Call to Action

Quality and Simulation Professionals Should Collaborate

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Summary Statement: Simulation is underutilized as a tool to improve healthcare quality and safety despite many examples of its effectiveness to identify and remedy quality and safety problems, improve teamwork, and improve various measures of quality and safety that are important to healthcare organizations, eg, patient safety indicators. We urge quality and safety and simulation professionals to collaborate with their counterparts in their organizations to employ simulation in ways that improve the quality and safety of care of their patients. These collaborations could begin through initiating conversations among the quality and safety and simulation professionals, perhaps using this article as a prompt for discussion, identifying one area in need of quality and safety improvement for which simulation can be helpful, and beginning that work.
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Healthcare quality, safety, and risk management professionals[†] use various tools to achieve the 6 aims of the Institute of Medicine (now known as the National Academy of Medicine): safe, patient centered, effective, efficient, equitable, and timely care.[1] In our team's efforts to enhance collaboration between surgical and anesthesia simulation professionals, we observed that the techniques of simulation are underutilized in pursuit of the quality aims and, in particular, patient safety. An underlying reason for this missed opportunity is the lack of communication between the quality and simulation fields. In this commentary, we advocate for fostering new connections and collaborations between these groups. We first describe how our group came to adopt this advocacy. To orient quality professionals, we describe healthcare simulation; for simulation professionals, we discuss key concepts in quality relevant for simulation applications. Finally, we present various ways in which simulation can advance quality care, challenges in designing and implementing such applications, and keys to successfully enhance healthcare quality and safety through simulation. Although our focus and expertise are in perioperative care, the issues and concepts are applicable to all healthcare arenas, so we include some examples from outside perioperative care.

BACKGROUND: CALL TO ACTION FOR COLLABORATION

Our team of authors represents anesthesiologists and surgeons who have met collaboratively for 4 years. Each profession has hosted simulation-focused meetings for over a decade. More recently, the American Society of Anesthesiologists and the American College of Surgeons initiated joint meetings to address ways to improve perioperative care through simulation-based activities. At our 2022 session, we were encouraged by the Accreditation Council of Graduate Medical Education leadership, informed by their 2021 *Clinical Learning Environment*

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[†]We refer hereafter to "quality professionals" as an abbreviation to include all 3 professions and the term "quality" to include all 3 terms, recognizing that each has distinct attributes requiring unique focus and practices. Patient safety is considered by many to be an aspect of quality; however, patient safety has its own attributes distinct from quality.

Review (*CLER) Report*,[2] to take the perspective of hospital CEOs and make quality and safety a focus of simulation efforts. Once quality and safety leaders were invited into the conversation, we recognized the missed opportunities between the simulation and quality communities. For instance, quality and simulation professionals rarely attend each other's meetings or have shared speaking presentations. To foster collaboration in patient care, we are now focusing on using simulation to meet the needs of healthcare quality improvement and patient safety via joint curricula, faculty development, instructional events, and multi-institutional collaboration, among other options. Our call to action is for collaboration between these fields in the shared pursuit of improving patient safety and providing outstanding, high-value patient care. We summarize key actions needed to realize success in Table 1 and provide examples within the body of this commentary and in a case study.

KEY CONCEPTS IN HEALTHCARE SIMULATION (FOR QUALITY PROFESSIONALS)

The Society for Simulation in Healthcare defines simulation as "a technique that creates a situation or environment to allow persons to experience a representation of a real event for the purpose of practice, learning, evaluation, testing, or to gain understanding of systems or human actions."[3] The many different forms of simulation include a spectrum from low-realism tabletop games to high-realism mannequins and environments. Standardized patients, virtual reality, and "what-if" thinking exercises qualify. For many if not most types of simulations, debriefing the participants is a critical element for effective learning. Simulation is not just a technology; it is a technique of learning intended to shift the culture toward more openness about discussing errors and vulnerabilities of humans and the systems in which they work.[4]

Simulation is widely applied in healthcare for education and training, where its pedagogical approach provides an environment characterized by psychological safety, which fosters an atmosphere conducive to learning and innovation.[4,5] Capabilities for broader uses, especially for quality, are extensive but not well appreciated by most healthcare professionals.

