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# Core curriculum online lecture series in musculoskeletal imaging: initial results

Lawrence M. White<sup>1,2</sup> · David A. Rubin<sup>3</sup> · Mini N. Pathria<sup>4</sup> · Michael J. Tuite<sup>5</sup> · Michael P. Recht<sup>6</sup>Received: 4 May 2019 / Revised: 10 June 2019 / Accepted: 17 June 2019  
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## Abstract

**Objective** To augment the educational resources available to training programs and trainees in musculoskeletal (MSK) radiology by creating a comprehensive series of Web-based open-access core curriculum lectures.

**Materials and methods** Speakers with recognized content and lecturing expertise in MSK radiology were invited to create digitally recorded lecture presentations across a series of 42 core curriculum topics in MSK imaging. Resultant presentation recordings, organized under curriculum subject headings, were archived as open-access video file recordings for online viewing on a dedicated Web page (<http://radiologycorelectures.org/msk/>). Information regarding the online core curriculum lecture series was distributed to members of the International Skeletal Society, Society of Skeletal Radiology, Society of Chairs of Academic Radiology Departments, and the Association of Program Directors in Radiology. Web page and online lecture utilization data were collected using Google Analytics (Alphabet, Mountain View, CA, USA).

**Results** Forty-two lectures, by 38 speakers, were recorded, edited and hosted online. Lectures spanned ACGME curriculum categories of musculoskeletal trauma, arthritis, metabolic diseases, marrow, infection, tumors, imaging of internal derangement of joints, congenital disorders, and orthopedic imaging. Online access to the core curriculum lectures was opened on March 4, 2018. As of January 20, 2019, the core curriculum lectures have had 77,573 page views from 34,977 sessions.

**Conclusions** To date, the MSK core curriculum lecture series lectures have been widely accessed and viewed. It is envisioned that the initial success of the project will serve to promote ongoing content renewal and expansion to the lecture materials over time.

**Keywords** Musculoskeletal · Radiology · Curriculum · Open access · Education · Lectures

## Introduction

Radiology residency programs must provide an educational experience that will allow their residents to achieve competency in multiple subspecialty areas defined by the Accreditation

Council for Graduate Medical Education (ACGME) [1]. A critical and mandated portion of this educational experience is a core didactic curriculum that must include a component for each subspecialty area within radiology. The American Board of Radiology (ABR) has developed guidelines, including the

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ABR Core Exam Blueprints [2] and the ABR Core Exam Study Guide [3], to help develop this curriculum. However, there is no universally accepted standardized lecture series utilized by all or even the majority of radiology residency programs. This lack of standardization between programs leads to a varied and potentially uneven learning experience between residencies. In addition, developing and delivering such a core curriculum lecture series can present a major challenge, particularly for smaller programs with limited faculty in each subspecialty area.

Currently, programs fulfill ACGME requirements through a mix of traditional in-person lectures and interactive case-based conferences. Multiple studies have documented that millennials often prefer Web-based and E-learning resources over traditional methods and some have proposed eliminating in-person traditional lectures for medical education and adopting a flipped classroom model, with resources such as digital lectures employed to facilitate and enable self-directed independent learning, allowing for in-person “class-time” to be used for case-based interactive sessions [4–7].

Although there is much radiology educational material available online, the quality of such material is variable, and little of it is curated or focused primarily for residents [8–10]. To augment the educational resources currently available to training programs and trainees in musculoskeletal radiology, this paper discusses the process and results of developing a comprehensive series of Web-based open access musculoskeletal core curriculum lectures for radiology resident trainees, organized by the authors, with the support of the International Skeletal Society (ISS) and Society of Skeletal Radiology (SSR).

## Materials and methods

A planning group of five members of the ISS and SSR interested in enhancing open-access online training was formed to develop a series of MSK core-curriculum lectures.

Using the detailed list of knowledge objectives previously highlighted for MSK radiology resident training [11, 12], the panel selected 42 topics to initiate the project from across the topic domains of MSK trauma, arthritis, metabolic disease, marrow, infection, tumors, internal joint derangement, congenital disorders, and orthopedic imaging.

The panel invited 38 internationally accomplished MSK radiologists, recognized for their expertise and didactic lecturing skills, to create the initial core curriculum lectures. Speaker expertise was objectively confirmed by number of individual peer-reviewed publications in MSK imaging (range, 21–804, mean, 120), membership in the International Skeletal Society and/or Society of Skeletal Radiology, and years in subspecialty MSK imaging practice (range, 9–46 years, mean, 25 years). Educational didactic lecturing skills were confirmed through individual speaker presentation evaluation scores (speaker score range, 4.2/5–4.9/5, mean, 4.6/5)

collected from attendees of the 2017 and 2018 Annual Continuing Medical Education refresher courses of the International Skeletal Society.

