Advancing Medical Education Through Innovations in Teaching During the COVID-19 Pandemic

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ABSTRACT

Background: Medicine relies on education of trainees for growth of the field. Medical education has benefitted from a rapid pace of innovation, but due to the coronavirus disease 2019 (COVID-19) pandemic, many paradigms underpinning the medical education of trainees shifted—rendering numerous teaching modalities unusable. The COVID-19 pandemic, however, accelerated the development of novel teaching methodologies, which our trainees are now adapting to. We sought to examine emerging teaching methodologies to understand the opportunities available for medical education to innovate our teaching practices for learners in the midst of the COVID-19 pandemic.

Methods: In this narrative review, we drew upon the experiences of the authors as both life-long learners and educators. We then reviewed literature pertaining to novel teaching methodologies developed in medical education since the start of the COVID-19 pandemic.

Results: Several medical specialties have employed novel teaching methodologies including use of telemedicine, remote teaching, online curricula, virtual rotations, virtual conferences, simulations, and learning consortia to continue engaging trainees during the COVID-19 pandemic. There is a paucity of literature that addresses efficacy of novel teaching methodologies compared to more traditional teaching methodologies.

Conclusions: The COVID-19 pandemic presents an opportunity for medical education to combine new and innovative teaching methodologies to create novel, accessible, and engaging learning opportunities for our trainees.

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Medicine relies on the education of trainees for growth of the field.[1] Furthermore, education flourishes when innovative teaching methods enhance the learning of modern trainees.[1] The coronavirus disease 2019 (COVID-19) pandemic, with requirements for social distancing, has interfered with bedside rounding and forced educators to find alternative practices and solutions.[2,3] As bedside rounding traditionally represented the gold standard for education in clinical medicine,[4] physicians needed to innovate to maintain a high-quality educational environment. In this narrative review, we examine the literature published since the beginning of the COVID-19 pandemic (March 2020) until October 2020 using the keywords *teaching methodologies*, *educational methodologies*, *COVID-19*, *medical education*, and *primary care* to better understand how teaching methods have evolved in response to social distancing protocols.

Challenges During the COVID-19 Pandemic

The COVID-19 pandemic has disrupted many aspects of our health care system, including the education of our trainees.[5] COVID-19 has created a great deal of uncertainty—especially early in the pandemic.[6] For instance, the need for staff to quarantine hampers hospital services, social distancing requirements have limited use of shared spaces, and physicians have been necessarily teleworking from home or a site separate from their patients' physical locations.[6,7] For academic institutions in particular, this has compromised the usual face-to-face education of their learners (Table 1) and has also made finding mentorship more challenging given the reductions in normal day-to-day interactions between faculty and trainees.[8] Literature describing adaptations to medical teaching methods during the COVID-19 era are beginning to be published.

Adaptations to Medical Education

Traditional teaching methods can be combined with more novel methods to provide enriching educational experiences for learners.[1] With adherence to social distancing guidelines and parsimonious deployment of onsite hospital personnel, bedside rounding was not feasible during the early phase of the pandemic. Furthermore, more novel teaching methodologies (such

Clinical Points

- The COVID-19 pandemic has disrupted traditional educational modalities such as bedside rounds; however, the necessary transition toward online platforms and virtual learning has led to innovations in teaching and increased opportunities for interinstitutional collaboration.
- The mental health and well-being of physicians and trainees should be prioritized, and virtual teaching methodologies should be deployed thoughtfully to mitigate burnout caused or exacerbated by the stressors of the ongoing global pandemic.
- Impact on patient care should always be considered during development of medical education curriculum.

Table 1. Recommendations for Medical Education During the COVID-19 Pandemic

- Maintain social distancing (> 6 feet between people)
- Limit the number of people present in work spaces
- Educate trainees to monitor signs and symptoms of COVID-19 infection and quarantine at home if symptoms develop
- Consider limiting or disallowing personal and business travel
- Alter service structures to allow residents to work from home
- Teach all didactics virtually (remotely)

Abbreviation: COVID-19 = coronavirus disease 2019.

as "teaching rotations" for medical trainees) would also be disrupted.

