



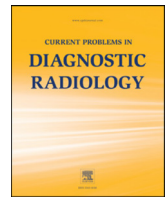
Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Current Problems in Diagnostic Radiology

journal homepage: www.cpdjournal.com



The Virtual Homeroom: Utility and Benefits of Small Group Online Learning in the COVID-19 Era



Robin Perlmutter Goldenson, MD, MPH^{a,*}, Laura L. Avery, MD^b, Ritu R. Gill, MD, MPH^c, Sara M. Durfee, MD^a

^a Department of Radiology, Brigham and Women's Hospital, Harvard Medical School, Boston, MA

^b Massachusetts General Hospital, Harvard Medical School, Boston, MA

^c Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA

ABSTRACT

Objective: During COVID-19, Harvard Medical School pivoted to online learning. A large student cohort took a completely virtual Radiology clerkship with daily programming including virtual small group teaching sessions or “homerooms.”

Materials and methods: One hundred and eleven medical students were divided into 12 virtual small group sessions which emphasized foundational concepts. Uniform teaching materials were used across all homerooms in order to deepen understanding and allow insight into the working methods of radiologists. Students evaluated the homeroom learning and teachers for utility and benefit to their educational experience.

Results: Most students (93%) felt the homerooms provided an educational benefit and reinforced topics studied (77%). Most students (84%) felt the leaders created an environment conducive to learning. Despite being virtual, students were able to form interpersonal connections with the homeroom leaders.

Conclusions: Incorporating virtual small group learning can be a valuable component of a virtual or hybrid Radiology clerkship, solidifying foundational concepts with the homeroom leaders playing a major role. While developed by necessity due to COVID-19, virtual small group learning with engaged leaders is an educational strategy whose benefit can continue even as there is return to in-person learning.

© 2021 Elsevier Inc. All rights reserved.

Introduction

Due to the COVID-19 pandemic, in the spring of 2020, Harvard Medical School (HMS) removed all students from in-person clinical rotations and pivoted to online learning. As a result, a large cohort of students took a completely virtual Radiology Core clerkship. Daily didactic teaching sessions for the entire cohort introduced foundational concepts. Because small group teaching sessions have been shown to be an effective method for synthesizing and consolidating concepts in medical education,^{1–3} daily small group or “virtual homeroom” sessions were paired with didactic sessions. This study was undertaken to assess the utility and benefit of virtual homeroom sessions as part of a comprehensive virtual core Radiology clerkship.

Methods

When the COVID-19 pandemic hit in the spring of 2020, 111 Harvard Medical School (HMS) students were midway through their core clerkship year and had not completed their required Radiology clerkship. A 4 week entirely virtual Radiology clerkship was implemented for these students to continue their medical education despite the pandemic.⁴ The clerkship consisted of daily live, virtual didactic lectures for the entire

cohort emphasizing foundational concepts of Radiology. Each day, the foundational material was reinforced in small group learning sessions, or “virtual homerooms” held via Zoom (Fig 1).

All 111 students enrolled in the virtual Radiology clerkship were assigned to a virtual homeroom for the duration of the course. Twelve homerooms of 8–10 students were formed, 4 at each teaching hospital, to accommodate all students enrolled in the course. One or 2 Radiology resident(s) were designated “homeroom captains” for the duration of the course, serving as teachers and mentors for the homerooms. The homeroom captains were selected by the clerkship directors because of their previous effectiveness as medical student teachers. In total, seventeen homeroom captains were recruited to lead the twelve homerooms. There was no formal training prior to the start of the course but all the teaching materials were uniform across the homerooms.

Live virtual homeroom teaching sessions were held each day via Zoom. The students and leader would review the day's topic, pre-viewed by the students the night before using Aquifer teaching materials, an evidence-based, online subscription teaching resource (aquifer.org, Lebanon, NH). Concepts were then reinforced with an Unknown Case panel, with cases chosen by the course faculty to emphasize the topic of the day. This exercise mimicked a clinical Radiology readout where students would take turns describing and interpreting imaging findings.

At the end of the 4-week virtual clerkship, the students completed the standard online course evaluation which is administered to all students

*Reprint requests: Robin Perlmutter Goldenson, MD, MPH, Department of Radiology, Brigham and Women's Hospital, 75 Francis St, Boston, MA 02115.

E-mail address: rperlmutter@bwh.harvard.edu (R.P. Goldenson).

