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Erini S. Serag-Bolos
University of South Florida

Liza Barbarello Andrews
Rutgers University

Jennifer Beall
Samford University

Kelly A. Lempicki
Midwestern University

Aimon C. Miranda
University of South Florida

See next page for additional authors

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Authors
Erini S. Serag-Bolos, Liza Barbarello Andrews, Jennifer Beall, Kelly A. Lempicki, Aimon C. Miranda, Carol Motycka, Chelsea Phillips Renfro, Brittany L. Riley, Chasity M. Shelton, Deepti Vyas, and Kimberly Won

Chapter 12
Clinical Skills Development in the Virtual Learning Environment:
Adapting to a New World

Erini S. Serag-Bolos
Taneja College of Pharmacy, University of South Florida, USA

Liza Barbarello Andrews
Rutgers University, USA

Jennifer Beall
https://orcid.org/0000-0002-9709-5741
College of Pharmacy, Samford University, USA

Kelly A. Lempicki
https://orcid.org/0000-0002-4623-7308
Midwestern University, USA

Aimon C. Miranda
Taneja College of Pharmacy, University of South Florida, USA

Carol Motycka
College of Pharmacy, University of Florida, USA

Chelsea Phillips Renfro
University of Tennessee Health Science Center, USA

Brittany L. Riley
School of Pharmacy, Marshall University, USA

Chasity M. Shelton
University of Tennessee Health Science Center, USA

Deepti Vyas
https://orcid.org/0000-0002-2412-1873
School of Pharmacy, University of the Pacific, USA

Kimberly Won
School of Pharmacy, Chapman University, USA

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ABSTRACT

The rapid transition to distance learning in response to the unexpected SARS-CoV-2/COVID-19 pandemic led to disruption of clinical skills development, which are typically conducted face-to-face. Consequently, faculty adapted their courses, using a multitude of active learning modalities, to meet student learning objectives in the didactic and experiential settings. Strategies and considerations to implement innovative delivery methods and address potential challenges are elucidated. Furthermore, integration of a layered learning approach may allow for more broad perspectives and allow additional interactions and feedback, which is especially necessary in the virtual environment.

INTRODUCTION

The novel coronavirus disease 2019 (COVID-19) pandemic caused by SARS-CoV2 precipitated a tremendous and tumultuous wave of unexpected changes, including immediate curricular challenges among academic health professional programs and the need to adapt to a permanently altered healthcare practice landscape. The rapid transition to virtual learning environments posed many challenges, especially related to clinical skills development in both the didactic and experiential settings. This challenged academicians to expeditiously adapt curricula to meet student needs while maintaining accreditation requirements. Since the peak of the COVID-19 pandemic, it has become increasingly clear that the healthcare environment to which learners enter has morphed more permanently than expected to include more telehealth and a greater focus on social determinants of care. The objectives of this chapter are to elucidate innovative ways to teach clinical skills in the virtual environment through active learning and simulation. Lessons learned are also discussed to further develop and enhance such pedagogy in the virtual setting.

BACKGROUND

Health professional degrees culminate in licensure exams, which are required for clinicians to enter the workforce. Respective accreditation bodies provide guidance to ensure that graduates are practice-ready. While programmatic structure varies among disciplines and programs in course format, duration, schedule, faculty model, and number of campuses served, a common thread is the use of active learning and simulation to enhance critical thinking and develop hands-on clinical skills in various settings (Bonwell & Eisen, 1991). The scope of this chapter encompasses various health professions that require training in clinical, technical, and communication skills including athletic training, audiology, dentistry, medicine, nursing, pharmacy, physical therapy, physician assistant, and social work.

Accredited programs require satisfactory completion of a minimum number of clinical hours to ensure that graduates are practice-ready in real-world settings. However, the different accreditation bodies that guide various health disciplines define and quantify simulation in various ways (Table 1). The COVID-19 pandemic has posed multiple challenges that require adjustment, necessitating faculty to become ever more resourceful to rapidly adapt to virtual learning. From a faculty perspective, the amount of time needed to modify existing course materials for the virtual learning environment represented an unexpected expansion of the faculty workload. The ability to involve adjunct faculty members in this process remotely has been advantageous in increasing their involvement in the didactic setting. Students have shared that many feel overwhelmed, disengaged, and lack a sense of community with virtual learning. These factors should be taken under consideration by faculty when reformatting courses and focusing on clinical skills development.

Table 1. Accreditation standards regarding incorporation of simulation

Health Profession	Simulation Guidance in Accreditation Standards
Athletic training	No specific guidance regarding the use of simulation, however defines the laboratory setting as one "where students practice skills on a simulated patient (i.e., role playing) in a controlled environment" (Commission on Accreditation of Athletic Training Education, 2013, p.17).
Audiology	No specific guidance regarding the use of simulation, but states in Standard 21 that the program should use multiple methods of instruction where simulation is provided as an example (Accreditation Commission for Audiology Education, 2016).
Dentistry	No specific guidance regarding the use of simulation, but states in Standard 2-9 those prospective simulations in which students perform decision-making can be used as evidence to assure graduates are competent in the use of critical thinking and problem-solving skills (Commission on Dental Accreditation, 2016).
Medicine	No specific guidance regarding the use of simulation, but states that skills (e.g., communication and clinical) should be taught (Commission on Osteopathic College Accreditation, 2019; Liaison Committee on Medical Education, 2021).
Nursing	An expert panel consisting of representatives from several nursing organizations and the National Council of State Boards of Nursing (NCSBN) developed guidelines for the use of simulation as a substitute for traditional clinical experience. These guidelines are based on data from the NCSBN National Simulation Study, which found that there was no statistically significant difference in knowledge acquisition or clinical performance when substituting clinical experiences with up to 50% simulation (The National Council of State Boards of Nursing, 2016).
Pharmacy	States that simulated practice experiences can be incorporated into the Introductory Pharmacy Practice Experiences (IPPE) to mimic pharmacist-delivered patient care situations for a maximum of 60 of the total 300 clock hours. Accreditation standards also state that colleges and schools of pharmacy should have a sufficient number of faculty members to address the needs of simulation teaching and provide access to educational simulation capabilities (Accreditation Council for Pharmacy Education, 2015).
Physical therapy	States that clinical education experiences that occur before the completion of the didactic curriculum cannot be satisfied with the use of simulation (Commission on Accreditation in Physical Therapy Education, 2020).
Physician assistant	No specific guidance regarding the use of simulation, but states that skills (e.g., communication and clinical) should be taught (Accreditation Review Commission on Education for the Physician Assistant, Inc., 2019).
Social work	States that each competency should be assessed by two measures, one of which can be based on real or simulated practice encounters (Council on Social Work Education Commission on Accreditation Commission on Educational Policy, 2015).

These were not the only factors that impacted healthcare education during the COVID-19 pandemic. Within the experiential setting, many sites were forced to limit or discontinue students' clinical rotations in response to the overwhelming numbers of COVID-19 positive patients and the need to reduce exposure risk. Simulation-based mastery learning allows for convergence of multiple adult learning theoretical models, which represent ideal means to engage learners in the application of didactic content (Aebersold, 2018; McGahie &Harris, 2018). Multiple simulation modalities are available for use, including role playing with standardized patients, use of manikins, utilization of task-trainers, and virtual reality. Many innovative techniques that span many learning styles have been embedded within courses. While active learning strategies had already been implemented in the traditional classroom setting, the increase in online learning and the concomitant emergence of new technologies has caused a shift in the paradigms used for online active learning (Allen et al., 2002). In particular, the expectations of appropriate etiquette in the virtual learning environment should become essential components of orientation sessions to optimize the learning experience for both learners and instructors.

Methods by which to strengthen critical thinking and clinical problem-solving skills in both didactic and experiential settings have shifted due to the COVID-19 pandemic. Since the terminology used within the literature varies widely, clarification of definitions is offered to support standardization throughout this chapter. Here, virtual learning (i.e., e-learning) is defined as instruction delivered on a digital device (e.g., laptop computer, tablet, smart phone) that is meant to support learning (Clark & Mayer, 2016). Virtual learning can be thought of in two different ways: synchronous or asynchronous. Each form of instruction can support collaborative learning via discussion boards, breakout rooms, or other forms of virtual collaboration. Synchronous and asynchronous learning can also be combined to generate blended learning delivery. Regardless of the delivery format or type of media used, virtual learning requires engagement of learners through behavioral (e.g., typing an answer to a question in the chat box) and psychological engagement (e.g., cognitive processing that leads to new skills). While virtual learning has many benefits, there are also several challenges to consider during its implementation, such as incorporating new technology that does not align with the instructional goal or incorporating too much or not enough of the new technology. These opportunities and challenges will be further discussed with a focus on active learning strategies that strengthen clinical skills in didactic or virtual settings, respectively, followed by a discussion of strategies to enhance etiquette that fosters a sense of community and collaboration within the virtual learning environment.