Another key consideration in the education of trainees is recruitment, which has also been affected by the pandemic. Although the pandemic has not affected specialty choice, students may not be able to get as much exposure to specialties of interest prior to applying for residency positions.[9] Additionally, each of the medical specialty societies (including internal medicine, family medicine, and pediatrics) recommended restricting away rotations for the 2020–2021 academic year, with exceptions for students who lack access to certain clinical experiences at their school or in cases in which an away rotation is required for graduation.[10] As a result of these limitations to learning experiences, asynchronous or remote educational methodologies have been deployed during the COVID-19 pandemic.

Telemedicine. Telemedicine was first adopted by psychiatry in the 1950s[11,12] and subsequently made its way to primary care in the late 1960s.[13] Despite the convenience, barriers (most notably reimbursement and licensing) prevented its growth and widespread use.[13,14] However, since it is important to limit exposure for vulnerable populations, use of telemedicine has expanded rapidly in the COVID-19 era. Learners were necessarily required to adapt and learn how to conduct remote patient encounters, both from an adjacent room in the hospital and offsite. In addition, telemedicine technology has been utilized to allow trainees to continue with research projects during the COVID-19 pandemic.[15]

Remote teaching. Online platforms, such as Zoom, have offered a way to transition in-person didactic teaching to an online and remote format in primary care training programs worldwide.[16] In addition, Australian psychiatry programs have found success teaching trainees (residents and medical students) with platforms like Skype, Microsoft Teams, GoToMeeting, Webex, and others.[17] Although many institutions had not been equipped to teach psychiatry online, one Irish institution found that teaching psychiatry remotely during the COVID-19 pandemic could overcome barriers to learning (eg, lack of structure, lack of engagement, and social isolation).[18] Guerandel and colleagues[18] described key facets of their online curriculum: having lectures at appointed times to facilitate structure, engaging trainees with use of frequent "breakout rooms," and making the online space available for students outside of lecture times to facilitate peer social support. Finally, remote teaching may also make it easier for faculty to teach didactic sessions, as they will not have to travel to a different site or reserve physical space for the session.

Online curricula. As more faculty and learners worked from home or were quarantined at home, online curricula were developed to facilitate remote teaching. Although video platforms allow didactic sessions to be delivered synchronously, online curricula allows learners to work at their own pace, asynchronously. The National Neuroscience Curriculum Initiative (NNCI), based out of New Haven, Connecticut, developed a 14-day "Quarantine Curriculum" specifically targeted to residents and fellows in quarantine.[19] The NNCI Quarantine Curriculum includes self-study resources as well as interactive experiences meant to empower learners to participate as opportunity allows and creates virtual communities of learners. Other areas of psychiatry have found success implementing online curricula. In Germany, child and adolescent psychiatrists rapidly developed an online curriculum with over 2,000 subscribers.[20]

Virtual rotations. Virtual rotations allow for the combination of the above teaching methodologies into circumscribed educational experiences. Recently at the Massachusetts General Hospital, a geriatric psychiatry virtual rotation for residents[21] was developed using telepsychiatry, didactic education delivered via Zoom, and the NNCI Quarantine Curriculum. Although the traditional rotation experience was disrupted, innovation through consolidation of novel teaching methodologies allowed for preservation of the rotation in a new format.

Virtual conferences. Participation in regional and national conferences has facilitated the relationship of trainees and mentors, built peer networks, provided opportunities to present scholarly work, and allowed for learning from others in the field.[22] Due to travel restrictions and limits on large gatherings, many live, in-person national conferences were canceled in 2020 and 2021. To preserve these important experiences, these conferences were converted to virtual formats with remote presentations. Additionally, residency interviews for all medical specialties will be conducted virtually to allow applicants to participate remotely.[10]

Service structure alterations. Many residency training programs have altered their structure in response to COVID-19. Some programs have chosen to divide their residency programs in half, with half of the trainees working onsite for 14 days while the other half is quarantined and working from home.[23,24] This strategy guarded against potentially catastrophic circumstances, such as quarantining an entire training program's housestaff, and ensured that half of a program's trainees remained healthy at any given time.

In addition to altered structures within residency programs, residents from several medical specialties (including psychiatry[7]) were redeployed[25,26] to work on hospital medicine teams to help with the COVID-19 response. The Accreditation Council for Graduate Medical Education has also allowed for fellows to function in their core specialty if needed, as long as their time on their core specialty is limited to 20% of their total education time.[27] By collaborating to care for a growing number of COVID-positive medically ill patients, trainees from many different programs were immersed in experiential education.

