The Role of Technology in Health Professions Education During the COVID-19 Pandemic

Pamela R. Jeffries, PhD, Reamer L. Bushardt, PharmD, Ragan DuBose-Morris, PhD, Colton Hood, MD, Suzan Kardong-Edgren, PhD, Christine Pintz, PhD, Laurie Posey, EdD, and Neal Sikka, MD

Abstract

The COVID-19 pandemic has sparked radical shifts in the ways that both health care and health professions education are delivered. Before the pandemic, some degree programs were offered fully online or in a hybrid format, but in-person learning was considered essential to the education and training of health professionals. Similarly, even as the use of telehealth was slowly expanding, most health care visits were conducted in-person. The need to maintain a safe physical distance during the pandemic rapidly increased the online provision of health care and health professions education, accelerating technology adoption in both academic and professional health care settings. Many health care professionals, educators, and patients have had to adapt to new communication modalities, often with little or no preparation. Before the pandemic, the need for cost-effective, robust methodologies to enable teaching across distances electronically was recognized. During the pandemic, online learning and simulation became essential and were often the only means available for continuity of education and clinical training. This paper reviews the transition to online health professions education and delivery during the COVID-19 pandemic and provides recommendations for moving forward.

In this paper, we discuss the emergence and usage of various technologies to support the continued education, training, and practice of health professionals during the COVID-19 pandemic, which began at the end of 2019, but took firm hold in the United States in March 2020. Although some institutions and organizations have been early and prolific adopters of technology, academic health centers, health professions education (HPE) institutions, and credentialing bodies have shown a reluctance to change course, preferring to remain largely dependent on traditional methods requiring face-to-face, hands-on learning in the clinical setting to prepare graduates to enter the workforce. Due to the pandemic, increases in technology adoption that would have taken years instead took place in a matter of months. HPE and health care practice may return to an emphasis on in-person activities once the pandemic is over, but new knowledge, skills, technologies, and innovations will remain.

Transition to Online Learning

Online learning increased 900% worldwide between 2000 and 2016 and, in 2020, there were 1.22 billion online learners worldwide. Evidence-based best practices and frameworks exist to guide faculty with online teaching and learning. In a recent survey, however, only 49% of faculty believed online learning was effective as a pedagogy. Faculty beliefs changed somewhat after they received sufficient support and training, and improved dramatically after they actually taught an online course. Those who believed they were well prepared to teach online during the pandemic were more likely to have adopted the evidence-based strategies that result in an engaging and effective digital learning experience. Many of the innovative approaches implemented early in the pandemic were developed by experienced educators and consistent with what we already know about effective online learning. As the pandemic worsened, many institutions moved to fully online teaching, increased hybrid approaches, or offered classes both in-person and online simultaneously. Most higher education institutions had resources and infrastructure to support the delivery of fully online or hybrid courses before the pandemic, but in spring 2020, were at varying levels of readiness for a complete transition to online learning. Health professional educators at institutions with a centralized learning management system had access to an array of features to create and postinstructional materials online. For example, faculty could conduct synchronous videoconferencing sessions, facilitate learning through asynchronous discussions or small-group work, and assess learning through submitted assignments or online exams. Colleges and universities with instructional design and technology staff responded quickly to provide training and support faculty in using these resources effectively, including moving faculty development for online teaching to online formats. Many colleges and universities made instructional technology, educational design, and round-the-clock support available to help assist novice faculty.

The need to pivot quickly from in-person to online learning sparked renewed interest in a teaching model known as “HyFlex,” a multimodal approach to hybrid course delivery that allows students to attend classes online or in-person simultaneously. Several institutions adopted this approach to allow students the option to return to campus or continue learning from home.
At a minimum, HyFlex classrooms require live-stream videoconferencing that enables students to participate in real time or view class recordings asynchronously. HyFlex courses allow for instructional continuity in the face of disaster while allowing a diverse student body to choose the mode of instruction that best meets individual student needs. Successful adoption requires careful planning and adequate support for both students and faculty.16

**Innovations in teaching method**

Easy, low-cost access combined with the ability to connect people in real time made videoconferencing one of the more popular ways to deliver virtual education to both students and practicing clinicians. Platforms such as Zoom, Microsoft Teams, WebEx, Skype, and Blackboard Collaborate offer a range of features to support virtual learning. These features allowed educators to facilitate active participation through real-time discussion, interactive tutorials, and student-led case and clinical topic presentations31; Socratic questioning within virtual discussions of nursing care plans13; collaborative case-based learning in biochemistry16; and data analysis exercises during a virtual structural biology boot camp.14 Another example of interactive videoconferencing is the University of New Mexico’s Project ECHO, which connects experts and health care providers in “all teach, all learn” telementoring sessions. These sessions, modeled on the grand rounds method of information sharing amongst clinicians, use case studies to promote discussion, disseminate knowledge, and offer support for participants.