INNOVATIVE APPROACHES TO ACTIVE LEARNING IN THE DIDACTIC SETTING

Many approaches for developing clinical skills in a virtual environment were introduced to the curriculum as programs quickly pivoted to virtual instruction during the COVID-19 pandemic. While didactic lectures can be delivered via video conferencing platforms, the inclusion of some active learning strategies (i.e., think-pair-share, case studies, and simulation) may require additional preparation. Logistics for developing and offering virtual simulations (using standardized patients for telehealth visits, virtual/augmented reality, and/or low- and high-fidelity manikins) using video conferencing platforms and other gamification approaches, such as virtual escape rooms, will be discussed in this section.

Telehealth

Telehealth refers to the use of technology to connect health professionals with patients and other professionals who are in remote or distant locations (American Telemedicine Association, 2021). By comparison, digital health refers to a broader field that uses additional technologies, such as smart devices, artificial intelligence, genomics, and big data to improve health (World Health Organization, 2019). Prior to the COVID-19 pandemic, telehealth and virtual care had already proven to be beneficial for underserved, vulnerable, and/or rural populations (American Telemedicine Association, 2021). During the COVID-19 pandemic, patient care provided through telehealth increased from 47% in 2019 to 97% in 2020 in one study of health centers (Demeke et al., 2021). Since the peak of the COVID-19 pandemic, increased utilization has persisted as healthcare administrators begin to establish regulations that support long term telehealth integration into routine healthcare delivery with support (American Hospital Association, 2021).

Within health professions education, it is imperative that students receive training on best practices, patient privacy, available modalities, advantages and disadvantages of digital health and telehealth versus face-to-face visits, and effective communication skills so that graduates may deploy successful services in their future practice environments, especially given the changing landscape (Agency for Healthcare Research and Quality, 2015; Koonin et al., 2020). The International Pharmaceutical Federation (FIP) Digital Health in Pharmacy Education report urges schools of pharmacy to provide education for students in digital health to prepare them for this vast and growing aspect of practice (International Pharmaceutical Federation [FIP], 2021). One method for doing so would incorporate this technology into lab activities. From that perspective, development of simulations that provide opportunities for students to practice in a telehealth environment, with targeted feedback, would be beneficial for the student's professional growth. Several modalities can facilitate telehealth collaboration, including telecommunications technology, electronic medical records (EMR), wearable devices, store-and-forward technology, and mobile health (Health Resources & Services Administration, 2021). Procurement of these and other digital health technologies and products for device demonstration is critical for hands-on instruction in these modalities (FIP, 2021). The use of standardized/simulated patient actors (SPs) to simulate virtual patients in the ambulatory and acute care settings, and even in the community pharmacy setting where their use is traditionally less common, may be of particular help in replicating telehealth practice sites in the actual or virtual classroom or laboratory.

Likewise, simulations that are centered around the development of affective skills in the virtual environment can be beneficial for health professions students. Such skills are especially essential in the telehealth setting, which can be unfamiliar to many patients, especially those who are older or less technologically savvy. Depersonalization of the provider-patient relationship can occur in the telehealth setting due to physical distance, lack of sensory cues, and unclear norms/standards (Gordon et al., 2020; Miller, 2003). Creating simulations that emulate the telehealth setting can provide learners a realistic and safe learning environment to develop self-awareness, emotional intelligence, empathy, and social and emotional competence. These affective skills are pertinent for developing graduates able to build rapport and relationships to set the patient at ease in the virtual environment. Telehealth-based interprofessional education (IPE) may also provide opportunities for students to interact with other health professional learners who are in distant locations. Development of telehealth IPE that centers around topics such as complex disease management, social determinants of health, pharmacogenomics, special populations, quality improvement, and patient safety can enhance students' knowledge of telehealth in modern day healthcare. Also, as standards of best practice for digital health are being adopted, IPE allows for the spread of these practices across disciplines (FIP, 2021).

Choosing the Right Telehealth Tools

Video Conferencing

When developing a telehealth program, there are several considerations regarding choice of modalities. With cost as a primary concern, faculty could consider adopting platforms offered by their home institutions as the center of simulation design. At most US institutions, educators have access to teleconferencing technology such as Zoom Video Communications® (San Jose, CA), Cisco WebEx® (Milpitas, CA), Microsoft Teams® (Redmond, WA), or Skype Communications® (Palo Alto, CA). Most of these products are relatively similar to one another and the choice of tool will depend on the instructor's need for specialized capabilities such as breakout rooms, patient privacy, maximum number of attendees, screen sharing, and whiteboard tools. Clarity of the audio/video may also drive the choice of video conferencing technology, as the simulation may require clear audio and visual cues to collect an accurate history and perform a physical exam. Video conferencing may be an appealing mode for interprofessional learning experiences that simulate multi-disciplinary patient encounters. Depending on the simulation design, it may be prudent to have a waiting room available to allow standardized patients (SPs) to wait for their telehealth appointment or a separate room for the health professional teams to meet to discuss the patient. Other tools such as SimulationIQ® (Exton, PA) may offer a telehealth platform that provides videoconferencing, patient scheduling, and the patient's chart all in one. Regardless of which platform is selected, early involvement of the home institution's information technology (IT) personnel is key to ensure that the telehealth tool is compatible with the current system and any school-sanctioned student devices. Adequate internet connectivity and bandwidth should also be considered and discussed with IT personnel.

Electronic Medical Record (EMR)

Simulated electronic medical records can be easily utilized in virtual learning settings to strengthen multiple clinical skills, with the simplest being care plan development. Choosing the best EMR program for the activity will depend on the way the simulation is designed. Questions to consider include:

1. Is there a need for order-entry and verification capabilities?
2. Is there a need for the ability to document on a medication administration record (MAR)?
3. Is there a need for crisp diagnostic imaging within the EMR?
4. For IPE, do interprofessional teams need to make real-time or asynchronous changes to the patient's record, such as patient documentation, order entry by a provider and verification by a pharmacist, or sign-off by a senior team member?
5. Is the ability to query the EMR for population-health data necessary?
6. Would teleconferencing and group interaction within the EMR help facilitate the simulation?
7. Is there a need for assessment capabilities within the portal so that instructors can easily grade student work?

There are several educational EMR programs on the market and the choice of program will depend on individual needs and cost. One available product is EHRGo® (Duluth, MN), a comprehensive EMR platform that allows educators to use previously developed patient charts, edit existing charts, and build their own patient charts from a blank template. The program has order-entry/verification, provider documentation, group instances of patient charts, electronic prescribing, label generation, structure query language (SQL)-based data querying, and the ability to change the practice setting based on the case scenario. Another web-based program, SimEMR® (Pittsburgh, PA), is equipped with a dashboard that allows instructors to assign activities and manage courses. SimEMR® allows students to chart within the program, navigate through patient data, and submit assignments. EHR Tutor® (Parma, OH) contains prebuilt patient charts, unfolding patient cases, and group instances. The free EMR program, OpenEMR® (Altamont, NY), allows patient scheduling, e-prescribing, and laboratory integration. The comprehensive EMR MedAffinity EHR® (Tallahassee, FL) includes electronic medication administration record (MAR), provider documentation, e-prescribing, and unfolding patient data for real-time updates.

Wearable Devices

Several wearable devices are available for virtual monitoring of patients, including blood pressure, blood glucose, electrocardiograms, and patient weight. This data can be transmitted to the provider for assessment and subsequent development of a treatment plan. In simulated settings, virtual patient data could be provided to students for analysis prior to SP telehealth appointments or for IPE activities that center around developing an assessment and plan based on data obtained from wearable devices. For longitudinal patient cases, data from wearable devices can be sent to the student/team for regular monitoring and assessment. For telehealth simulations, the use of data from wearable devices in conjunction with other modalities can enhance the student experience and better prepare them for clinical practice.

