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.

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Coronavirus Disease 2019 (COVID-19) and Radiology Education—Strategies for Survival

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Radiology practices are facing unprecedented challenges not only in how they are providing care to patients but also in how to continue to educate the next generation of radiologists. Although the priority is on providing timely and high-quality imaging to patients, especially those infected with coronavirus disease 2019 (COVID-19), there is still a need to maintain our educational mission. For many institutions, remote learning has become the solution, although in reality, many radiology educators lack the expertise and experience using these technologies effectively.

DURING THESE CHALLENGING TIMES, HOW CAN WE BEST BALANCE THE COMPETING DEMANDS OF CLINICAL WORK AND THE EDUCATIONAL NEEDS OF OUR LEARNERS?

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Situated in the epicenter of the COVID-19 pandemic, addressing coronavirus and the safety of our residents and patients is the number one priority. And although our residents are working to ensure imaging studies are rapidly dictated and necessary interventional procedures are performed, many are stepping up to the front lines alongside our medical and surgical colleagues. Despite these challenges, we continue to learn in adaptive ways through consistency, flexibility, innovation, and, importantly, social distancing.

Along with free open access education, strategies to aid learning generally fall into the following four areas.

1. Consistency with the "status quo" using virtual platforms. Traditional radiology teaching stems from clinical "at the workstation" learning as well as didactic and case-based teaching. Continuing this approach virtually gives residents a sense of normalcy. Residents now read out with a dedicated teaching attending through a built-in chat function and virtual screen sharing. Daily didactic teaching is delivered virtually via Cisco WebEx (Milpitas, California), with residents logging in from their workstations.

Residents can also host "virtual rounds" with clinicians on the floors. For example, senior residents lead pediatric intensive care unit rounds via video conferencing and screen sharing. Residents gather clinical information from the team and interpret or review radiographic findings. Even in this time of social distancing, residents add value by maintaining open lines of communication with referring teams, thereby improving workflow efficiency and patient management.

2. Continuity of learning through innovative approaches. The key is to be creative and find innovative ways to meet resident educational needs without burdening radiologists who are trying to meet increasing clinical demands. For example, our neuroradiology section now sends out weekly articles (ie, radiographics) with accompanying multiple-choice questions that can be answered on a mobile device. In contrast, our abdominal imaging section hosts a virtual "body club" in which residents discuss body imaging cases encountered when on rotation or on call.
3. Informatics: PACS database and radiologic-pathologic learning. Institutions should update their teaching files and accessible databases of existing cases for trainee review. By harnessing the power of informatics, a quick search of the PACS database can quickly identify COVID-19 cases, which could then be reviewed by residents and faculty to "train their eye" on the multimodality appearance of COVID-19 pneumonia. Radiology-pathology correlation can be streamlined by

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creating a module that sends automated e-mails once pathology or operative reports become available for imaging cases, thereby enhancing resident learning and improving accuracy.

4. Residents as teachers. As medical schools transition to a virtual platform, radiology trainees can play a prominent role in teaching, particularly using imaging as a means to teach anatomy and disease pathology, possibly in an interdisciplinary setting. Perhaps a "virtual radiology elective" would offer students a structured learning platform.

Teresa Chapman, MD, Program Director, Diagnostic Radiology Residency, University of Washington

A recent statement by Tom Nasca, MD, president and chief executive officer of the ACGME, acknowledged the many changes we are experiencing across the country and specifically addressed the use of telemedicine and the impact of COVID-19 on clinical volume [1]. His communication emphasizes that as needs and policies evolve, the program director, with consideration of the program's Clinical Competency Committee, will assess the competence of each individual trainee before graduation. Program directors must remain committed to providing excellent training to residents and fellows despite our current challenges.

In response to the need for social distancing, the first adaptation in our educational environment was to eliminate side-by-side supervision and to reduce congestion in reading rooms by establishing remote office spaces and home workstations. Faculty and trainees have quickly become facile using screen-sharing software for teaching. This rapid and widespread change in behavior has both immediate and long-lasting benefits. The ability to share a teaching session allows medical students and visiting learners to participate remotely. Furthermore, setting up a text page system for announcing upcoming interesting case conferences can bring residents together, thereby benefitting education and overall well-being.

Postponing nonurgent and elective procedures has led to a profound decrease in clinical work for some subspecialties leading to a reduced daily workforce, including trainees. While at home, residents are available to assist at any moment and can also participate in readout sessions, lectures, and multidisciplinary sessions remotely. Multiple radiology societies, including the ACR, Association of University Radiologists (AUR), Association of Program Directors in Radiology (APDR), and RSNA, quickly organized and disseminated free learning material for residents with the aim of providing a core resident curriculum. In addition, senior residents with an interest in radiology education can help develop curricular materials in their area of interest when they are on a remote study rotation.

The impact of decreased clinical volumes as it relates to meeting graduation and program requirements is of concern to both trainees and program directors. ACGME has posted communications from several specialties, including radiology [2]. Accrediting and certifying bodies, including the ABR, ACGME, FDA, and Nuclear Regulatory Commission (NRC), recognize the impact of this pandemic on trainees' education, and specific allowances may be granted for those residents impacted by COVID-19. For example, creative solutions such as interpretation of blinded, historical patient cases may become necessary for some senior residents. As always and especially at this time, program directors should pay close attention to senior residents' clinical experiences and ensure their readiness to practice independently.

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How do we adapt to the restrictions related to this pandemic in a way that allows us to continue to support the educational mission? Continuing educational activities preserves some "normalcy" for residents and can decrease anxiety, given the current uncertainty.

First, do what is easy. Keep the lecture schedule and use technology to allow all parties to participate irrespective of physical location. A virtual platform such as Zoom (San Jose, California), Cisco WebEx, or Go To Meeting (Boston, Massachusetts) can facilitate virtual meetings. Assigning one or two technologically savvy residents to support faculty can facilitate rapid adoption. For faculty uncomfortable talking to a computer screen, the session could still take place in a conference room provided on-site attendees are socially distanced.

With medical students, virtual learning can be as interactive as in-person learning provided the faculty explicitly encourages questions. This can be accomplished by either stating up front that questions are encouraged at any time or pausing frequently and asking for questions. Sometimes providing prompts, such as asking for the modality, plane of imaging, or imaging finding, can engage students more successfully.

With workstations spread out and sometimes in different buildings, faculty must find new ways to provide meaningful feedback and facilitate learning. Most PACS systems have direct messaging that can allow faculty to provide case-specific feedback.

Faculty can also share interesting cases and provide trainees with a list of teaching cases to review at their convenience.

Finally, having a virtual town hall can help trainees reconnect, share updates, and express concerns. These conversations can break the feeling of isolation and remind us that we are all in this together.

SUMMARY

In summary, the COVID-19 pandemic has challenged the status quo but has led to rapid adoption of virtual and experiential learning opportunities that none of us could have imagined just a few months ago. Most institutions have embraced technology as a means to maintain normalcy. Virtual meetings preserve dedicated teaching conferences for both trainees and medical students, facilitate ongoing workstation feedback to residents, and bring the community together in this era of social distancing. This rapid and exponential integration of distance learning has great promise to reach learners across the globe and potentially attract the best and brightest students into the field. For residency programs and trainees, although there remains some uncertainty around how to best meet expected case logs and rotation requirements, we must all remain adaptable, embrace innovation, and continue to add value to patient care. In fact, COVID-19 may just be revolutionizing how we teach in the future.

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