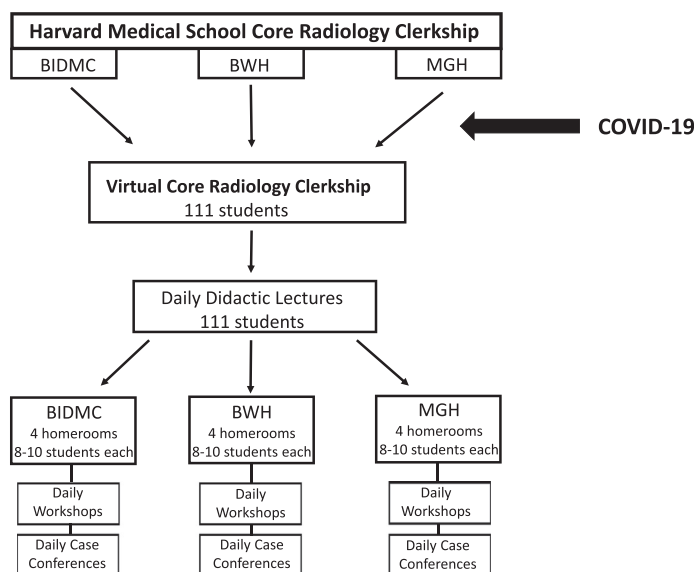


FIG 1. Organization of Harvard Medical School core Radiology clerkship before and during COVID-19 pandemic with transition from in-person to completely virtual clerkship. BIDMC, Beth Israel Deaconess Medical Center. BWH, Brigham and Women's Hospital. MGH, Massachusetts General Hospital.

completing HMS courses. The students were also asked open response questions in order to assess the utility of the virtual homerooms. Because students routinely complete course evaluations as part of an ongoing quality assurance program, IRB approval was waived.

Results

Student Assessment of the Virtual Radiology Clerkship

Of the 111 students enrolled in the virtual Radiology clerkship, 56 (50%) completed the online survey at the end of the clerkship. 100% of students rated the course as “excellent” or “good” on a 5-point Likert scale.

When the students were asked to list the major benefits of the virtual Radiology clerkship, 40/56 students responded (71%). Most students cited the virtual homeroom sessions as the most worthwhile aspect of the course (68%; 27 of 40). The virtual homeroom faculty was the second most cited asset (55%; 22 of 40), with the teaching materials being the third (48%; 19 of 40).

Student Assessment of the Virtual Homerooms

40/43 responding students (93%, Table 1) felt that the virtual homeroom provided an added benefit beyond the didactic lecture with 77% of students (33/43) stating that the small group learning environment served to reinforce and consolidate the foundational Radiology topics introduced in the didactic sessions.

TABLE 1

Student evaluation of virtual homerooms and homeroom captains.

Survey Question	Affirmative Student Response
Virtual homerooms added educational benefit beyond didactic lectures	93%
Virtual homerooms reinforced/consolidated foundational topics	77%
Virtual homerooms were engaging	67%
Homeroom captains were the most beneficial aspects of the homeroom	84%
Homerooms would be beneficial after in-person learning resumes	86%

The resident leaders of the small group sessions were cited as the most worthwhile element of the virtual homerooms, with 84% of the students (26/31 responding) stating the homeroom captains were a valuable resource in their learning. In open-ended questioning, comments from the students about the homeroom captains included that they “created an engaging and supportive environment conducive to learning” and with their help, students were able “to clarify material and reinforce foundational concepts.” Other students remarked that “the Unknown Case panels challenged (them) to think like a Radiologist.” This mimicked an in-person Radiology reading room experience which was curtailed during the pandemic. In addition, many students remarked they were able to form interpersonal connections with their homeroom captains who offered insights into the field of Radiology and Radiology training, despite the virtual nature of their interactions.

Anticipating the eventual return to traditional in-person rotations as the COVID pandemic wanes, the students were asked whether continuing the small group homeroom model would be of benefit. 86% (38 of 44) of responding students felt continuing this program would be useful, with having the opportunity to consolidate foundational concepts and forming mentor relationships with the homeroom captains cited as the chief benefits.

Discussion

In early spring, 2020, the worldwide COVID-19 pandemic resulted in an immediate cessation of in-person learning throughout the United States,⁵ resulting in an abrupt pivot to online learning, including at HMS. More than 100 students in their core clinical year were enrolled in a 4 week entirely virtual Radiology clerkship, teaching the same foundational material which would be covered in an in-person clerkship. This allowed these students to continue their medical education despite the pandemic.

Daily didactic lectures introduced foundational concepts to all 111 students in the clerkship. However, a strictly lecture format was unlikely to foster a deep understanding of essential topics and students would not gain insight into the work experiences and challenges of practicing Radiologists. To address these concerns, a small group learning component, the “virtual homeroom,” was developed for the clerkship. Educational theory in medical education has long demonstrated the benefits of small group learning,⁶⁻⁸ with a small group of students and an engaged facilitator promoting deep

understanding of complex material. Specifically, the constellation of a small student group, an engaged leader, and well-designed teaching materials creates an effective learning environment in which students develop an increasingly nuanced understanding of the topic, build the skills of processing, formulating and articulating questions, and work with teammates, all to deepen their understanding of the material.⁹ This process and this skill set is important to hone as students' progress in their medical education and become life-long learners.

We demonstrate that most students felt the virtual homeroom added significant value to the Radiology clerkship beyond large group didactic lectures. We identify specific elements of the homeroom experience which made this strategy for learning and student engagement successful. In these daily discussions, the students initially engaged with the material on a superficial level, but through guided discussion with their homeroom leaders, often formulating and articulating questions with their peers, developed a deeper, more nuanced understanding of the material. This was particularly true during the Unknown Case panels each day. For these panels, students were presented with a patient history and imaging studies highlighting a specific topic. Through guided group discussion, the correct diagnosis was reached, and broader conclusions about the disease process were drawn. In summary, the small group format, aided by an engaged homeroom captain and well-designed teaching materials, encouraged group discussion, leading to clarification, consolidation, and ultimately a deeper understanding of foundational concepts in Radiology.