Store-and-Forward Tools

Store-and-forward tools allow asynchronous access to data which is recorded and transmitted to the healthcare professional. This includes diagnostic imaging (e.g., radiographs, computerized tomography scans, electrocardiograms, and echocardiograms), pre-recorded patient interviews/assessments, recorded patient messages, photographs of wounds or dermatologic conditions, retinal images, and medication vials and prescriptions. For simulated activities, store-and-forward tools can allow educators to develop scenarios where the patient case does not require real-time face-to-face interactions with an SP. This approach may reduce the faculty workload and the need for scheduling SPs when resources and manpower may be limited. Some store-and-forward data can be incorporated within the EMR platform for ease of access and to offer a more realistic experience.

Designing the Telehealth Simulation

In the design phase of a telehealth activity, some important considerations include faculty workload, level of learners/participants, activity objectives, availability of SPs and facilitators, budget, class size, the need for IT support, allotted time, and the structure/capabilities of the telehealth platform. As with all simulated experiences, smaller groups with fewer students will allow for more learner participation and learning. Thus, synchronous telehealth simulations with SPs may be more manageable with smaller class sizes, whereas asynchronous simulations with store-and-forward strategies may be easier and more realistic for larger class sizes. For example, asynchronous simulations could center around assessing patient data obtained from the EMR, wearable devices, and/or store-and-forward tools, then documenting a patient encounter or sending a clinical note to a patient or another health care provider to practice written communication skills and documentation.

If the intent of the telehealth simulation is the development of clinical skills, the choice of a synchronous route with clinical data available in the EMR may allow a more authentic simulation. For example, a learner can counsel a patient on how to use an inhaler or glucometer and then incorporate the teach-back method. By asking the patient to summarize key points from the counseling session, the learner may confirm understanding and clarify any misconceptions. SPs can also be useful for professional communication and affective skills development and feedback. For example, they can provide essential practice in obtaining an accurate medical and medication history, delivering bad news, or dealing with an angry patient. Box 1 depicts a sample vignette with an SP. Training students to overtly demonstrate empathy and compassion may allow learners to connect with virtual patients in a meaningful way.

Box 1. Example of a telehealth encounter with an SP

A patient presents to the telehealth clinic with complaints of a skin mole. Students would have access to the patient's chart on the EMR prior to the face-to-face video conference so that the video conference could focus on obtaining a medical and medication history with limited physical exam. In addition to the clinical evaluation, the patient might express worry that the mole may be cancerous, requiring the student to address the patient's psychological concerns in addition to the physical condition.

Telehealth encounters typically include only limited physical exams based on the nature of the platform. When assessment of learners' physical exam skills is desired for educational purposes, however, adjustments to the scenario may be made while using some of the same logistics employed for telehealth. For example, during a video conference with a simulated patient, the learner can verbalize the components of the physical exam they would perform, with the patient providing the findings. While this approach does not permit assessment of the learner's ability to perform the exam skill, it would help to capture their knowledge of which components of a focused physical exam are pertinent in this case, based on the patient presentation and initial findings. This information could be used by the learner to develop a differential diagnosis and initial plan of care. When the need exists to virtually evaluate learners' physical exam skills, the learner could demonstrate on another individual in the household or even a doll or stuffed animal. Faculty can view these sessions live via video conferencing or students can record the session for submission via the course management site, for example, for later review.

Simulated telehealth IPE activities can also be conducted asynchronously or synchronously, with or without an SP, depending on the activity's learning outcomes. Synchronous activities can focus on interprofessional communication and teamwork using video conferencing, and even real-time patient interviewing and assessment if using SPs. Depending on the case scenario and objectives, video conferencing or a telephone encounter can be used. For example, a video conferencing format could mimic a telehealth visit by a home health team, whereas a simulated telephone encounter may be more appropriate and realistic for verbal communication between health professionals, such as a pharmacist intern calling a prescriber for a clarification or recommendation of a medication order.

Asynchronous simulations may be a more feasible option where timing is an issue, since it would eliminate the need for finding a time that works for all programs to schedule synchronous simulations, a common IPE challenge. For asynchronous simulations, educators could use a shared instance of a patient's chart. Teams could make shared decisions in the EMR and document their assessment and plan for the patient (as in Box 2). Students would communicate through computerized provider order entry (CPOE), intervention notes, and/or Subjective, Objective, Assessment, and Plan (SOAP) notes, with no requirement for face-to-face video conferencing.

Box 2. Example of an asynchronous IPE activity

Students receive an EMR containing pertinent patient data and a recording of a history collection and physical conducted by another healthcare professional. Interprofessional teams could meet via videoconferencing technology to collaborate on the care of the patient. These collaborations could occur in breakout rooms during a time set aside by the instructor or students could schedule the video conferences on their own.

Educators can also get creative in using a combination of both synchronous and asynchronous simulations for more complex interprofessional scenarios and to simulate multiple follow-up visits with a patient (as in Box 3). For example, the interprofessional team can meet with an SP in real-time to assess and develop a plan and present subsequent follow-up visits as asynchronous written communications through the EMR.

Box 3. Example of a combined synchronous and asynchronous activity

During a virtual home health visit, a physical therapist recognizes signs of a suspected deep vein thrombosis (DVT) in the patient and wants to communicate this concern to the patient's primary care provider (PCP). An interprofessional telehealth contact can occur while the physical therapist is virtually visiting the patient (synchronously) or the physical therapist can send a clinic message to the patient's PCP after the virtual visit (asynchronously) regarding next steps. After the patient is evaluated and diagnostic testing confirms the DVT diagnosis, an e-prescription for an anticoagulant could be sent to the patient's pharmacy and the PCP could send a message back to the physical therapist regarding continuation of care. Educators can make the scenario as complex as they would like by bringing in additional professions, such as social work, pharmacy, etc.

Standardized/Simulated Patients (SPs)

Standardized/simulated patients (SP) are individuals who are trained to portray a patient, a patient's family member, or even another healthcare provider, depending on the simulated scenario (Lopreiato et al., 2016; Rutherford-Hemming et al., 2019). Many medical schools have programs where individuals can undergo specific training and receive an SP certification (Aranda & Monks, 2020; Lewis et al., 2017). Planning for an SP encounter involves several factors related to how the simulation is designed. Questions to consider include:

1. What is the role of the SP and what demographics are needed to fulfill the role?
2. What is the level of fidelity necessary to meet the learning outcomes and what props may be needed?
3. What is the duration of the encounter?
4. How many SPs are needed to conduct the activity in a timely manner?
5. What are the components of the SP script and which aspects should be shared voluntarily versus only if asked?

6. What are the components of student feedback and will SPs be involved with debrief?
7. What are the components of SP training to prepare for successful delivery of the encounter?

If there are budget constraints that limit hiring of SPs, faculty members can consider asking for volunteer preceptors, faculty, staff and/or advanced learners (upperclassmen) to play the role of an SP. If there is limited manpower for facilitators and SPs, the faculty or preceptor who is facilitating the experience may double as both facilitator and SP. While this could make the grading process more challenging, additional time can be allotted to the encounter.

One of the five domains of the Association of Standardized Patient Educators (ASPE) Standards of Best Practices involves provision of training for role portrayal, feedback, and completion of assessment instruments, all of which are necessary to ensure the intended outcomes of the simulation are met. The other domains involve safe work environment, case development, program management, and professional development (Lewis et al., 2017). Regardless of whether certified/professional SPs or volunteers assist with the simulation, adequate time should be dedicated to orienting the SPs to both the scenario and caveats associated with the telehealth/video conferencing platform being used. Many have grown accustomed to live scenarios and, as such, may be unfamiliar with virtual modalities.

As in the live setting, SP orientation should encompass details of the scenario and patient case, student learning objectives, schedule/agenda, instructional cues, etc., as would normally be conducted for in-person simulations. Training the SP to provide feedback on the student's affective and communication skills can be beneficial in providing insight into the patient experience and the educators should consider bringing the SP in during the debrief session with learners. To address any apprehension with the use of the electronic platforms, it is often helpful to conduct a practice run ensures the SP is comfortable using the platform and allows troubleshooting of potential issues that arise during the practice.

Logistical Considerations for Inclusion of Standardized Patients

Some logistics to consider for telehealth encounters with an SP include enabling a virtual 'waiting room' for the SP, deciding on when/how the SP will enter/exit the virtual room, and whether certain props need to be sent to the SP. If technology is a barrier, some institutions may consider sending a loaner device with the virtual platform or other capabilities installed. To avoid confusion during the interaction, the SP will often change their name on the videoconference platform to the name of the patient and they may even put 'patient' in parentheses after their name. For telehealth-based IPE simulations, it may be helpful for the learners to include their discipline, program, or role on the healthcare team in parentheses after their name on the video conference platform. Camera placement may need to be considered if the telehealth visit involves assessing a patient's movement, such as in a physical therapy simulation. Clear audio may be required for simulations that require assessment of the patient's speech or verbal abilities, such as for speech language and pathology assessments.