KEY CONCEPTS IN QUALITY (FOR SIMULATION PROFESSIONALS)

All healthcare organizations strive to optimize patient safety and quality. The Institute of Medicine defines quality as "the degree to which health care services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge."[6] Patient safety refers to freedom from accidental or preventable injuries produced by medical care. In 2000, the seminal *To Err is Human: Building a Safer Health System* was published, catapulting the field of patient safety onto the international stage.[1] The book estimated the shocking number of people who die each year in US hospitals from medical errors and made recommendations in the areas of leadership, data collection and analysis, and development of effective patient care systems. Despite a widespread flurry of improvement efforts, recent studies show that current rates of adverse events remain disturbingly high.[7]

WAYS TO ADVANCE QUALITY USING SIMULATION

Delivering outstanding patient-centered care requires creating a culture, resonant with the organization and supported by senior leadership, that embraces quality, safety, and equity. Government regulators such as the Centers for Medicare and Medicaid Services have created measures to hold hospitals and health systems accountable for the care they provide, eg, reporting programs such as the Inpatient Quality Reporting and other Pay-for-Performance programs, which levy penalties or pay incentives based on a hospital's performance and outcomes on these metrics. The development of patient safety indicators (PSI) is part of many quality rating systems, eg, Centers for Medicare and Medicaid Services Stars, Vizient, and Leapfrog. Table 2 lists perioperative PSIs that are likely amenable to outcome improvement via simulation-based interventions. Also, most hospitals consider reducing healthcare-acquired infections (HAIs) and hospital-acquired conditions as essential patient safety initiatives. Common HAIs include surgical site infections, central-line associated bloodstream infections (PSI 07), and catheter-associated urinary tract infections. These PSI and HAI measures continue to be quality improvement challenges. They present an opportunity for

TABLE 1. Recommendations for Using Simulation to Enhance Healthcare Quality and Safety

Recommendation	Description
Reach out/collaborate	Facilitate collaboration between simulation and Q&S professionals
Engage interprofessionally	Foster simulation-based interprofessional education to reduce errors and improve patient safety
Expand scope by training teams	Extend scope of simulation beyond individual skills to address system-level issues, such as simulation training for workflow optimization, equipment testing, and disaster preparedness
Address current challenges	Use simulation to adapt to evolving challenges such as infectious outbreaks and workforce shortages
Customize content	Create customized simulation scenarios that address Q&S issues for the organization
Set clear objectives	Establish clear Q&S learning and change objectives for scenarios for each simulation-based program and session
Seek data-driven outcomes	Design simulation programs to address institutional quality goals; assess the impact of simulation-based training on targeted clinical measures; collect and analyze data from simulation programs to assess whether learning objectives are met
Make quality a part of "everything you do"	Incorporate Q&S goals in simulation debriefings and reflection
Focus on safety culture	Promote a culture of safety by using simulation to train in safety protocols, error prevention, and adverse events reporting
Provide resources	Allocate resources for simulation with equipment and technology to support effective simulation-based Q&S uses
Demonstrate ROI	Assess the impact of simulation training on healthcare Q&S by measuring ROI through improved patient outcomes, reduced errors, and enhanced staff confidence

Q&S indicates quality and safety; ROI, return on investment.

TABLE 2. Selected Perioperative PSI

PSI 6	Iatrogenic Pneumothorax Rate
PSI 9	Postoperative hemorrhage or hematoma rate
PSI 10	Postoperative acute kidney injury requiring dialysis rate
PSI 11	Postoperative respiratory failure rate
PSI 12	Perioperative pulmonary embolism or deep vein thrombosis rate
PSI 13	Postoperative sepsis rate
PSI 15	Abdominopelvic accidental puncture or laceration rate

the application of proven simulation techniques to hard-wire and sustain behavior changes that improve patient outcomes.

IDENTIFYING, UNDERSTANDING, AND DEFINING QUALITY AND SAFETY PROBLEMS

There are now many examples of simulation being used to identify quality issues, prevent harm, and improve organizational effectiveness.

In situ simulation, which can be conducted in any clinical environment, has a dual purpose—training clinical teams to respond to evolving events and identifying latent safety threats (LSTs), hazards, or conditions that risk patient safety but are not readily apparent without system stress.[5,8] LSTs have been identified during simulations in interventional cardiology, emergency medicine, pediatrics, and elsewhere.[9,10] Taxonomies have been developed for classifying LSTs identified via simulation.[11]

Root cause analysis (RCA) is used to determine "what went wrong" when an adverse outcome occurs. The retrospective nature of RCA has serious limitations for revealing causal factors. Simulation-based reenactments of events, followed by postencounter debriefing, can identify causality that is not identified purely from recollection. Simulation has been shown to be effective in improving the usefulness of perioperative RCAs,[12] enhancing error discovery and developing remediation strategies for drug errors.[13] When completed RCAs have been replicated in a simulated environment, participants gained new insights from those specified via a nonexperiential RCA.[14] Simulation has also been used for teaching how to conduct RCAs.[15,16]