Each speaker was invited to create a PowerPoint (Microsoft Corporation, Redmond, WA, USA) lecture presentation on one of the 42 selected MSK imaging topics, specifically geared to radiology resident trainees. Three speakers were asked to prepare two lectures each, and one speaker was asked to contribute three lectures, based on their recognized content expertise. Speakers were asked to construct lectures that were approximately 20–30 min in length. Speakers were informed and asked to sign a consent acknowledging their agreement that their recorded lectures would be hosted on the World Wide Web as open-access content for viewing, as a component of a MSK resident core curriculum lecture series. Involvement in the initiative was voluntary and speakers were not remunerated or reimbursed for their participation.

Each speaker was requested to deliver their respective lecture(s) in-continuity with live speaker audio, and video of presentation slides with mouse/pointer movements, recorded using the Open Broadcaster Software (Open Source, Version 21.1.1, OBS Studio). In the setting of presentation errors, speakers were encouraged to pause and re-present the content in-continuity during the lecture recording. Resultant lecture recordings, in MP4 format, were distributed to each individual speaker for approval or identification of required edits. Edit requests were limited to deletion cropping of unwanted or purposefully duplicated recorded content. The MP4 files and accompanying “editing” requests were then professionally edited (Communications Resource Management, Lombard, IL, USA). The resultant finalized lectures were then redistributed to all participants for final approval. The lectures were subsequently hosted as a series of archived open-access video files on commercial server space maintained by the organizations (ISS and SSR), organized under MSK imaging curriculum subject headings, for online viewing on a dedicated Web page (<http://radiologycorelectures.org/msk/>).

Information regarding the online core curriculum lecture series was distributed by e-mail notice to all active members of the International Skeletal Society (ISS) ( $n = 560$ ), the Society of Skeletal Radiology (SSR) ( $n = 1454$ ), Society of Chairs of Academic Radiology Departments ( $n = 139$ ) and the Association of Program Directors in Radiology ( $n = 597$ ). Society members were encouraged to inform colleagues, trainees, and training program directors of the existence of the lecture series and to openly share and distribute the Web address of lectures for individual or programmatic use. Information regarding the lecture series, along with links to the lecture series Web page were additionally posted on the ISS and SSR Web sites.

Access to lecture playback is currently limited to online viewing through an active Internet connection. Online video playback functionality supports the ability for users to speed

up or slow down playback as well as to skip, pause, or repeat portions of a presentation being watched. Viewer display of lecture playback timing additionally enables users to “save their place” if interrupted, and the ability to manually restart their next session where they left off.

Web page and online lecture utilization data were collected using Google Analytics (Alphabet, Mountain View, CA, USA).

## Results

Forty-two lectures, created and presented by 38 speakers, were recorded, edited and hosted online. Lectures span ACGME curriculum categories of musculoskeletal trauma ( $n = 8$ ), arthritis ( $n = 5$ ), metabolic diseases ( $n = 3$ ), marrow ( $n = 2$ ), infection ( $n = 2$ ), tumors ( $n = 4$ ), imaging of internal derangement of joints ( $n = 11$ ), congenital disorders ( $n = 2$ ), and orthopedic imaging ( $n = 5$ ). Finalized and edited lecture recordings averaged 26 min and 37 s in duration (range, 12 min, 48 s to 51 min, 46 s).

Online access to the core curriculum lecture Web site was opened on March 4, 2018. As of January 20, 2019, the core curriculum lectures have had 77,573 page views from 34,977 sessions. The total number of page views by category ranged from 1768 to 22,210, with mean page views per lecture within each topic category ranging from 884 to 2776 (Table 1). To date, the most popular lecture has been viewed 7491 times and the least accessed lecture has been viewed 800 times. There have been 15,947 users from a total of 124 countries, with 50% of users coming from United States; 68% of users came from the

Americas, 7% from the Middle East and Africa, 8% from Asia, 2% from Australia and New Zealand, and 14% from Europe.

## Discussion

Variability of educational resources across residency training programs is an ongoing reality and is part of the challenge in providing optimal trainee education across all the various subspecialty areas of radiology. Considerable variability exists in the timing and duration of resident subspecialty rotations, as well as in local programmatic clinical volumes and patient population characteristics. Additional challenges to radiology resident education include availability and expertise of faculty, especially in the setting of heightened operational prioritization of faculty clinical care delivery [13, 14].