If multiple telehealth simulations will be occurring at the same time, it is important to consider the capabilities of the video conference platform and ease of monitoring the simultaneous sessions. Prior to the simulation, reviewing video conferencing etiquette with the learners, either as part of a pre-brief or posted pre-simulation instructions, can contribute to an optimal telecommunication environment (this will be further discussed in the section entitled "Etiquette in the Virtual Learning Environment"). All those participating in the encounter (e.g., learners, SPs, faculty) should also receive basic instruction about the video conferencing platform. An opportunity to practice with the platform, especially if it is not familiar to users, is ideal to allow time to troubleshoot any problems that may arise with audio/video functionality. This would be especially prudent in the case of summative assessments that are to be conducted virtually.

Low- and High-Fidelity Manikins

Mankins may also be used in lieu of or in addition to utilizing SPs in telehealth simulations (Lateef & Too, 2019). Though some learners may prefer SPs over manikins, studies have shown that there is no difference between the two with improving knowledge-based outcomes (Grice et al., 2013). However, it might add more complexity with coordinating schedules, involving simulation lab time, and planning on behalf of simulation operations personnel. The use of manikins and simulation aids (simulaids) may be especially helpful for the virtual teaching of anatomy and physical assessment skills (Weller et al., 2004). When determining the type of manikin(s) to utilize for an activity, the simulation's objectives and desired learning experience or outcomes are important to consider.

Simulations with manikins may also be used to expose virtual learners to common emergency situations or rare, but serious, disease states and scenarios (Malhotra & Kumar, 2021). The fidelity of the manikin refers to the level of realism portrayed within a simulation, which ranges across a broad spectrum that is based on the intent of the activity and setting (Lioce et al., 2020; Lopreiato et al., 2016; Munshi et al., 2015). Several studies report similarly increased effectiveness in enhancing learner experience with both low- and high-fidelity manikins (Massoth et al., 2019). More basic low-fidelity manikins would likely suffice for demonstrating physical assessments and skills that would normally occur in a clinical skills or anatomy lab, such as palpating a pulse, performing a head-to-toe assessment, placing a wound dressing, stabilizing a fracture, performing chest compressions, and demonstrating exercises or physical therapy maneuvers (Nestel et al., 2011). High functioning high-fidelity manikins possess all of the 'bells and whistles' and would be more appropriate for realistic scenarios that require the learner to listen to heart and lung sounds, assess vitals after administering medications, and even to draw blood. High-fidelity manikins usually require a simulation technician to operate and some of them even have voice capabilities where the simulation technician can 'talk' for the manikin. High-fidelity manikins may be useful in simulating telehealth scenarios in inpatient or healthcare facility settings. For example, to simulate a telehealth visit with a patient who resides in an assisted living facility that does not allow face-to-face provider visits, the learner can communicate directly with a manikin with voice capabilities. Otherwise, the facilitator can act as a consulting clinician or caregiver and 'relay' the patient's responses.

Low- and high-fidelity manikins can still be used in the virtual setting, but their use would likely require some improvisations. For example, if the educator wants to assess a learner's knowledge of a procedure that would normally be demonstrated in lab, such as an incision and drainage or securing a fracture in the pre-hospital setting, the facilitator can 'act' as the learner's hands and the learner can provide detailed instructions as to which physical actions the facilitator should perform. Simulations using a high-fidelity manikin can be used to simulate a telehealth appointment or consult in a manner that is similar to telehealth appointments and consults that routinely occur in rural areas lacking certain healthcare specialties. Interprofessional simulations with a high-fidelity manikin could also take place in a hybrid format where some of the learners are on site with the manikin and some participate via video conferencing.

At a basic level, a patient's vital signs monitor may be shown along with images of the patient to cue changes in physical appearance. Most high-fidelity manikin platforms can run without the physical manikin for this purpose. Alternatively, several applications (apps) are available that can mimic a telemetry monitor, or at the simplest level, a document or presentation slide with key vital signs and cardiac and respiratory waveforms could be shared on the video conferencing platform. During the simulation, learners can obtain the patient's history, verbalize a physical exam, and identify interventions while an operator or facilitator responds as the patient and adjusts the vitals based on the planned case scenario and in response to learner actions.

Physical exam findings may also be relayed to the learner verbally or via audio clips (such as heart or lung sounds) that can be played. If faculty or simulation staff can be present in the simulation room, showing the learners a live video stream of the room can enhance the experience and permit learners to participate in the activity. For example, by stating which physical exam skills or interventions the learner would like to perform and how to do so, the faculty or staff present in the room could be the hands of the learner enacting the task, as noted above (Grice at al., 2013). Based on room capacity and the availability of a small group of learners to be physically present in the simulation room, another option could involve dividing the class into sections in which some learners participate live while others view what is occurring in the room via video conference. These viewers can be assigned roles as observers who must present their findings during the debrief. Depending on the number of participants, they may also engage with the live simulation via chat or by unmuting their microphones. In a course with multiple simulations, these roles could rotate with the learners in the room becoming the viewers and vice versa.

Designing Activities That Utilize Manikins

Planning these activities requires additional logistical considerations such as a means of connecting the virtual learners with the manikin and simulation room. Questions to consider include:

1. What are the technical and non-technical skills practiced in the simulation?
2. Does the simulation require low- or high-fidelity manikins?
3. How many manikins will be needed, based on the simulation schedule?
4. Is there a simulation operations specialist available to facilitate set-up and manage/control the manikin?
5. Will training be necessary for faculty involved with operations?
6. What are the costs associated with manikin use and maintenance (purchase, rental, cost-sharing among programs)?
7. Is there adequate space for the simulation to and for storage of the manikin and associated equipment?
8. Will transportation of the manikin and equipment be necessary?

Video conferencing platforms, such as those discussed previously for telehealth simulation activities, may be used concurrently with manikins (as depicted in Box 4). Additional personnel are needed to control the manikin (to elicit a response) and to facilitate other aspects of the encounter. Laerdal's LLEAP® (Stavanger, Norway) simulation software allows instructors to rapidly control a high-fidelity manikin's physiology remotely as long as a simulation operations specialist is available to set up the manikin in its physical location.

Box 4. Example of a synchronous IPE activity

A code blue situation could be called in the midst of simulated interdisciplinary team rounds in a 360-degree virtual room setting. A high-fidelity manikin can be controlled remotely or at the simulation center to depict vitals consistent with cardiac arrest. Learners should quickly identify their roles and begin caring for the patient using the advanced cardiac life support (ACLS) algorithm. Vital signs on the manikin may be adjusted by the faculty or simulation operation specialist in response to simulated administration of medication. This scenario involves a hybrid modality of manikins and augmented reality, as discussed further in the next section).

Virtual and Augmented Reality

Technological advances have led to new simulation opportunities that were once mainly used for entertainment purposes. Augmented reality (AR) and virtual reality (VR) are two methods that may be added to aid in a student's learning and overcome limitations of physical space and location (Lopreiato et al., 2016). The availability of VR has become increasingly more widespread as computers become more powerful and graphics continue to improve.

VR refers to three-dimensional, interactive, immersive environments developed by computer technology to simulate an environment in which the student has a sense of being physically present (Lopreiato et al., 2016; Marr, 2019; Pottle, 2019). Participants may utilize head mounted display (HMD) to engage within an experience. VR is defined by the Merriam Webster Dictionary as "an artificial environment which is experienced through sensory stimuli (such as sights and sounds) provided by a computer and in which one's actions partially determine what happens in the environment" (Lopreiato et al., 2016; Merriam Webster's Collegiate Dictionary, 2021, para. 1). However, multiple differing definitions may be found throughout the literature with one simplistic definition stating that it is "a real or simulated environment in which a perceiver experiences telepresence," with telepresence being defined as a "medium-induced presence" (Steur, 1992, p.76).

In contrast, AR combines superimposed computerized images into the real world to depict an environment (Lopreiato et al., 2016; Marr, 2019). AR has also been provided many definitions, with one of the most simplistic being, "the combination of reality and overlay of digital information designed to enhance the learning process" (Berryman, 2012, p.213). AR involves blending real and virtual elements and can be considered as more of an enhancement to live simulation experiences, whereas VR may include activities in which the student is not actually present in the lab or location of the activity (Riva et al., 2016).