While many health professions courses could be adapted to online formats relatively easily, replacing some types of clinical learning experiences challenged educators to explore alternative options. The spring 2020 closings of university campuses for in-person learning necessitated a rapid transition of clinical experiences and clerkships to online learning. Clinical entities closed their organizations to students due to the increased patient load and the need for COVID-19 precautions, which put a strain on health care providers, limited personal protective equipment supplies, and reduced the time they could spend with students.15 With limited or canceled clinical experiences for students, some HPE programs adopted a service-learning approach. For example, through a partnership between a university and a local nonprofit organization, public health nursing students participated in a remote service-learning experience by making phone calls to older adults who may have been experiencing increased isolation during the pandemic.16 In a similar project, medical students who called and interviewed homebound veterans with a goal of alleviating social isolation while improving history-taking skills found it to be a deeply meaningful learning experience.17 When senior medical students required a comparable experience to replace clinical rotations, educators implemented virtual peer teaching, with senior medical students facilitating online problem-based sessions with other students.18

Helping learners develop hands-on clinical skills online presented unique challenges. Some instructors used a blended approach to replicate different aspects of hands-on skills learning, such as replacing face-to-face, small-group ophthalmology skills sessions with a combination of written materials, video demonstrations, and small-group Zoom meetings.19 Similarly, when students in a gross anatomy course could not access on-campus laboratories, instructors created narrated demonstrations on models and tissue slices, assigned application exercises, and held weekly synchronous “drop-in” sessions.20 Bhaskar and colleagues delivered a spirometry practicum using Zoom to demonstrate the procedure and allowed students to conduct the analysis by controlling the instructor’s laptop remotely.21 Other educators took advantage of existing online simulations and datasets to enable students to complete biochemistry and microbiology experiments remotely22 or made use of items available to students at home, such as a cup of hot coffee to teach the principles of specific heat capacity.23 Noted benefits of virtual labs included immediate feedback, the ability to repeat experiential activities without time limitations, and the opportunity to gain experience with technology in preparation for in-person laboratories.24

Also, during the early waves of the pandemic, knowledge and skills assessments that were historically conducted face-to-face were moved online, which raised some academic integrity, validity, and reliability concerns.25 Using critical thinking questions that cannot be easily looked up in a textbook and limiting the time and time frame during which learners can complete an online exam can minimize these concerns.11 There are also many options to support remote proctoring of exams, although these can be costly and require careful planning.26 Objective structured clinical examinations, in which students rotate through a series of virtual stations electronically, proctored by faculty using streaming technologies, can aid in the assessment of clinical skills.

The transition to online learning was challenging for some students. Students who chose traditional on-campus programs for the social and intellectual experience were forced to put those preferences aside. Some students may have lacked self-regulation or independent learning skills needed to be successful in online courses.27 For others, mental health concerns may have been compounded by isolation and lack of connection to instructors and peers.28 Students from lower-income and rural backgrounds may have had less access to technology and were more likely to face financial issues and health worries.27,29 All of these issues highlighted the need for additional student support, including digital literacy education, academic coaching, access to technology, tutoring, and counseling.