Simulations. In the early days of the COVID-19 pandemic, decreased patient volume in many institutions meant trainees treated fewer patients. This was especially true for surgical training programs (including neurosurgery,[28] thoracic surgery,[29] plastic surgery,[30] otolaryngology,[31] and orthopedic surgery[23]) who suspended their elective procedures. While surgery training has often involved simulated exercises, the in-person nature of simulations and the limited supply of personal protective equipment presented challenges.[32] As such, surgical programs have begun to utilize virtual reality for skills training.[33] Anesthesia programs have also combined remote teaching and simulations into a "telesimulation" exercise wherein learners who are offsite can instruct preceptors onsite in simulation laboratories on how to run the simulation.[34]

Other medical specialties have also found simulations useful. Radiology programs noted that both volume of imaging and case mix diversity decreased.[35,36] To ensure that residents could continue to see a wide range of normal and abnormal cases, a "simulated daily readout" involving archived and anonymized images helped to maintain exposure to cases.[35] Finally, while some institutions restricted trainees from providing direct care of patients infected with COVID-19, simulation allowed trainees to learn to care for this population of patients.[37]

Learning consortia. While many institutions adapted their educational materials for trainees, travel restrictions limited opportunities for collaboration with those at other institutions. Thus, 3 learning consortia were developed for otolaryngology trainees during the COVID-19 pandemic.[31] These consortia comprised faculty and trainees from across the nation and were each meant to build a collaborative network of educators in otolaryngology. Faculty from a wide range of institutions gave lectures, allowing students to learn from faculty outside of their own institution. These recorded lectures also ensured access for trainees regardless of the time zones in which they lived/worked.

Wellness and burnout. While adaptations to medical education have been made, wellness and burnout of medical trainees is a key consideration that should be made. Eight months into the COVID-19 pandemic, health care workers as a whole have reported anxiety, depression, distress, and sleep problems.[38] Trainees have particularly been affected, with 1 in 5 resident physicians at a safety net hospital in New York City reporting having contemplated suicide or self-harm during this time.[39] Resident physicians report increased anxiety due to the pandemic and fears of spreading disease.[40] Another common factor that has been found to negatively impact well-being during the pandemic is social isolation, which has increased for all, but especially physicians who may have worries about infecting loved ones.[7,40] Residents have also expressed concern about the effect of the COVID-19 pandemic on their didactic education and clinical rotations.[40] Some medical schools such as the University of California, Los Angeles David Geffen School of Medicine have created teams to address the mental health and wellness of its trainees, including an "Emotional Support Response Team" that serves as a hotline for staff and faculty.[41] Similar support groups have also been developed for frontline clinical staff of academic medical centers.[42] The "Physician Support Line" was also established since the advent of the pandemic and is staffed by over 700 psychiatrists who are available to speak with resident physicians and medical students as a free and confidential resource—it has been widely utilized.[43] What has become abundantly clear is that we need to attend to trainee mental health and well-being as part of their overall health and academic growth during this stressful period of time.

Discussion

Although COVID-19 has been a disruptive force in medical education, several medical subspecialties have risen to the challenge and have adapted teaching innovations meant to ensure that trainees receive a high-quality and enriching education (Table 2). Although there is limited literature that specifically addresses primary care teaching innovations in response to COVID-19, there is now an opportunity to develop new approaches to teaching.

As medical education primarily aims to train competent clinicians, we must also consider patient care considerations in any discussion about medical education. Furthermore, while necessity has been called the mother of invention (eg, the rapid transition toward telemedicine), longstanding concerns could contribute to slower uptake in medicine. For instance, both patient and physician may feel a perceived loss of quality of care when compared to in-person visits. In some conditions, performance of physical and neurologic exams, use of catatonia rating scales, and testing with cognitive screens (eg, clock drawing) may be better suited to in-person visits. In addition, concerns about patient privacy and security and a perceived lack of personal connection to patients[44] may represent barriers to implementing telemedicine. Resistance to introduction of technology into the clinical encounter, as well as logistics (eg, lack of access to equipment) may also

Table 2. Summary of Novel Teaching Methodologies Used During the COVID-19 Pandemic

Telemedicine	Using audio only or video-enabled services to render patient care remotely allows trainees to maintain caseloads
Remote didactic teaching	Using online platforms (eg, Zoom) with screen sharing and video technology allows for remotely delivered didactics
Online curricula	Building repositories of educational material meant to be completed in a structured fashion allows learners to work at their own pace and can be asynchronous
Virtual rotations	Combining other teaching methodologies (eg, telemedicine for remote patient care, remote didactic teaching and online curricula) approximates an in-person rotation experience remotely
Virtual conferences	Distributing content of annual meetings and conferences via an online format allows residents to build peer networks, seek mentorship, and present scientific work
Simulations	Using in-person or online simulated patient care experiences can make use of virtual reality
Learning consortia	Developing consortia comprised of faculty from different institutions nationally and internationally can deliver diverse viewpoints remotely

Abbreviation: COVID-19 = coronavirus disease 2019.