At the height of the COVID-19 pandemic, studies showed that simulation-based failure mode and effects analysis (FMEA), involving in situ simulations and structured debriefings, identified 32 failure modes in 7 hospitals[17] and identified airway management LSTs in an emergency department.[18] A systematic FMEA approach with simulation has demonstrated effectiveness in identifying patient safety threats in the design and building of healthcare facilities.[19,20]

TEAMWORK FOR CLINICAL TEAMS

In addition to improving technical skills, simulation-based teamwork training emphasizes nontechnical skills such as structured communication, including briefing, debriefing, and closed-loop communication. Through simulation-based teamwork scenarios, interprofessional team members can discover each other's skills set and scope of practice. An environment that fosters psychological safety, encourages speaking up to authority, and flattens hierarchy is important to the development and refinement of nontechnical skills. Leadership engagement is critical for implementing each of these.[21] Normalizing use of cognitive aids and implementing treatment protocols for low-frequency, high-risk events help to develop a shared mental model; several free resources and manual downloads are available, eg, through *The Emergency Manual Implementation Collaborative*.[22,23] Miscommunication, a known source of medical errors, is particularly common in the operating room where ambiguous language occurs frequently.[24]

Teamwork failures and poor communication contribute to two-thirds of patient harm events,[25] which has motivated an increasing prevalence of team training in healthcare. Two meta-analyses concluded that healthcare team training improves transfer of learning to the clinical setting and patient outcomes while reducing medical errors.[26,27] The American Association of Medical Colleges has recommended tools to assess predefined teamwork competencies. Although the competencies were designed for medical students, the evidence underpinning them is universal.[28]

Team training is often modeled upon the Agency for Healthcare Research and Quality (AHRQ) program Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS).[29] TeamSTEPPS-based team training for trauma teams improves patient throughput from the emergency department to the operating room[30] and safety culture as assessed by AHRQ's Hospital Survey on Patient Safety Culture.[31]

Increases in maternal mortality led the American College of Obstetricians and Gynecologists to include multidisciplinary, simulation-based team training in their practice guidelines.[32] The Joint Commission issued a simulation-based training mandate in 2021 for hemorrhage and severe hypertension, which are high-risk peripartum events.[33] Obstetrical simulation-based team training reduces hemorrhage-related morbidity,[34] obstetrical malpractice claims,[35] and, when bundled with evidence-based protocols, adverse outcomes.[36]

The American Heart Association, in a 2013 scientific statement on patient safety in the cardiac operating room, advocated for teamwork and structured communication, citing simulation as both a training methodology and an environment for assessing technical and nontechnical skills.[37] The authors noted opportunities based on the frequency of adverse events in cardiac surgery patients, over half of which were preventable.[38]

APPLYING SIMULATION TO QUALITY AND SAFETY CHALLENGES

Simulation is an effective tool for implementing evidence-based practices and evaluating implementation gaps. Once a quality issue is identified, simulation can be used to mitigate risk, promote adherence to protocols, introduce new tools and equipment, correct LSTs, inculcate best practice through repetition, and assess training effectiveness. Residents trained via simulation had a higher success rate and lower mechanical and infectious complications rates during central venous line insertion compared with residents with traditional, non–simulation-based training.[39,40]

Just-in-time in situ training for COVID-19 preparedness is another example of simulation's use in maintaining safety and mitigating the impact of evolving challenges.[41] Simulation was a pivotal resource during the pandemic, eg, by identifying best practices for and training in the use of personal protective equipment.[42] Simulation can also be applied to workforce shortages by augmenting training pipelines and preparing

healthcare professionals for the demands of a rapidly changing healthcare landscape.[43]

Simulation identified LSTs in designing a hospital helicopter landing pad, the optimal path for patient transport and evidence for failure mitigation.[44] Simulation-based training has also reduced infant mortality following a 3-day training.[45] Other examples include reduction of door-to-needle time for stroke thrombolysis[46] and improving code blue response.[47] Simulation-based training for high-stakes clinical settings is illustrated by study training anesthesiology residents to wean patients from cardiopulmonary bypass, a complex algorithmic activity.[48]

Simulation has been successfully incorporated into Plan-Do-Study-Act (PDSA) cycles by interprofessional groups,[49] eg, for LST identification in the cardiac catheterization laboratory[9] and for airway management during the pandemic.[18] When testing a change in the clinical environment is not efficient, simulation provides an alternative. Scripted simulations addressed adherence to policies reproducibly and efficiently and assessed staff ability to access and use emergency equipment.[50] Other examples include an intervention to decrease neonatal hypoxic-ischemic encephalopathy[51] and an assessment tool for mitigating LSTs.[52,53]