**Clinical education, interrupted**

A major concern for HPE during the pandemic was clinical education; faculty and clinicians were needed to facilitate instructional continuity to keep students progressing so they could graduate successfully and be ready to enter an already depleted workforce. Many nursing school leaders engaged their state legislatures, boards, and regulators in making compromises that enabled students to matriculate and complete their education. Due to the lack of clinical sites, which made it difficult to meet program requirements for clinical care hours, some boards of nursing and other boards quickly began to modify their policies and expectations for direct patient care during this unprecedented time. One such policy change, supporting atypical, varying clinical experiences, was initiated by the state of Virginia. The state’s director of its Department of Health Professions, in concert with the Virginia Board of Nursing, initiated...
a temporary waiver for regulations governing nursing education programs. The waiver allowed nursing education programs to substitute competency in course outcomes for clinical contact hours. Because health care organizations, hospitals, community centers, and other clinical learning sites closed to students, faculty needed to turn to screen-based simulations, virtual simulations, and other types of simulated activities, designed for students to apply their knowledge and skills in a virtual environment.7

Some educators used mannequins and standardized patients within a recorded Zoom platform while learners and facilitators were also in Zoom in real time or in an actual simulation room being directed by facilitators in various stages of assessment and patient care. Virtual simulation, described as head-mounted display software as well as augmented reality software, was used in addition to screen-based, vendor-prepared, or homegrown computer-based simulations. While different types of simulations were used, the pedagogical approaches, practices, and evaluations were embryonic and fragmented due to the lack of standardized terminology. The evolving pandemic accelerated the need for clarity even as the quick pivot to remote, distance, virtual, or screen-based simulations provided the instructional methodology and potential continuity needed for health professions’ clinical education to continue.

Both undergraduate and graduate medical education were also heavily impacted by the pandemic.30 Many medical school programs worldwide completed clinicals in a telesimulation and virtual environment in the spring of 2020.31 E-learning modules, virtual conferencing, and surgical and other skills simulation training were used in place of, rather than to augment, traditional educational methods.30 Numerous trainees became immersed in telehealth patient opportunities as clinics closed.32 While nursing students were often shut out of hospital settings, many physician fellows and residents were deployed into the clinical environment and pressed into service as additional clinical providers.23 This placed them in high-risk and high-stress positions that they had not been prepared for, and many were “cognitively and emotionally challenged by the significant morbidity and mortality occurring over a sudden and short span of time.”33

Wide-scale adoption of simulation to replace a portion of required clinical hours led to many uneasy moments and questions about the adequacy of this methodology, though learners, safe at home, understood faculty were doing the best they could in this time of crisis to help HPE students continue to progress. With all the hospitals, community centers, and other health care agencies closed to HPE students, the major shift to online simulations for clinical education on such a large scale presents questions about the effectiveness on clinical learning.

Facilitation and debriefing skills associated with simulation are adaptable and transferrable, but is this the case for online environments? The concept of debriefing, “a critical conversation to reframe the context of a situation to clarify perspectives and assumptions, both subjectively and objectively,”34 is one of the major components of learning using simulation. The National League for Nursing suggested that the skill of debriefing be used across the curriculum and mastery of this aspect of simulation is necessary for student success.34

Larger questions related to the pivot to online simulations, without direct patient care, also include teaching knowledge and skills around ethics and spirituality, cultural needs, family visitation, socioeconomic factors, and the concept of patient and family advocacy in a simulated environment. Whether faculty are teaching these concepts and students are embracing them remains unclear. Another challenge in using online simulations would be the aforementioned lack of faculty development in using, implementing, managing, and evaluating this type of clinical learning. The art of technology evaluation was nascent at best.35 Professional organizations note the continued lack of faculty preparation for even well-established technologies such as simulation.33

**Digital Disruption for Health Care Providers and Patients**

As use of telehealth, remote monitoring, and other digital technologies increased, health systems also faced challenges in ensuring their health care teams were adequately prepared to use these tools. In some cases, learners had their roles shifted to providing technical support to patients, ensuring they were able to access their virtual consultations online. Even though basic phone-based protocols were put into place to support COVID-19 testing, urgent care needs, translational services, and continuity of care protocols, HPE students lacked training on the appropriate use of this simple technology in the sphere of complex consultations or when interpreter services were required. There was a lack of delineation between learner levels due to the need for care to continue in modified ways.36

Layered training protocols were needed to allow students, residents, and providers with little prior knowledge to understand telehealth fundamentals at levels appropriate to their positions. Learners often assimilated into administrative or technical roles even though training was light or nonexistent on roles and responsibilities specific to telehealth. Equally challenging were instances where providers were required to demonstrate knowledge and skills they were just learning themselves without formal feedback.

