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Expansion of simulation and extended reality for undergraduate health professions education: A call to action

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ABSTRACT

In the spring of 2020, the COVID-19 pandemic limited access for many health professions students to clinical settings amid concerns about availability of appropriate personal protective equipment as well as the desire to limit exposure in these high-risk settings. Furthermore, the pandemic led to a need to cancel clinics and inpatient rotations, with a major impact on training for health professions and interprofessional health delivery, the long-term effects of which are currently unknown. While problematic, this also presents an opportunity to reflect on challenges facing the traditional clinical training paradigm in a rapidly changing and complex health care system and develop sustainable, high-quality competency-based educational models that incorporate rapidly progressing technologies. We call for pilot studies to explore specific simulation-based inpatient and outpatient clinical rotations for professional and interprofessional training.

1. Background

Current models of simulation and extended reality (augmented/virtual/mixed reality) include several effective instructional design features, and studies have demonstrated benefits across health professions educational programs. These techniques allow for the acquisition of a range of knowledge and skills through deliberate practice, lessen the risk posed to patients and learners, and can increase decision-making and task prioritization abilities. Simulated environments support the development and practice of behavioral skills, such as self-confidence and professionalism, that are not readily replicable in traditional clinical settings. Further, in interprofessional training, simulation has increased students’ ability to effectively communicate within a team environment, while also aiding in students’ understanding of their own and others’ role and responsibilities in a clinical environment. Simulation and extended reality also provide opportunities to design rare scenarios and practice procedures that health professions students may otherwise not encounter in their education.

Simulation is widely used as an adjunct to teaching in most academic health centers in the country. Similarly, extended reality is increasingly being incorporated into various aspects of health care practice, particularly for perioperative precision planning for complex surgical procedures in organs with relatively rigid structures such as the brain, skull, bones, and pancreas. Simulation and extended reality can also provide substantial cost savings in medical care through prevention of medical errors, and a subsequent reduction of hospital acquired infections, malpractice costs, and readmission rates.

While some health professions, such as nursing, allow up to 50% of student training to be conducted through simulations, the role of simulation is inconsistently defined in other professions, such as medicine, with vast differences in the level of incorporation and application of simulation and extended reality observed across institutions.

As simulation and extended reality technologies become more advanced and widely available, and as clinical education curricula continue to evolve, it is timely to reevaluate how to optimize the incorporation of these innovative methods into specific simulation-based rotations to benefit students, including in interprofessional education. Simulation offers the opportunity to design scenarios with various health professions students to assess and improve teamwork and communication – fundamental skills when students transition to work collaboratively in team-based models of care. Early introduction to the various roles and responsibilities of other health disciplines can improve students’ understanding of their own roles and those of other health professions in interprofessional care; in turn, this can increase application of expertise in team environments and improve patient outcomes.

In assessment, simulated rotations would lend themselves well to a range of studies, including randomized, controlled trials, to see how they impact desired competencies identified through a thorough review of educational standards, including those established by the Interprofessional Education Collaborative and the Health Professions Accreditors Collaborative. Further, the utility of these techniques can be evaluated both quantitatively and qualitatively using a variety of robust outcome measures, including objective structured clinical examinations and program evaluations.

2. Modern limitations on traditional clinical rotations

The heavy reliance on inpatient clinical rotations in academic health centers, during which trainees spend a fixed amount of time in different medical specialties, poses challenges in an era where the number of physicians and residents is increasing and hospital resources are limited.

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length of inpatient stays has been historically reduced across all sectors. As the health care system has evolved, training hours have been reduced and collaborative team-based models of care have been adopted; as such, the traditional model of clinical rotations may not be able to fully address the competency needs of many learners into the future. Training continues to be heavily focused on the inpatient setting, while most care is now provided in outpatient settings. This trend is expected to continue, with inpatient hospital services making up an ever decreasing proportion of health system activity and outpatient, home, and virtual care delivery gaining popularity. 

The traditional inpatient clinical rotations model is also challenged by the increasing specialization of the health professions, and the transition of inpatient care to quaternary care practice. Even when core experiences are available for students, with increasingly reduced lengths of hospital stays, it is unlikely that each trainee will be exposed to all stages of evolution and management of specific illnesses. Furthermore, the seasonality of some specific prevalent diseases limits the ability of some trainees to gain exposure, and as a result, a trainee can go through a month or more of a clinical rotation without having exposure to clinical scenarios necessary to establish competency in the subject.