IMPROVING INSTITUTIONAL PSIS

Simulation has been used to directly improve PSIs. A systematic review found simulation-based training was associated with decreased pneumothorax risk[54]; single site trials showed a 58% to 74% reduction in central line-associated bloodstream infection with simulation training.[55,56] A separate systematic review concluded that simulation-based training decreases sepsis-related mortality and hospital stay.[57] The reduction in postprocedure hemorrhage noted earlier is another example. Despite these exemplars, simulation is infrequently used to improve outcomes related to clinical safety indicators. These examples of simulation-based interventions for quality and safety serve as a model for application to other PSIs.

CHALLENGES AND KEYS TO SUCCESS IN USING SIMULATION FOR QUALITY AND SAFETY

Most large and moderate-sized healthcare institutions have access to some simulation resources. Using, growing, and sustaining that simulation capacity for improving quality requires a shared mental model among quality leaders and simulation experts.

There are many challenges and barriers to using simulation as described previously, both initiating and sustaining programs. Among the most formidable is the scheduling: RCA, FMEA, or other simulation sessions require accommodating multiple work schedules of interprofessional participants; enabling personnel availability requires a major investment of time and money, particularly for nonsalaried personnel.[58] For many applications, relatively short, eg, 1-hour, training events can be effective, especially if done repetitively, and thus minimize personnel expense.

Designing simulation-based education to address specific quality problems can be challenging for several reasons. Where team training is employed, true interprofessional team sessions have high value but are challenging to facilitate, requiring skilled instructors. A guide for these educators about the effective use of simulation for healthcare education emphasizes the principles of curricular integration, feedback and debriefing, and deliberate practice with rigorous skills assessment.[59] Mastery learning, including a range of difficulty that captures clinical variation, and individualized learning were also highlighted as best practices. Involving quality, safety, risk, and regulatory colleagues into simulation design and implementation is optimal for outcome improvement.[33]

It is difficult to sustain new quality and safety practices. Routine use of simulation for quality applications helps to sustain changes and can alter culture by reinforcing safety as a core organizational value. In a report of operating room team training,[60] first-case starts, antibiotic administration, venous thromboembolism prophylaxis, patient satisfaction, and National Surgical Quality Improvement Program morbidity and mortality improved. However, those improvements deteriorated when limited finances led to termination of the training, demonstrating that sustaining success is often more challenging than implementation. Skill decay is well recognized for any behavior change and or any behavior or skill that is not frequently called on, and thus, periodic reinforcement is needed.[61]

High-volume training programs may require a dedicated simulation center; however, many objectives can be addressed using less resource-intensive, in situ simulation. In situ training facilitates assembly of the team for training, minimizes time away from other assigned tasks, and permits an assessment of a clinical unit's capabilities. Scheduling time in clinical spaces can be a challenge, especially in heavily used clinical environments. Although most organizations face space and time challenges, a recent survey of anesthesiology residency programs identified pandemic-related precautions, lack of trainers, and financial challenges as additional obstacles.[62]

Buy-in from clinicians can also be a challenge. To address that, a project can begin with 1 or 2 motivated teams or units to serve as examples of success for other teams and "champions" for future training. Sustainability requires ongoing training of new team members and retraining of established members. Maintaining psychological safety for participants during the reenactment of high stress events helps establish a commitment to the program.

Demonstrated success of training is best done with clear, measurable outcomes that align with institutional goals (eg, decreases in patient complications or mortality, length of hospital stays, and costs). This requires sharing of data between the simulation educators and the healthcare system. Success needs to be continuously reported and celebrated by both the leaders and the teams.

Calculating the return on investment (ROI) for simulation and team training in healthcare, especially financial ROI, is inherently challenging due to the complexity and variability of clinical settings, although there are examples where this has been done.[39] Unlike traditional investments with more straightforward financial metrics, the benefits of simulation-based training are multifaceted and often intangible, including improved patient safety, enhanced team communication, and reduced medical errors.[63] These outcomes, although difficult to quantify in monetary terms, are crucial for maintaining high reliability in healthcare environments. Just as in other high-stakes

industries, such as aviation or nuclear power, where the risk of catastrophic mishaps necessitates rigorous training and simulation, healthcare must prioritize these methods to mitigate risks, enhance team coordination, and ultimately save lives. A key value of simulation and team training lies in its potential to prevent adverse events, thus justifying the investment through its alignment with the overarching goal of high reliability and safety in patient care.