There is a growing need to document training toward technology-enabled care and health informatics competencies to support learners as they complete training and move into their professional careers.37 Before COVID, accrediting bodies and professional practice organizations had started to develop competencies for certification. The process moved from a future state to an immediate need based on the amount of clinical work being supported by telehealth technologies. As waivers and regulations shift, it will become imperative to document initial and continuing education exposure as part of credentialing and privileging systems.

Moving forward, opportunities exist to further support learners in their access to technology and supervision of roles that enhance their clinical education.38 Improving the education and training of graduates in the health professions so they are workforce ready is an established priority, but the pandemic has created a sense of urgency to build upon the
existing momentum to bridge gaps that exist from education to practice.

Telemedicine and telehealth education

Before the COVID-19 pandemic, telehealth had limited adoption in health care settings as well as in HPE programs. Training and education around new telehealth services and in support of early telehealth adopters had been steadily gaining momentum, but there was no imperative regarding its inclusion in HPE curricula. Accreditors and professional associations were exploring formal requirements related to certification and competency. Still, trainees were largely being given the option to engage in experiential education activities as electives or as part of capstone projects. COVID-19 accelerated the timeline for the preparation of trainees and the implementation of telehealth services by providers, thus necessitating a need for timely telehealth education interventions. The need for documented training and certification is now seen as imperative in postpandemic planning.

In the decades preceding the pandemic, telehealth education and training were largely provided as part of the development and implementation process for new telehealth services and applications. Often this education was provided by telehealth platform vendors or as part of in-person training to prepare providers on organization-specific workflows and technologies. In early 2020, with the rapid decrease in patient volumes in the ambulatory, emergent, and inpatient care settings, providers quickly sought out the skills needed to provide telehealth visits. For many, this meant implementing a free or low-cost video conferencing platform followed by onboarding through live webinars and online training sessions delivered during lunch breaks or before clinics. Across the United States, the educational pedagogy that supported telehealth education shifted to account for the need to train in the basics of conducting a telehealth visit. The emphasis was placed on connecting with patients, completing some form of examination, and adequate documentation. There was little time or consideration for emergency protocols, web-side manner, virtual exam skills, patient engagement, operation efficiency, or even the inclusion of learners.

Limits on the number of patients who could safely receive in-person care as well as the procurement of personal protective equipment impacted how students could be trained and in which settings. HPE programs faced constraints and challenges in the provision of clinical hours required for graduation. In addition, historical training models that used a hierarchy of learners (i.e., providers, residents, students) flattened with all learners needing to be trained simultaneously for several interwoven roles and responsibilities. The result was the need to implement a train-the-trainer approach that allowed all learners to receive training for immediate implementation.

Patients and privacy first

Intertwined with clinical services and education processes were the clinical needs of patients. Their roles as health care consumers and the study of quality and guideline adherence were documented before COVID-19, but the need to ensure patient safety while reducing risk and improving access took on increased importance as health facility closures were extended in 2020. The application of telehealth moved beyond the concept of convenience to necessity for access. Still, significant engagement is required to ensure patients are receiving care in a way that reinforces continuity of trust between patients, providers, and institutions as well as privacy for their sensitive health information and assurance of security through the knowledge that their needs will be met by reputable systems. New venues for communication into the home or assisted-living environments require patient safety models to be examined and updated.

Addressing the technical and educational divides

Providing virtual care to patients in home settings is challenged by patients' needs for digital health literacy as well as access to technology, including high-speed connectivity, and access to basic health services. The increased need for individuals to have access to health care services, such as screenings and data related to the pandemic, further drove the need to address access and equity. These long-standing systemic issues have been further elevated to the forefront of conversations about long-term sustainability for telehealth and HPE.

Industry decision makers in health care and technology must ensure access to appropriate technical and connectivity solutions for both providers and consumers. During the past year, health care systems and individual providers had to make quick decisions about appropriate modalities and available access points to facilitate telehealth in their communities, including nontraditional locations, such as providers' homes. Little time was available for testing or pilot phases, so creativity was needed to ensure that providers could engage with their patients and provide the appropriate level of care while also including trainees in the patient care experience as part of their formal learning objectives. Providers had to learn how to optimize data gathering in collaboration with patients to ensure that the information used for their decision making was of sufficient quality to meet the standards of care.