Heightening the aforementioned factors are clinical site shortages. In 2013, of 112 Doctor of Medicine and 31 Doctor of Osteopathic Medicine programs surveyed, 80% (n = 89) and 81% (n = 25) respectively were moderately or very concerned by the number of clinical sites available for students; as of 2019, the proportion of Doctor of Medicine programs expressing those concerns had increased to 84%. Similar concerns were expressed in nursing education. Despite a nationwide nursing shortage, in 2018, of 134 surveyed Bachelor of Science in Nursing programs, 45% reported turning away qualified applicants due to a shortage of clinical placements. Most recently, in the spring of 2020, the COVID-19 pandemic limited the access of many students to clinical settings amid concerns about availability of appropriate personal protective equipment as well as the desire to limit exposure in these high-risk settings.

In addition to concerns about the supply of available clinical sites, a shortage of well-trained and available preceptors has been observed in recent years. In the 2019 survey of Doctor of Medicine programs, 86% of institutions expressed concerns about the supply of primary care preceptors, and 71% were concerned with the availability of specialty preceptors. Further, in a study of 63 physician assistant programs, 89% of programs reported that a shortage of preceptors was one of the main barriers faced when placing students in clinical rotations.

Moreover, the traditional model of clinical education creates a siloed environment, with health professions students training exclusively with other members of their field, rather than as members of interprofessional teams. This discipline-centric model of learning contributes to poor collaboration and communication among health professions students, and ultimately, gaps in patient care and compromised patient safety.

The traditional model of clinical rotations also presents challenges to competency assessment. Although direct observation is a key assessment strategy in competency-based education, the traditional model of clinical rotations often leaves a student learner alone in a room with the patient to gather an independent history and learn key interactive skills. This approach often does not allow routine direct observation by faculty supervisors, who are caring for increasing numbers of patients while also supervising interns, residents, and fellows. Even when direct observation is feasible, observers are often unable to provide real-time, actionable feedback to learners. Furthermore, patient variability may impact supervisors’ abilities to easily compare learners’ clinical skills.

3. Importance of maximizing use of simulation and extended reality

Numerous consequences result from the heavy reliance on traditional inpatient clinical rotations in health professions education, with ramifications for students and health care organizations. Firstly, any persistent shortage of adequate training sites will increasingly impact students’ ability to complete sufficient training in a timely manner, fueling competition for sites between health care training programs. In the absence of expanded options to traditional clinical rotations, disruptions, even temporary ones such as the COVID-19 pandemic, accentuate the possibility of students not completing their training in a timely manner. Delays for any reason may compound trainees’ debt burden and cause undue stress.

In many specialties, particularly critical care environments, students are limited in their opportunities to participate in clinical decisions. This limits the assessment of students’ competency and critical thinking capabilities. Considering impacts to health care organizations, if students fail to acquire necessary skills during clinical rotations, hiring health care organizations become responsible for retraining students to ensure specific organizational competencies are met; as a result, resources and time must be allocated to educate and train on skills and concepts that should have been previously acquired. Simulation and extended reality, however, allow for standardization of curricula and evaluation. Content can be developed to focus on and assess the necessary knowledge and skills in a standardized way that best prepares students for their profession as well as for working in highly collaborative interprofessional care environments, assuring hiring health care organizations that trainees have met those competencies. Moreover, the ability to construct tailored content through simulation and extended reality technologies addresses gaps in the traditional model related to variability in clinical rotation experiences. With nearly unlimited possibilities and scenarios, simulation and extended reality can offer learning experiences that might otherwise be unavailable to students in traditional rotations (e.g., seasonality of diseases, rarity of case studies).

4. Call to action

We make a case for the increased adoption of simulation and extended reality technologies through specific simulation-based clinical rotations across health professions and interprofessional education programs. High-fidelity simulation (i.e., high-quality reproduction of the clinical situation) in lieu of some traditional clinical experiences has documented success across educational domains. In studies of pharmacy and medical students and residents that compared trainee performance after traditional clinical experiences with trainee performance after simulation use, those who received simulation-based training outperformed those who were trained with more traditional methods.