There are also varying levels that exist within AR and VR based on immersion (Kardon-Edgren et al., 2019). Mixed reality (MR) combines VR and AR, allowing the user to interact with objects in the real world (Lopreiato et al., 2016; Marr, 2019). Although terms have been used interchangeably in the medical literature, distinctive terminology is increasingly employed as new programs are developed and in demand.

Expansion of VR and AR Opportunities in the Virtual Learning Environment

Several VR/AR platforms are available for training students in various healthcare fields. For example, a Doctor of Pharmacy program that needs its students to develop sterile compounding skills may consider a platform such as the Virtual Interactive Cleanroom® by Penguin Innovations (West Lafayette, IN), which provides a virtual pharmacy interface that allows students to compound intravenous medications including those for chemotherapy. For development of patient communication and medication counseling skills, the Second Life® platform by Linden Labs (San Francisco, CA) allows students to interact with a virtual patient using their own avatar. For development of core surgical skills, Surgical Theatre® by Precision VR (Cleveland, OH) can help trainees understand the nuances of surgery and visualize the surgical path prior to the actual surgery. For development of physical assessment skills in the virtual environment, Shadow Health® (Gainesville, FL) offers a comprehensive health assessment package that allows students to conduct a full physical exam and communicate with a virtual patient. VR can also be used to help learners visualize pharmacologic mechanisms in drug design and discovery (Ventola, 2019).

Platforms that involve interactions with virtual patients show great promise in training undergraduate health professions students and offer a demonstrated benefit in socializing students to their professional roles and allowing them to learn from their mistakes (Peddle et al., 2019). Patient assessments and development of treatment plans through a 'choose your own adventure' style asynchronous software or the use of virtual escape rooms can also serve as meaningful ways to apply key concepts in fun and interactive sessions that bring the experience to life. Some programs are pre-loaded with scenarios and cases that have already been developed, while others possess the potential to build cases tailored to the instructor's learning objectives and the learners' level. In the latter case, implementation would require considerable planning to develop the case and patient script and to test run algorithms that reflect the manifold combinations of potential student responses for each clinical scenario. For this reason, it may not be feasible to implement a new program with new cases in the rapid timeframe necessitated by the COVID-19 pandemic (or similar emergent situation). Sessions conducted via VR/AR platforms may be recorded for asynchronous grading when faculty are not available to attend live sessions.

Selection of VR and AR Platforms for Implementation

The utility of VR/AR has varied among disciplines based on learning objectives and skills performance. There are several VR/AR platforms on the market, as described previously. When selecting a platform for implementation, the core skills that learners need to develop should drive the process. Questions to consider include:

1. What are the technical and non-technical skills practiced?
2. Will the platform be used for formative or summative assessment?
3. Are there scenarios and cases developed within the program or will they need to be created?
4. Will the platform be accessible on student devices or will the school need to purchase devices specifically for this program?
5. How many users may utilize the system at one time?
6. What are the associated costs for the license agreement?
7. What is the duration of each user license (how often will users need to renew)?
8. Will user licenses be paid by the institution or the student?
9. Is the platform compatible with the institution's IT requirements?
10. Is technological support available to users?

If financial resources pose a barrier, use of a 360-degree video may provide a home-grown alternative. This entails filming a 360-degree view of a room to visually depict a nearly three-dimensional space that users can view by zooming in on various aspects of the room, much like a virtual home tour available on a real estate website (Pottle, 2019). For example, if students cannot be physically present in a patient exam room or within a simulation center, this approach can serve as a compromise to help make the situation feel more realistic. However, a limitation is that this becomes a passive rather than active learning experience since students cannot move within or interact with the environment.

Considerations for Successful Implementation of VR and AR

The use of VR and AR provides numerous opportunities for increased learning. Scheduling is one of the greatest challenges when developing interprofessional activities and the use of VR allows flexibility of scheduling. For instance, if teams of students are provided a link to enter a virtual simulation, they may connect using video conferencing technology and record the session during the time their team deems best. Although this will reduce the required amount of time dedicated in a day to that activity, it is imperative that the instructor reduces course load elsewhere to allow students some flexibility to complete the activity. When creating a virtual simulation, it is imperative that the instructor assess the activity for rigor and overall learning experience to ensure that it remains a worthwhile exercise that meets its intended learning outcomes despite the transition to the new virtual environment. As such, comparison of data between delivery of live simulations and VR simulations would be imperative for programmatic assessment and continuous quality improvement that includes plans for enhancement in the next iteration. Although many VR experiences were available prior to the COVID-19 pandemic, its emergent aspects prompted many educators to adopt these forms of learning quite rapidly. It is estimated that 50% of simulation may transition to either VR or AR platforms by the year 2025 (Kardon-Edgren et al., 2019). Therefore, the timing is ripe to provide students with the opportunity to learn in these newer environments and to provide educators with the opportunity to learn to use these novel modalities to inform their teaching moving forward.

As students return to the live classroom environment, further considerations will be necessary to facilitate their compliance with social distancing requirements and associated challenges of space allocation, time to complete activities due to smaller room capacity, and more faculty time for facilitation. For these reasons, performing various face-to-face procedures on patients, standardized patients, and/or manikins may be more cumbersome in the immediate post-pandemic setting, and thereby, less favorable. AR with the use of manikins and computer-simulated patients may become more commonplace to afford flexibility in scheduling logistics and will also reduce variability in student experiences. If VR headsets or head mounted displays (HMD) are necessary, concerns may arise regarding students sharing multiple products or items and the need to sanitize items between encounters, which will require the expenditure of supply funds and time for cleaning. To permit the use of individual VR headsets on campus and at home, HMD or related equipment may become required materials that students must purchase when they are admitted into their post-graduate training program. In such cases, the professional program may select specific types or brands of devices to be used by students and may be able to negotiate reduced rates for bulk orders. Considerations may also be given to having the program purchase headsets or other equipment including laptops or tablets and either lending or providing them to students through an organized process (Updike et al., 2021).

Lastly, problem-based learning (PBL) often utilizes cases to set the clinical scenario for students to work through. Trigger videos are typically short films that stimulate discussion and allow students to work through complex concepts to promote active learning (Nichols, 1994). In health education, the use of trigger videos rather than traditional paper cases has the advantage of better exposing students to clinical cases in a way that requires their powers of observation (Chan et al., 2010) and, therefore, invokes the affective domains of their brains. In the virtual setting, such films could be developed as short vignettes that can augment PBL and class discussions. Manikins can be used in trigger videos to simulate high acuity patients while the students are asked to make real-time decisions regarding their care. This also offers a solution to the time involved in coordination of live simulations while overcoming the accompanying scheduling issues. This is similar in concept to the method used in basic life support (BLS) and acute cardiac life support (ACLS) training, where learners view short vignettes followed by discussion and reiteration of key concepts.

Simulation Debrief in the Virtual Environment

The International Nursing Association for Clinical Simulation and Learning (INACSL) standards for debriefing simulation uphold the evidence that essential learning in a simulation-based experience occurs in the debriefing phase. The debriefing is where the outcomes for the experience should be considered and gaps in performance based on the outcomes and simulation objectives should be identified (INACSL, 2016). Debriefing for an online simulation should mirror that of an in-person simulation in terms of content and process, although more time may be required to manage technical aspects that are not applicable to in-person experiences (Thomas et al., 2021). One way to maintain the interactive nature of the debrief is to recommend that all participants activate their cameras during the virtual debriefing sessions.

The 'communities of inquiry' framework includes the core elements of social presence, educator presence, and cognitive presence. This framework was developed for asynchronous online learning, but also applies to the synchronous experience as well (Cheng et al., 2020). There are barriers to successful debriefing in each of these elements, yet these barriers can be overcome. Barriers to social presence include difficulty interpreting body language, perceived lack of privacy if a learner is participating in debrief in a public space, and reduced group cohesion. Ways to overcome these barriers and to promote psychological safety for participants include the use of verbal cues to help learners feel invited and acknowledged, educators sharing their own experiences, and the use of inclusive language. Barriers to educator presence include technical difficulties with the virtual platform and the mental workload that is involved in working in unfamiliar platforms. These barriers can be overcome by testing the new technology ahead of time, formatting the platform to view as many learners at one time as possible (such as the gallery view in Zoom), and ensuring good visibility and sound quality. Barriers to cognitive presence include learners who are unfamiliar with how to engage with other learners in this environment, difficulty with technical aspects, or a heavy cognitive load when attempting to perform other tasks during debriefing sessions. These barriers can be overcome by sharing expectations for engagement, orienting learners to the platform, using visual aids, or dividing the class into smaller breakout groups.