To maximize the effectiveness of small group teaching, a dedicated, knowledgeable workforce was needed to serve as homeroom captains. The clinical responsibilities of the Radiology residents throughout the HMS teaching hospitals were curtailed by the pandemic. As a result, many residents were available, and eager to serve as homeroom captains. Residents who had previously demonstrated an aptitude for medical student teaching were selected as homeroom captains.^{9,10} In most cases, the homeroom captains interacted with their students daily for 4 weeks. We show that most of the students felt their homeroom captain was a valuable resource, facilitating a learning environment which promoted the educational mission of this clerkship.

Every practicing Radiologist today has had the benefit of “at the elbow” learning from mentors. Removing the students from hospitals as a result of COVID-19 meant this traditional teaching model needed adaptation for social distancing. A completely online Radiology clerkship is a different experience than an in-person clerkship. However, we show many students made personal connections with their homeroom captains, despite remote interactions. These connections, in conjunction with opportunities such as Unknown Case panels, approximate the “at the elbow” reading room experience which was otherwise lost in a completely virtual clerkship.

In order to meet educational and mentorship goals of virtual homerooms, the ratio of students to group leader had to be small, and the groups had to meet for at least 2 to^{1–4} 3 hours each day. The workforce required to staff these homerooms was immense and poses the greatest impediment to implementing this teaching strategy. During the Spring of 2020, at the start of the pandemic in Massachusetts,

most of the Radiology residents at HMS teaching hospitals were not present in the hospital and not yet incorporated into remote imaging workflow. In addition, elective radiologic studies done in our region were markedly curtailed. As a result, the residents' clinical responsibilities were significantly diminished, and they were unavailable for online medical student teaching. As remote image interpretation and conferencing have evolved, Radiology residents now remain fully engaged in their clinical training and responsibilities regardless of their location.^{11,12} If a remote clerkship of this scale is required in the future, gathering a workforce to staff a small group learning program would be a major obstacle. However, if implemented for a smaller group of students, such as at a single hospital, the staffing requirements would likely be achievable.

In summary, the COVID-19 pandemic necessitated a dramatic pivot from in-person to virtual medical student teaching. While our virtual Radiology clerkship had daily large didactic sessions, the students felt the small group virtual homeroom teaching sessions were the most valuable element of the clerkship. Guided discussions led by homeroom captains including Unknown Case panels resulted in clarification and consolidation of foundational Radiologic concepts. These elements formed a learning experience which students felt one would be beneficial in the future, regardless of whether clerkships were in person or virtual. As the COVID-19 pandemic continues to impact the United States, some degree of online medical student teaching, whether in a hybrid or completely virtual model, is likely. A small group learning experience, despite the staffing challenges, would be a highly valuable resource.

References

1. Shaffer K, Small JE. Blended learning in medical education: use of an integrated approach with web-based small group modules and didactic instruction for teaching radiologic anatomy. *Acad Radiol* 2004;11:1059–70.
2. Steinert Y. Student perceptions of effective small group teaching. *Med Educ* 2004;38:286–93.
3. Ayoub Meo S. Basic steps in establishing effective small group teaching sessions in medical schools. *Pak J Med Sci* 2013;29:1071–6.
4. Durfee SM, Goldenson RP, Gill RR, et al. Medical student education roadblock due to COVID-19: virtual radiology core clerkship to the rescue. *Acad Radiol* 2020;27:1461–6.
5. Whelan A, Prescott J, Young G, et al. Guidance on medical students' clinical participation: effective immediately. March 17, 2020, <https://www.aamc.org/news-insights/press-releases/important-guidance-medical-students-clinical-rotations-during-coronavirus-covid-19-outbreak>.
6. Walton H. Small group methods in medical teaching. *Medical Education* 1997;31:459–64.
7. Darras KE, Spouge RJ, de Bruin ABH, et al. Undergraduate radiology education during the COVID-19 pandemic: a review of teaching and learning strategies. *Can Assoc Radiol J* 2020;4:1–7.
8. Cendan JC, Silver M, Ben-David K. Changing the student clerkship from traditional lectures to small group case-based sessions benefits the student and the faculty. *J Surg* 2010;68:117–20.
9. Koh GC, Khoo HE, Wong ML, et al. The effects of problem-based learning during medical school on physician competency: a systematic review. *CMAJ* 2008;178:34–41.
10. Naeger DM, Wilcox C, Phelps A, et al. Residents teaching medical students: how do they compare with attending educators? *J Am Coll Radiol* 2014;11:63–7.
11. Slanetz PJ, Parikh U, Chapman T, et al. Coronavirus disease 2019 (COVID-19) and radiology education – strategies for survival. *J Am Coll Radiol* 2020;17:743–5.
12. Li CH, Rajamohan AG, Acharya PT, et al. Virtual read-out: radiology education for the 21st century during the COVID-19 pandemic. *Acad Radiol* 2020;27:872–81.