Further, when comparing nursing students who had 50% of their traditional clinical hours replaced by high-fidelity simulation to nursing students who exclusively had traditional clinical experiences, no statistically significant differences could be found in comprehensive nursing knowledge assessments, NCLEX® pass rates, or clinical competency as assessed by clinical preceptors and instructors.

The use of simulation has been widely accepted; however, the COVID-19 pandemic has reinforced the opportunity to embrace rapidly advancing simulation and extended reality technologies in new ways in a time when clinical education evolves to meet the 21st century challenges that face healthcare. Innovative models for clinical education are necessary to address emerging gaps in healthcare training, mitigate clinical training site shortages, and prepare trainees to practice effectively in a complex health system. Expansion of clinical simulation and extended reality can address several of these challenges while enhancing health professions education by providing an environment for integrated learning and competency assessment.

The role of simulation in health professions education should also extend to interprofessional education. As highly-coordinated, patient-centered, team-based models of care increasingly become the healthcare delivery model of choice, students must also acquire teamwork, collaboration, communication, and leadership skills. Simulation can be leveraged to introduce the various roles in multidisciplinary teams early in a student’s education in a low-risk environment. Previous studies
have found interprofessional simulation experiences can improve students’ understanding of their roles in interprofessional care, increase cultural competence, improve interprofessional communication, and promote teamwork. 6,21,22

With documented success and support for using simulation and extended reality in training and competency assessment, we propose exploration of the expansion of these high-fidelity platforms in health professions education, with focused assessment to inform the optimal structure and process of required clinical rotations into the future. A review of competencies across clinical rotations and specialty teaching is necessary to identify which competencies can be met by using these innovative methods. For optimal incorporation of simulation into curricula, this will demand the close integration of simulation trainers and managers into health education leadership. When assessing competencies, evaluation and restructuring will provide greater alignment of training methods to competency needs. Simulation-based approaches can also play a key role in standardizing curricula for students, both on a professions-specific level (e.g., with simulations designed for and mapped to competencies) as well as for the broader interprofessional healthcare team (e.g., behavioral skills, professionalism, interpersonal communications). As appropriate, there should be greater investment in platforms that produce life-like competency-based training.

5. Outcome measures for the use of simulation and extended reality

To evaluate any competency-based training provided with simulations or extended reality, the goals and anticipated impact will need to be measurable in a quantifiable manner.

1. Additional high-quality studies are required to understand the incremental value of enhanced simulation and extended reality in interprofessional education, particularly with respect to optimal deployment in the clinical curriculum. These may include randomized controlled trials to compare the competencies gained from use of simulation with regular clinical rotations. 41 Moreover, studies are needed to understand the economic and broader health care impact of simulation-based rotations; for example, how simulation-specific rotations impact competition for clinical training sites, preceptorship payments, satisfaction of hiring agencies, etc.

2. Studies should span the Kirkpatrick levels of competency (Level 1, acceptability of simulation training; Level 2, knowledge acquired; Level 3, what happens to performance or behavior with patients; and when feasible, Level 4, patient outcomes). 45,46

3. Performance can be evaluated in a variety of ways, including objective structured clinical examinations or through surveying program directors, employees, and institutional and regional performance measures. Such evaluation was completed when comparing simulation based training to traditional training in nurses, with use of comprehensive nursing knowledge assessments, NCLEX® pass rates, and evaluations from clinical preceptors and instructors. 61

4. Evidence of simulation and extended reality modules’ capability to meet local, regional and statewide patient care needs and to improve system performance should be reported. Likewise, measurement of investment of financial and human resources is needed.

5. To continually demonstrate the value of the innovative model to payors and investors, ongoing communication and evidence of sustainability will be necessary. Such evidence may include mandated participation in interprofessional simulation activities across disciplines 47,48 and documented support from institutional and broader community leadership. 48

6Conclusions

Numerous benefits of simulation and extended reality have been recognized within health professions education and, albeit to a lesser extent, interprofessional education. The question becomes how to balance the opportunities and challenges across all training modalities to meet rapidly evolving practice needs. By aiding in skill acquisition and competency development, the expansion of simulation and extended reality can provide critically needed learning opportunities and enhance interprofessional education across health professions. It is time for health professions programs to determine which components of the currently mandated standard clinical rotations could be augmented by carefully constructed simulation and extended reality rotations, and to study the impact.

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