Games and Gamification

The use of games and gamification in medical education has become increasingly popular over the past decade (Sera & Wheeler, 2017; van Gaalen et al., 2020). Gamification and games can be used to help encourage learners to motivate actions, progress through content, and reinforce behavior and knowledge. While the terms games and gamification are often used interchangeably, there is a difference. Games are self-contained activities that require suspension of disbelief. Gamification for learning is not about using a self-contained game for learning purposes, but rather applying elements of games to learning activities to engage learners (Rutledge et al., 2018). The use of both strategies can encourage and engage interprofessional learners. Various platforms have been used for gaming and gamification in the classroom as a means of formative assessment. Learner satisfaction with gamification is generally high. This section will describe some of the gaming and gamification platforms that are widely used to promote student learning and that can or have been adapted to the virtual environment.

Online programs that apply gamification to learning have become widely used for formative assessment. Some examples of these include Kahoot!® (Oslo, Norway) and Quizlet Inc.© (San Francisco, CA). Prior to the COVID-19 pandemic, these technologies were used in the classroom to motivate students' learning with great success (Ismail, 2019). Once classrooms were moved to the virtual environment, these technologies emerged as a means of engaging learners in the virtual classroom (Kalleny, 2020). These digital game-based platforms have the added advantage that they can provide educators with immediate feedback on the comprehension of the material being taught (Sera & Wheeler, 2017). This is particularly useful when the audiovisual platforms used for virtual instruction make it challenging to detect the learners' non-verbal responses to the delivery of educational content. When used intermittently throughout a virtual class to gauge learner comprehension, this crucial immediate feedback allows the educator to reinforce complex and challenging concepts during class time. The use of online gamification technologies equally engage students in a manner similar to traditional face-to-face modalities, such as lab-based skills sessions (Kalleny, 2020).

An example of an educational game is the virtual escape room. Recently, the use of escape rooms has increased in popularity in healthcare education and has shifted activities to being more learner centered (Guckian et al., 2020). Escape rooms provide a creative method for encouraging individuals to work together to solve puzzles with the goal of escaping the room and advancing to the next step. While escape rooms were initially available commercially for entertainment purposes, the same structure can be applied in the academic environment. Their application to a clinical scenario can promote recall and application of prior instructional material, strengthen skills in problem-solving, teamwork, and communication, and ultimately encourage development of an interprofessional team. During the COVID-19 pandemic, traditional in-person healthcare education escape rooms required modification to allow them to be delivered virtually. The creation of a virtual escape room can be labor intensive and require more knowledge, skills and effort than do traditional approaches to teaching (Cates et al., 2020). When developing a virtual escape room, survey software such as Google Forms® (Mountain View, CA) or QuestionPro® (Austin, TX) can be used to deliver clues to students or a website can be developed with clues embedded in the pages. Students can be placed in breakout rooms on a virtual platform such as Zoom Video Communications® (San Jose, CA) or Microsoft Teams® (Redmond, WA). It works best if each team designates a leader who will share their screen so that the team can work through the provided clues together. Another example of a game is a scenario-based or 'choose your own adventure' game in which the choices that the learner makes at each decision point impact the details of subsequent scenarios. This example is similar to the virtual escape room and can be delivered using survey software or PowerPoint® (Redmond, WA).

Innovative Approaches to Active Learning in the Experiential Setting

Experiential training is essential for all disciplines to hone clinical skills developed throughout the professional curriculum. Environmental and resource restrictions during the COVID-19 pandemic created significant and fluctuating barriers in student access to direct patient care areas, including ambulatory, community, and acute care settings (Fuller et al., 2020). Experiential training, regardless of healthcare discipline, is routinely inclusive of patient engagement/management, interprofessional team integration, and active learning conferences, such as educational seminars, topic discussions, journal clubs, and case evaluations. This section will explore the use of simulation to close the gap created by limited access to clinical environments during the COVID-19 pandemic while assuring achievement of learning objectives.

Hybrid teaching strategies have routinely been employed throughout the COVID-19 pandemic to meet experiential education goals (Badreldin et al., 2020). Simulation modalities have provided methods to apply existing technology to fill gaps created by the interruptions to patient access and assist organizations and students in applying social distancing, particularly for educational forums not involving direct patient care. The interpretation of national and local guidance, such as those provided by the Centers for Disease Control and Prevention (CDC) and by educational and clinical organizations, created a variable and often fluctuating environment. Factors influencing the interpretation included clinical concerns, such as infection control measures and management of contacts with confirmed or suspected COVID-19 patients, and practical ones such as shortages and conservation strategies for personal protective equipment (PPE).

The video conferencing platforms discussed earlier in this chapter have been essential tools to support continued engagement of students through educational meetings, particularly since many organizations have placed firm limitations on in-person gatherings (Almarzooq et al., 2020; DeFilippis et al., 2020). Journal clubs, clinical debates, and seminar/topic discussions can be conducted across large student groups within or across healthcare disciplines by virtual means that support social distancing (Johnston et al., 2021). Learners can remain engaged during these sessions by using various active learning modalities, including online educational games such as Jeopardy Labs® (Vancouver, Canada), Kahoot!® (Oslo, Norway) and others discussed in the gamification section; polling mechanisms such as Poll Everywhere® (San Francisco, CA) and Mentimeter® (Stockholm, Sweden); crossword puzzles; and so on. Groups of precepting clinicians or faculty can share the workload of moderating sessions, thereby mitigating some of the stress of the increased workload created by need for rapid, real-time course re-design and implementation (Moreau et al., 2021).

The CDC compared trends in telehealth encounters for patients in the first quarter of 2019 and the first quarter of 2020 (Koonin et al., 2020). Overall, the number of telehealth visits were 50% higher in the first quarter of 2020 and the last week of the quarter in 2020 alone saw a 154% increase in telehealth visits compared to the same period in 2019. When in-person patient encounters have not been possible, HIPAA-compliant video conferencing platforms have provided methods to discuss and evaluate patient cases through real-time use of electronic medical records (Higbea et al., 2021; Moreau et al., 2021). Such discussions can simulate the pre-round or pre-encounter preparation that students routinely undergo prior to engagement with a patient (DeFilippis et al.; 2020). If remote access to the record is limited by organizational licensure, a moderating clinician or faculty member can navigate the chart at the student's direction. The clinician, who often remains actively engaged in clinical care, can provide clinical assessment or event information to fill any gaps in the charted information when prompted by the student. This format permits for assessment of critical thinking skills, interpretation of clinical information (e.g., data and diagnostics), and medical and discipline-specific knowledge. By students 'knowing what (they) don't know,' articulation of how specific information or assessments can be obtained through interprofessional collaboration also facilitates the student's understanding of the interprofessional matrix and benefit of collaboration. If permissible by the organization, these video conferencing platforms can also provide a method for students to virtually attend acute care rounds or engage in telehealth encounters with the interprofessional team, the patient, and/or their family members. These methods may preserve some of the *ad hoc* learning often lost when the student is removed from the clinical environment (Higbea et al., 2021; Moreau et al., 2021). Additionally, providing students with experience related to telehealth or digital health gives them an opportunity to see how this will be incorporated into practice, particularly to address disparities in care (FIP, 2021).

As discussed earlier in this chapter, simulation using manikins or SPs can also provide a method for students to engage in high fidelity encounters for high risk, high intensity events such as a medical emergency response that cannot be completed at the bedside in the changed environment of the COVID-19 pandemic. Simulation can also expose students to the requirements of working within the stringent infection control environment of COVID-19 patients including donning and doffing PPE and infection control measures. Students can also gain experience with implementing care strategies such as proning (safely turning a patient from their back to their abdomen) that are otherwise rare in most other populations.

SOLUTIONS AND RECOMMENDATIONS

Adaptation of Existing Technologies

The transition to virtual learning has led to enhanced use of capabilities within learning management systems (LMS) to engage students. Institutions may have contracts with various LMS platforms, such as Instructure Canvas® (Salt Lake City, UT), Blackboard Learn® (Washington, DC), and Moodle® (Perth, Australia), that possess common functions for sharing content and maintaining grades. Each LMS also has unique capabilities for synchronous and asynchronous course delivery, such as polling, sharing screens, use of a whiteboard, etc. For example, discussion boards have great utility in the virtual environment, where they provide learners with opportunities to continue dialogue about course content asynchronously. Discussion boards can serve as a platform to clarify key points or have learners contribute to various aspects of a case discussion for more active learning. Participation may be required by the instructor or optional on an as-needed basis. If required, student contributions can be graded directly from the discussion board.