Behind the scenes, a great deal of integration occurred to facilitate learning and care provision using existing information systems as well as online learning platforms. These innovations in clinical care, application development, experiential education, and translational research previously would have been offered on a smaller scale. The pandemic necessitated integration of physical and online systems to determine not only appropriate care settings but also appropriate learning settings based on the needs of patients. In many cases, digital health solutions became a prominent method of health care education.

Competencies and teams of the future

As telehealth becomes more widely adopted and more often requested by patients, telehealth education will focus on the shift from confidence to competency. Primarily, introductory materials will continue to ensure that future and existing providers have a baseline of technical and professional knowledge related to telehealth. This framework will shift to include more formal evaluation and metric components for documenting and tracking the competency of trainees and providers. In addition, HPE will further integrate health informatics training to help inform effective and interoperable health information systems through a well-trained workforce that is knowledgeable,
competent, and innovative in its response to current and future health care needs. Along with the creation of new telehealth sites and services, telehealth education will also highlight the concepts of interprofessional clinical support as a way of bolstering the provision of care and improving the ongoing care coordination activities that benefit from a team-based approach.49 These approaches will be essential in services such as remote patient monitoring, where tiered teams will evaluate and adjust patients’ care plans to ensure improved health outcomes and reduced expenditures.

**Summary and Recommendations**

In 2020, health care delivery and HPE experienced an acceleration in opportunities for moves to digital platforms few could have anticipated. “COVID acted like a time machine: it brought 2030 to 2020” in a matter of months.50 The pandemic may have fundamentally changed traditional HPE, with a hybrid blend of traditional and online learning becoming the norm. The following are recommendations for the use of technologies in HPE to better support patients, practitioners, faculty, and students:

- **Embrace the “new normal” by carrying forward online teaching methods that have increased efficiency while maintaining or improving student engagement and learning.** Blended courses that are carefully designed to optimize the benefits of online and in-person formats may offer the best of both worlds.

- **Prepare faculty, courses, and classrooms for flexible delivery.** Academic institutions should ensure that faculty members have the technology, training, and instructional design and technical support needed to develop courses that can easily pivot from in-person to online delivery.

- **Address potential for inequities in education and health care delivery.** Universities must do more to ensure all of their students have adequate access to technology. While the increased use of telehealth and other forms of technology-enabled access to medical services for many, some vulnerable populations, such as the elderly, the uninsured, and those in underserved communities, were further disadvantaged by these measures. Federal and state governments need to incentivize health care insurers and providers to find innovative solutions that extend the reach of telehealth and community health support to these groups.

- **Establish systematic, ongoing evaluation to assess and monitor new uses of technology to inform continuous improvements.** Like the health system as a whole, HPE should continuously improve based on evidence. Quality improvement principles including small, incremental tests of change and establishing measures to assess processes and outcomes can support a continuously learning health care education system.

- **Expand the development of repositories of online resources within and across disciplines.** Educators in and outside of the health professions have long recognized the value of shared online resources. Open education repositories have the potential to save faculty valuable time, allowing them to focus on facilitating learning rather than developing e-learning content.

**Acknowledgments:** The authors wish to thank Marie Brown, senior advisor to the dean at The George Washington University School of Nursing, for her invaluable assistance with editing, formatting, and revising this manuscript.

**Funding/Support:** None reported.

**Other disclosures:** None reported.

**Ethical approval:** Reported as not applicable.

**Previous presentations:** This material was presented at a conference titled “COVID-19 and the Impact on Medical and Nursing Education,” sponsored by the Josiah Macy Jr. Foundation, July 12–15, 2021, via Zoom.

**References**

1. Gutierrez K. Facts and stats that reveal the power or elearning. Shift Disruptive Learning. https://www.shiftelearning.com/blog/bid/301248/15-facts-and-stats-that-reveal-the-power-of-elearning. Published April 7, 2016. Accessed November 14, 2020.

2. Li C, Lalani F. The COVID-19 pandemic has changed education forever. This is how. World Economic Forum. https://www.weforum.org/agenda/2020/04/coronavirus-education-global-covid19-online-digital-learning. Published April 29, 2020. Accessed February 14, 2021.