Table 3. Recommendations for Mitigation of "Zoom Fatigue" During Use of Novel Virtual Learning Methodologies

- Incorporate adequate break time
- Encourage learners and educators to keep video screens on to facilitate interaction
- Incorporate check-ins regarding wellness and morale
- Use "breakout rooms" to facilitate engagement in smaller groups
- Make virtual space available outside of lecture times to facilitate peer support

Table 4. Recommendations for Programs to Maintain Educational Quality During the COVID-19 Pandemic

- Prioritize safety of trainees, implement novel teaching methodologies to preserve educational experience while also limiting intrapersonal exposure
  - Teach telemedicine skills and implement telemedicine for inpatient and outpatient care
  - Continue to provide didactic education remotely
  - Tap into online curriculum resources, such as the NNCI quarantine curriculum
  - Encourage attendance and presentations at virtual conferences
  - Develop learning consortia to allow delivery of viewpoints from different institutions
- Assess efficacy of novel teaching methodologies

Abbreviations: COVID-19 = coronavirus disease 2019, NNCI = National Neuroscience Curriculum Initiative.

be concerns. These considerations are important, however, as telemedicine could facilitate adequate ongoing patient caseloads for trainees. Some models have used remote technologies to allow physicians who are present in the hospital to communicate with patients from an adjacent location, allowing the opportunity to augment the remote interview with in-person observation from a distance. Physicians who work and teach on inpatient services may also use telemedicine to allow quarantined trainees to continue to participate in inpatient care. It is important to note, however, that traditional medical education methodologies such as bedside rounding allow clinician-educators to "role model"[45] the integration of theory into clinical practice. It may be more challenging now for clinician-educators to demonstrate these concepts, and novel teaching methodologies must continue to be tailored to allow them to role model concepts for trainees—even remotely.

As rotations for medical students and residents may have been compromised due to COVID-19, "virtual rotations" can be created to combine remote didactic learning with online modules and remotely delivered care. Although this may contribute to social isolation in some learners and may not replicate the in-person experiences, it could provide a clinical experience for learners who might not otherwise get this chance. Opportunities for clinical exposure are especially meaningful for students and residents who may feel that they might like more experience in a specialty or subspecialty of interest.[9] Beyond clinical exposure, the increased availability of virtual rotations and virtual teaching could also allow learners to have more exposure to institutions in which they are interested.[46] Overall, this infrastructure can also increase opportunities for learners to gain exposure while also facilitating remote collaboration between people from different institutions after the COVID-19 pandemic subsides. This infrastructure has made many teaching adaptations possible during this time, but new technologies—particularly videoconferencing technology—should be deployed thoughtfully to avoid "Zoom fatigue."[47] Zoom fatigue is a newly recognized phenomenon of tiredness, anxiety, and irritability due to overuse of videoconferencing technologies. Table 3 lists our recommendations for implementations that could mitigate Zoom fatigue.

Finally, much of the literature regarding teaching innovations in medical education as a response to COVID-19 is descriptive. There is little evidence about the efficacy of these teaching innovations, as well as a lack of studies that compare novel and remote teaching methodology to pre–COVID-19 learning experiences. Since novel teaching methodologies are likely here to stay long after the pandemic subsides, the current crisis provides a wealth of opportunities to assess their value.

CONCLUSION

Medical education has been dramatically altered in the COVID-19 era. The pandemic has shifted the paradigm and pushed medical education to explore novel teaching methodologies by moving many teaching interactions to remote (and sometimes asynchronous) experiences. We can learn from our peers in other medical specialties. By carefully evaluating and combining the best teaching methods (pre and post COVID-19), we can create more novel, accessible, and engaging educational experiences for our learners now and in the future—despite the challenges of a global pandemic (Table 4).

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