS

The curriculum included in CORE cases was developed from guidelines provided by the Alliance of Medical Student Educators in Radiology (AMSER) [1]. The AMSER guidelines were created by a group of academic radiologists, including one of the authors of this paper (P.J.L.). The AMSER guidelines were made to help radiology clerkship directors and educators develop a more standardized medical student radiology curriculum. CORE cases were published using the CASUS authoring system (Instruct AG, Munich, Germany), which is Web-based proprietary software designed for authoring and delivering case-based learning [2,3]. The CASUS system was selected because of its ease of use and accessibility. The use of CASUS facilitated authorship from multiple contributors, and it had already been tested and used for a case-based pediatric curriculum at Dartmouth called the Computer-Assisted Learning in Pediatrics Program (CLIPP) [4]. In fact, 125 medical schools in the United States use CLIPP cases. Using a commercial and Web-based provider simplified issues of server support and multi-institutional access. Dartmouth pays a small fee to CASUS per student for access to both CLIPP and CORE cases.

The CORE cases were written in a case-based format to enable medical students to follow simulated patients through both the clinical and imaging stages of their diseases and associated complications. Cases were developed with an emphasis on developing skills appropriate for clinicians, not for the purpose of training aspiring radiologists. With this in mind, there is an emphasis on imaging management algorithms, common conditions, and important emergent findings that clinicians may encounter in their practice. The ACR Appropriateness Criteria® [5] are referenced extensively during the development of cases and are linked to accordingly. Cases were developed primarily by interested radiology faculty members and sometimes with fourth-year medical students applying to radiology residencies. Most cases were reviewed by clinicians in the appropriate specialties before publication.

Each CORE case begins with a brief clinical introduction and outline of the AMSER radiology curriculum topics that the case will cover. Cases use images, instructive text, "expert tabs," interactive questions, and hyperlinks to integrate the segments of the AMSER radiology curriculum. Figure 1 shows a schematic flow diagram that provides an overview of a single CORE case. The AMSER curriculum topics covered in a case are stated on the first card of each case. The second card consists of a brief clinical introduction to a fictional patient, with subsequent cards discussing the progress of the case and the numerous radiologic studies performed. Figure 2 provides an example of a card from a typical CORE case, which includes an expert tab, digital images, an interactive question and hyperlinks. Expert tabs (Figure 3) were designed to provide additional background or in-depth information about radiology topics and provide additional educational resources to interested students. The hyperlinks on cards provide students with links to a number of electronic resources, including academic and informational Web sites, electronic presentations, embedded images, free-text information, and academic papers. The use of hyperlinks that students can review separately simplifies the teaching interface, eliminates unnecessary "reinventing the wheel," and extends learning opportunities. Often, several choices of Web resources are provided for students who may prefer a brief overview or a more detailed resource. These links were extensively researched and are regularly reviewed.

Interactive elements consisting of free-text questions, multiple-choice questions, and short-answer questions are included throughout the cases and are intended to stimulate interactive learning and decision making. Before proceeding to the next card, students must submit or select an answer choice that will be checked online, with answers previously designated by the author at the time of authorship. Students are able to see if they submitted correct answers, and explanatory feedback is provided. Each case concludes with a summary card that provides students with a comprehensive list of the Web sites and the article links that were included during the case for the user's future reference.

Each academic year, all third-year and fourth-year students (approximately 75–85 students per class) having a