3. Lederman, D. Will shift to remote teaching be boon or bane for online learning? Inside Higher Ed. https://www.insidehighered.com/digital-learning/article/2020/03/18/most-teaching-going-remote-will-help-or-hurt-online-learning. Published March 18, 2020. Accessed February 14, 2021.

4. Fox K, Srinivasan N, Lin N, Nguyen A, Bryant G. Time for class COVID-19 edition: Part 2. Tyton Partners. https://tytonpartners.com/library/time-for-class-covid-19-edition-part-2. Published October 5, 2020. Accessed February 12, 2021.

5. Brooks DC, Graiek S, Lang L. Institutional readiness to adopt fully online learning. Educause Review. https://er.educause.edu/blogs/2020/4/institutional-readiness-to-adopt-fully-remote-learning. Published April 9, 2020. Accessed January 15, 2021.

6. Kessler A, Barnes S, Rajagopal K, et al. Saving a semester of learning: MIT’s emergency transition to online instruction. Inf Learn Sci. 2020:121:587–597.

7. Rabe A, Sy M, Cheung WY, Lucero-Prisno DE. COVID-19 and health professions education: A 360° view of the impact of a global health emergency. MedEdPublish. 2020. doi:10.15694/mep.2020.000148.1.

8. Beatty B. Values and principles of hybrid-flexible course design. Hybrid-flexible course design: Implementing student-directed hybrid classes. EdTech Books. https://edtechbooks.org/hyflex/hyflex_values. Published 2019. Accessed January 22, 2021.

9. McMurtie B. Colleges say hybrid courses will make the fall a success. But will students get the worst of both worlds? Chron Higher Educ. July 10, 2020. https://www.chronicle.com/article/collages-say-hybrid-courses-will-make-the-fall-a-success-but-will-students-get-the-worst-of-both-worlds. Accessed February 12, 2021.

10. Gannon K. Our hyflex experiment: What’s worked and what hasn’t. Chron Higher Educ. October 26, 2020. https://www.chronicle.com/article/our-hyflex-experiment-whats-worked-and-what-hasnt. Accessed January 15, 2021.
Vasiliadou R. Virtual laboratories during COVID-19. Biochem Mol Biol Educ. 2020;48:482–485.

Vollbrecht PJ, Porter-Stransky KA, Lackey-Shih KC, Chan JC, Chen JY, Lai JS. 20. Jeong L, Smith Z, Longino A, Merel SE, Gresh A, LaFave S, Thamilselvan V, et al.

Byrnes YM, Civantos AM, Go BC, Burley SK, Bromberg Y, Craig P, et al. Virtual Biochem Mol Biol Educ. 2020;48:511–513.

Thibaut D, Schroeder KT. A case-based learning approach to online biochemistry labs during COVID-19. Biochem Mol Biol Educ. 2020;48:528–531.

12 Konrad S, Fitzgerald A, Deckers C. Nursing fundamentals—Supporting clinical competency online during the COVID-19 pandemic. Teach Learn Nurs. 2021;16:53–56.

13 Thibaut D, Schroeder KT. A case-based learning approach to online biochemistry labs during COVID-19. Biochem Mol Biol Educ. 2020;48:511–513.

15 Byrnes YM, Civantos AM, Go BC, McWilliams TL, Rajasekaran K. Effect of the COVID-19 pandemic on medical student career perceptions: A national survey study. Med Educ Online. 2020;25:1798088.

16 Gresh A, LaFave S, Thamilselvan V, et al. Service learning in public health nursing education: How COVID-19 accelerated community-academic partnership. Public Health Nurs. 2021;38:248–257.

17 Danford J, Jain R, Holdcroft L, Warren C. Learning to blur the edges during COVID-19: Reconnecting with what matters via narrative medicine. J Am Geriatr Soc. 2020;68:2473–2474.

22 Costabile M. Using online simulations to teach biochemistry laboratory content during COVID-19. Biochem Mol Biol Educ. 2020;48:509–510.

23 Mahaffey AL. Chemistry in a cup of coffee: Adapting an online lab module for teaching specific heat capacity of beverages to health sciences students during the COVID pandemic. Biochem Mol Biol Educ. 2020;48:528–531.

24 Vasiiliadou R. Virtual laboratories during coronavirus (COVID-19) pandemic. Biochem Mol Biol Educ. 2020;48:482–483.