LMS platforms also have various capabilities for breakout rooms or individual channels within a course session to allow for small group discussions or group work. Use of breakout rooms permits synchronous collaboration among students while affording the instructor the flexibility to transition between rooms for observation or to assist students with activities such as case discussions, much like what would occur in a live classroom environment. Instructors can assign or move participants between rooms and call students back into a larger session or reassemble the whole group. Standardized patients can be invited to meet with students in breakout rooms for individualized assessments. Of note, the fact that not all platforms possess the capability for video recording may be an important consideration in establishing formative (student review and self-reflection) and summative assessments (to address any potential grade discrepancies). Such LMS platforms possess mechanisms by which to share portions of case information with students in a stepwise manner for gamification, virtual escape rooms, or assessments by adjusting the time that certain content becomes published or linking a file within the gradebook.

In-video quizzes are another way to keep students engaged during asynchronous delivery of course content (Cook, 2018). Task-based quiz questions can be embedded within the video, prompting the students to apply the material they are learning and to correctly answer the question before they can proceed to the next segment. A brief pop-up explanation can also be provided for immediate clarification. This modality encourages critical thinking through immediate application of learned concepts.

In live settings, students practice clinical skills and undergo assessments using medical devices such as blood glucose meters, insulin pens, or inhalers or task trainers such as airway management heads or advanced venipuncture arms. There are many challenges with obtaining these devices and physically sending them to students during a pandemic, such as limited funds for the purchase, sending, or tracking of devices and limited supplies due to students breaking, losing, or failing to return the devices. Although mailing devices to students during a pandemic is one adaptation that may be used when laboratory time is not possible, provided that resources are available for doing so, adoption of VR/AR may be used instead to augment a student's learning.

Table 2 summarizes the multitude of available technologies discussed in this chapter, categorized by the type of simulation modality. Table 3 summarizes the various available technologies in the didactic and experiential settings with practical considerations when planning for implementation. Factors to consider when selecting an ideal simulation modality include learning objectives, class size, faculty availability, cost, and support (technology or simulation operations).

Table 2. Available technologies

Technology Type	Available Technology
Telehealth platform	SimulationIQ® (Exton, PA)
Academic electronic medical records (EMR)	EHR Tutor® (Parma, OH) EHRGo® (Duluth, MN) MedAffinity EHR® (Tallahassee, FL) OpenEMR® (Altamont, NY) SimEMR® (Pittsburgh, PA)
Wearable devices	Activity tracker (FitBit, Garmin) Smartwatch (Apple Watch, Samsung Gear)
Virtual/augmented reality	Shadow Health® (Gainesville, FL) Surgical Theatre® by Precision VR (Cleveland, OH) Second Life® by Linden Labs (San Francisco, CA) Virtual Interactive Cleanroom® by Penguin Innovations (West Lafayette, IN)
Gamification	Kahoot!® (Oslo, Norway) Quizlet Inc.© (San Francisco, CA)
Games (i.e. escape rooms, 'choose your own adventure')	Google Forms® (Mountain View, CA) QuestionPro® (Austin, TX) Zoom Video Communications® (San Jose, CA) Microsoft Teams® (Redmond, WA) PowerPoint® (Redmond, WA)
Video conferencing platforms	Cisco WebEx® (Milpitas, CA) Microsoft Teams® (Redmond, WA) Skype Communications® (Palo Alto, CA) Zoom Video Communications® (San Jose, CA)
Learning management systems	Blackboard Learn® (Washington, DC) Canvas® (Salt Lake City, UT) Moodle® (Perth, Australia)

Table 3. Suitable technologies/approaches and general considerations

Setting	Technology/ Approach	Considerations
Didactic	Telehealth Platform	● Institutional use ● Synchronous versus asynchronous (store- and-forward) ● Faculty workload, level of learners/participants, class size, and IT support ● Use of other modalities (manikins, standardized patients, point of care testing devices) ● Skill(s) assessed: limited physical exams, communication, medication histories, etc.
	Simulation	● Various modalities (manikins, standardized patients, academic EMR, point of care testing devices)
	Academic EMR	● Need for capabilities such as order entry, verification, and documentation ● Assessment capabilities
	Wearable devices	● Type of data points needed ● Use in small patient case or simulation
	Manikin/Simulaid	● Can be used to: ○ teach anatomy and physical assessment ○ augment simulated emergency situations ● Can be used in conjunction with trigger videos
	Virtual reality/ augmented reality (VR/AR)	● Can be used as enhancement to live simulation (AR) or in place of lab or activity location (VR) ● Several programs depending on intended use ● Implementation into program (class size, scheduling, student workload) ● Cost to implement and maintain ● Need for IT support
	Games/gamification	● Encourage learners to motivate action, progress through content, and reinforce behavior and knowledge ● Selection of method and associated levels of complexity (simple as knowledge assessment versus critical thinking)
	Learning management system (LMS)	● Several tools available within system: discussion boards, breakout rooms, video recording capabilities, in-video quizzes ● Institutional use ● Need for IT support and training
Experiential	Video conferencing platform	Used to conduct telehealth visits, conduct patient rounds, or presentations
	EMR	Pre-round or pre-encounter preparation

Assessment of Clinical Skills in the Virtual Learning Environment

Social distancing requirements during the COVID-19 pandemic have also necessitated the virtual delivery of formative and summative clinical assessments, which has added more layers of complexity (Lara, et al. 2020). Students who may already experience test anxiety or feel overwhelmed in the virtual setting may be uncomfortable with the virtual delivery method or concerned about potential technology challenges. From the faculty perspective, protecting the academic integrity of the examination is an important consideration in ensuring that student performance records are accurate and reliable for progression (Updike et al., 2021). These concerns are especially true for summative or high-stakes assessments such as an objective structured clinical examination (OSCE), which is often resource intensive in regards to development and grading (Chon et al., 2018).

These challenges may be overcome by advanced planning and by considering other logistics to circumvent student concerns. By replicating the same or similar active learning modalities (such as VR, manikin, or SP) and platforms (such as Zoom Video Communications® (San Jose, CA) or Microsoft Teams® (Redmond, WA)) used previously for assessment purposes, the students' familiarity and comfort level will increase. This will allow the students to focus on conveying the knowledge they have gained and demonstrating their competency in the skills learned. Using the same convention for assessment methods will reduce distractions that may detract from the intent of the examination. For example, the same or similar computerized VR simulators that the students used to learn and practice their surgical skills can be used for the assessment. Similarly, students who practiced telehealth clinical cases with an SP via the institution's LMS should also be assessed within the same terms and environment (Silverman & Foulds, 2020).

Academic integrity can be upheld in the setting of virtual examinations by emphasizing clear expectations of students. A variety of cases and scenarios, mapped to the same learning outcomes, can be used for the examination to reduce the likelihood of sharing content among students (Hopwood et al., 2020). Breakout rooms can be set up for individual students and, in the case of multiple components or stations, can be used accordingly. Both passive and active examination stations may be proctored by faculty through video monitoring. To ensure comfort and consistency among faculty members, adequate training on exam structure and any new technology should take place in order to troubleshoot or circumvent unanticipated challenges.

Use of Layered Learning Models

The Layered Learning Model (LLM) recruits upper-level learners (upperclassmen) who have already completed years of training to assist in the teaching and mentoring of lower-level students (underclassmen) (Loy et al., 2017). For example, a fourth-year student may assist a second-year student. This model is similar to the medical model of active learning and has been widely adopted by medical and pharmacy residency programs, allowing residents to participate in precepting and teaching responsibilities. LLM in the experiential setting can take multiple forms based on the institution in which it is used. The typical layout is having the lower-level student report to the upper-level student or resident, who in turn reports to the preceptor. The upper-level student or resident also provides feedback and instruction to the lower-level students, under the supervision and coaching of their preceptor. Benefits of this type of model include improved efficiency in precepting, exposure to teaching opportunities as part of their own training, improved leadership skills, and allowing the preceptor to further expand clinical responsibilities and address related concerns in a timely manner (Loy et al., 2017).