It is well recognized that the learning strategies and preferred educational resources relied upon by resident trainees have dramatically changed over time. Radiology resident trainees have rapidly shifted their reliance upon textbooks and journals to Web-based educational resources and other materials easily and freely accessible through the Internet via personal electronic devices and modern PACS workstations [4–7].

Web-based lectures and educational resources are an effective means of disseminating highly accessible standardized content that can be easily updated. Such standardized content material can be used as an introduction or reinforcement of in-person clinical training, allowing for greater focus of program-based teaching on problem based and critical thinking learning strategies. Electronically accessible Web-based lectures are particularly well suited to self-directed technology-driven educational strategies commonly employed and familiar to millennial radiology resident trainees [4–7]. Millennial learners tend to be strong visual learners and radiology educational materials are typically highly visual in nature, lending themselves well to E-learning formats. Online lectures additionally provide functionality for users to personalize their learning by speeding up or skipping content they are comfortable with while slowing down or repeating playback of less familiar material. An additional important benefit of online Web-based lectures is the flexibility and convenience of accessing content when and where desired including outside of typical “work” hours. Online open-access material additionally enables access to content globally, facilitating educational outreach to trainees or radiologists in underdeveloped countries, who may not have access to teaching expertise locally or the financial resources to purchase printed educational materials or travel to educational courses elsewhere in the world.

Despite the benefits of the World Wide Web, a unique challenge of modern Web-based material, is the sheer volume of information currently existing online. While online material can facilitate immediate access to information, the quality and applicability of Web-based content can vary dramatically, and

**Table 1** Core curriculum online lectures in musculoskeletal imaging: page views in the first 111 days

Topic category	Number of lectures: topic category	Total page views: topic category	Mean: page views per lecture	Range: page views per lecture	Overall page views all topic categories (%)
Trauma	8	22,210	2776	1375–7491	28.6%
Arthritis	5	12,273	2455	1140–5056	15.8%
Metabolic diseases	3	3049	1016	812–1387	3.9%
Marrow	2	2472	1236	1214–1258	3.2%
Infection	2	3008	1504	1376–1632	3.9%
Tumors	4	6924	1731	842–3561	8.9%
Imaging of internal derangements of joints	11	17,929	1793	800–3887	23.1%
Congenital disorders	2	1768	884	858–910	2.3%
Orthopedic imaging	5	7940	1588	1347–2061	10.2%

efficient access to pertinent and trusted information can be challenging. Few, if any, mechanisms exist to guarantee the authenticity, accuracy, and quality of online resources, nor whether such materials are maintained and updated according to current best-practice guidelines. In this setting, online educational resources developed and maintained with the support of subspecialty societies familiar with the requirements of the ACGME and ABR, can serve as reliable vetted sources of curated learning material for radiology resident trainees.

The focus of most radiology-specific subspecialty online lecture material content has been geared toward continuing educational needs of post-graduate practicing radiologists and much of it is paid content generated on a for-profit basis. In contrast, the core curriculum MSK lecture series was developed as an open-access resource with a specific focus on the educational content needs of MSK radiology trainees in the hopes of augmenting resources available to individual trainees and their training programs. It is anticipated that the core curriculum online lectures will serve to effectively enable flipped learning models in which didactic materials are provided to trainees for independent learning in-advance of in-person group teaching, with group or classroom time dedicated to the reinforcement of concepts, interactive clinical discussions and problem-solving learning strategies. To date, even with a relatively focused dissemination of information regarding this MSK core curriculum lecture series, the hosted lectures have been widely accessed. Review of page view data collected during the first 323 days following initiation of the Core Curriculum Lecture site (Table 1), illustrates initial trends in lecture topic views. The highest percentage of page views across all topic categories were trauma and arthritis, topics emphasized early in residency training, and internal derangements of joints. At this early stage, it is unknown what percentage of users of the site materials have been radiology resident trainees, as users are not currently asked to identify their level of training or practice.

Future development initiatives for the MSK core curriculum lecture site include ongoing renewal of existing lectures, as well as the addition of new lectures to address existing and future potential core curriculum content gaps. Additional opportunities for evaluation of the lecture series include ongoing Web page analytics to assess trends in accessing lectures by month within the academic year, year over year, and as new material is added to the site. Surveys are also being considered to assess educational effectiveness of the lecture recordings.

In summary, we have successfully developed and implemented an open-access Web-based radiology resident trainee MSK core curriculum lecture series for MSK radiology resident training, to augment and enable resident self-directed learning. It is envisioned that initial success of the project will serve to promote ongoing content renewal and expansion to the lecture materials over time.

**Compliance with ethical standards** This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

**Conflict of interest** The authors declare that they have no conflicts of interest.

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