An expansion of the LLM is the use of various levels of learners to teach clinical skills during the didactic curriculum, both in person and virtually. This also provides an opportunity to prepare the upper-level learners for potential careers in health professions education, review previously learned content, and hone their communication skills in providing effective feedback. The LLM in the didactic setting is typically used in conjunction with a teaching certificate program that enrolls residents interested in teaching in didactic settings or precepting in clinical settings and provides clinical skills education within the associated or nearby academic institution. In addition to presenting didactic lectures, residents are typically involved in small group discussions and many of the active learning modalities discussed earlier in this chapter.

Some schools may also have a teaching or education track in which upper-level students can participate in courses that teach clinical skills as teaching assistants. During the early part of the COVID-19 pandemic, there was much discussion about whether these types of programs should continue. However, even in a virtual environment, the use of upper-level learners such as advanced practice students and residents can assist with the delivery of learning activities. One example is having upper-level students and residents act as the patients for SP encounters, which proved to be a necessity in the early days of the COVID-19 pandemic when many of the SPs were uncomfortable with the technologies being used or were not allowed into the classrooms. Another example is having the upper-level learners act as facilitators and guides through virtual discussions of case studies or journal clubs or provide feedback on recorded videos of the students performing certain skills. It is important to note that when using upper-level learners in this capacity, the instructor must ensure that they are capable and prepared with the information necessary and have clear, consistent expectations of the students being observed.

One area where upper-level learners may provide a new viewpoint is on how to achieve stated outcomes of a virtual activity. Since upper-level learners have already achieved the stated outcomes during their earlier training, they can provide insight on strategies that helped them or could have helped them to achieve these outcomes. This allows instructors to focus on the most important components and dedicate adequate time as the transition to virtual learning occurs. This is a valuable insight in a period of time where many faculty members have felt overwhelmed with teaching in the virtual environment. Upper-level learners can also provide real-time assistance in running the activities and providing additional feedback to students. This is mutually beneficial for all learner levels since it affords opportunities to review curricular content. The elimination of travel time to campus may also encourage the involvement of residents and adjunct faculty in providing assistance to students in the virtual environment. As an example, a resident who is located at a practice site more than an hour away from the school may be unable to provide assistance during in-person classes on a regular basis, but might be available to provide more assistance when the classes are virtual or hybrid. This in turn increases their teaching opportunities while providing skilled supervision for the students participating in the activity.

Etiquette in the Virtual Learning Environment

The virtual learning environment requires a unique set of etiquette rules compared to those for in-person learning (Wilfrid Laurier University, 2021). Students bring into the physical classroom norms that have been learned in prior educational settings. Some of these expectations involve dress, engagement, and behavior. There is a precedent for online interaction in social media, which necessitates defining clear expectations for professional engagement and behavior. Rather than the students entering a public space as is done for in-person encounters, the learning environment now enters their own private space. This opens the virtual classroom to potential disruptions from other people, pets, and the physical background. It should not be assumed that familiarity with the internet automatically translates into respectful 'netiquette'.

The fact that the learning environment is entering the learner's personal space may disrupt some norms that may need to be addressed surrounding dress in that environment, as compared to what a learner may wear to an on-campus encounter. There also may not be a space other than the learner's bedroom to connect virtually, so some flexibility about the physical background may be needed. This virtual environment may shed light on disparities that were not previously revealed, such as having the ability to participate in remote encounters in a private space free from distraction. The learner should have permission to leave the camera off if that helps to maintain privacy and minimize distractions.

Another way to foster positive etiquette for online encounters is through respectful and professional communication. Instructors can model this and set clear expectations for learners for interactions in the large group setting, discussion boards or chat functions, and in breakout rooms. Inappropriate interactions or frequent off-topic digressions can be handled immediately by having the moderator or instructor mute disruptive or off-topic participants where this technology is available, yet the issue should be addressed with the disruptive learner and the class as a whole. It is equally important to foster and recognize positive communication, including the use of the raised-hand function or other agreed-upon modality for asking a question. Frequent reminders of respectful communication are necessary, especially considering that other instructors may have different expectations for virtual encounters.

Establishing online etiquette is important to a student's perception of community in online learning (Gallagher-Lepak et al., 2009). Ideally, an orientation session should be used to introduce expectations for virtual encounters. At the very least, the first remote class session should include a conversation about etiquette and professional behavior for encounters in remote settings. Learners could also be asked what they need from the instructor, from other learners, and from themselves to safely participate remotely. For example, they may need to negotiate with colleagues, roommates, or family members for use of shared equipment, bandwidth, or office space during the time period that encompasses any synchronous class meetings. Negotiating a class contract of behavioral standards, processes for receiving feedback on the course as it is being delivered, and class representatives to serve as liaisons between learners and instructors are all tools that support professional communication. It is of equal importance that instructors maintain a professional and inviting teaching environment by establishing a teaching presence and continuing to provide timely feedback. This is critical for learner success in the virtual classroom (Chakraborty & Nafuko, 2015). Establishing a sense of community can be challenging, but it is imperative to increasing student engagement and improving learning outcomes in the virtual environment.

FUTURE RESEARCH DIRECTIONS

The COVID-19 pandemic has been both a positive and negative disruptor of professional education in healthcare professions. Rapid change and the pioneering of new processes were required, particularly in the area of clinical skills development. Some of the changes that were made may become new pedagogical processes in revised curricula after more normal operations resume. Despite new advances in vaccination development and access and public health recommendations, it may take a long time until classrooms can reach the full capacity practiced in pre-COVID times. For this reason, much consideration must be given to the careful scheduling of class sessions to comply with distancing requirements, faculty workload for implementation, and the selection of ideal active learning methods that facilitate the students' completion of learning outcomes. On the other hand, perhaps some students and faculty members may prefer the flexibility afforded by virtual learning and elect to maintain a hybrid form of course delivery. An advantage of hybrid format includes reduced travel time, which may allow for more engagement from clinical faculty who cannot step away from obligations at their practice sites.

As a result of the COVID-19 pandemic, many publications and presentations related to enhanced instructional design and protection of assessment integrity in the virtual environment are already available (Almarzooq, 2020; Badreldin, 2020; Cates et al., 2020; Cheng et al., 2020; DeFilippis et al., 2020; Fuller et al., 2020; Higbea et al., 2020; Lara et al., 2020; Kalleny, 2020; Malhotra & Kumar, 2020; Moreau et al., 2021; Silverman & Foulds, 2020; Thomas et al., 2021; Updike et al., 2021). Future research opportunities may elucidate student perceptions of learning clinical skills within the virtual setting and the corresponding changes to pedagogy even after learners return to face-to-face learning within the classroom setting. Furthermore, it would be interesting to compare outcomes on licensure exams between students among the various settings.

With the evolution of clinical practice that resulted from the COVID-19 pandemic, there are many opportunities for the development of new learning experiences. As telehealth experiences are undergoing exponential adoption, the use of wearable health devices is growing and becoming more integral in ambulatory care. For this reason, students must learn how to interpret the data from these devices, to use it to develop care plans, and to provide ongoing patient education and counseling.

CONCLUSION

With simulation at the cornerstone of clinical skills training, the COVID-19 pandemic has especially catapulted its utilization in the virtual setting (Pottle, 2019). Classroom and clinical site closures during the pandemic resulted in rapid adaptation to develop meaningful ways to engage students in clinical skills training, both in didactic and experiential settings. Despite the hurdles, faculty members stepped up to develop new innovations and to enhance existing content. Lessons learned and feedback obtained from students will be integral in making permanent enhancements as warranted.

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KEY TERMS AND DEFINITIONS

Augmented Reality (AR): A form of computerized technology imaging that allows for overlay of a visual aid to enhance the live environment.

Experiential Education: Immersive learning that occurs in the real-life setting to augment didactic instruction.

Gamification: A form of pedagogy that integrates game design to meet learning outcomes.

Layered Learning: A teaching strategy that utilizes underclassmen, upperclassmen, and post-graduate students or trainees who learn from one another's experience under the supervision of a seasoned practitioner.

Manikin: Full or partial-size body simulator to depict physiologic response in high-fidelity simulations.

Simulation: An encounter or environment that replicates a scenario within a controlled learning environment; followed by self-reflection and debrief.

Standardized/Simulated Patient (SP): A person trained to portray a character or role within a scenario in a repeatable manner.

Telehealth: Use of technology to connect health professionals with patients in remote or distance locations.

Virtual Reality (VR): A form of three-dimensional (3D) technology that resembles a real-life setting, enabling the user to be fully immersed within the environment.