CALLING ON PATIENT SAFETY AND SIMULATION PROFESSIONALS TO COLLABORATE

Generally, quality and simulation professionals do not work within the same spheres. Yet, both ultimately have the same goals of furthering high-quality, safe care. What might be done to create opportunities for these 2 professions to collaborate more toward these goals?

Collaboration begins by talking to each other, to learn about specific institutional needs and capabilities of the simulation program to serve those needs. We intend this article as a catalyst for opening interprofessional dialogue. In particular, quality and simulation professionals may approach each other using the items in Table 1 to begin the conversation.

Simulation should be *translational*, that is, it should be used to effect change in the organization beyond education and training in the usual ways. The Society for Simulation in Healthcare accreditation program for healthcare simulation programs provides useful guidance and examples in its Systems Integration Accreditation Standards and accompanying companion document.[64,65] The case study in the box provides an example.

The study, recently published in *Simulation in Healthcare*,[34] illustrates a number of important principles from our Table 1 (recommendations from Table 1 are italicized). First, the authors chose an important, impactful problem, as maternal morbidity related to PPH is increasing in the United States and a significant portion is preventable (*customized content* that *addresses current real challenges*). Second, the intervention has *clear objectives*, in that it addresses the authors' concern that PPH is underrecognized and undertreated. Third, the authors *seek data-driven outcomes* as they test the hypothesis that a simulation-based intervention would improve outcomes by training for earlier recognition of the condition and facilitating a standardized, team-based approach to treatment. Fourth, the scope of their intervention lends itself to a team approach, an ideal setting for *interprofessional* simulation. *Expanding the scope* of the intervention to the entire treatment teams of nurses, anesthesiologists, physicians, blood bank personnel, and pharmacists reflects an approach to *train teams* rather than individuals and increases the likelihood of a measurable, meaningful effect.

Lastly, the outcome measure provides a proxy for *ROI*: the study measured clinical results in a population of patients (Kirkpatrick level 4)[66] rather than reactions, knowledge, or provider behavior (level 1–3 outcomes). As pointed out by the authors, simulation studies that address clinical results are uncommon. The fact that many institutional quality improvement teams measure multiple, meaningful clinical results ("dashboards") on an ongoing basis provides an ideal opportunity to assess the impact of simulation-based interventions.

A Case Study Illustrating Kirkpatrick Level 4 Results after Simulation Training: The Translation of Simulation-Based Training to Population Outcomes.

A recently published study illustrates a large-scale simulation initiative associated with impactful, data-supported outcomes that was a collaboration of quality and simulation teams. From 2012 to 2016, a high-volume obstetrical service at a tertiary academic center implemented simulation-based training designed to improve maternal morbidity related to postpartum hemorrhage (PPH). PPH was defined as blood loss of >500 mL for vaginal delivery and >1000 mL for cesarean delivery. The composite outcome included death, hysterectomy, intensive care admission, blood transfusion, or unanticipated procedures to treat postpartum bleeding. Of nearly 20,000 deliveries, 4.5% of patients experienced hemorrhage. After training 346 members (85%) of the obstetrical team over a 3-month period, the PPH rate increased from 2.8% to 6.1%, whereas PPH morbidity was lower (44% vs. 35%; odds ratio, 0.7; CI, 0.52–0.93), a finding that remained significant after adjusting for confounding variables.

Concluding Thoughts

We urge all who work in the quality and safety professions to reach out to the other and, perhaps using this commentary as an introduction, to start by making specific plans to address one new issue that will improve quality, in the best case, measurably. Through shared, experiential learning and debriefing, simulation participants can contribute to messaging about *making quality a part of "everything you do"* and foster relationships and trust that bolster the *safety culture* of the organization. Ultimately, these experiences require *resources* and the commitment of leadership to assure feasibility and sustainability. The features listed in Table 1 can be considered when applying simulation to virtually any other clinical issue.

We have presented a case for substantive collaboration between 2 professions with a shared goal and vision of improving the quality and safety of patient care. This type of partnership helps to hard-wire the connections of a healthy safety culture. We recognize that our call for action is aspirational; this kind of collaboration and specific new activities will require a long and considerable effort to surmount the many challenges presented by the fundamental nature of our healthcare system and structures and incentives of our institutions. Yet, our interdisciplinary collaboration on this call to action is one example of the synergy we seek to achieve; we hope some who read this will reach out and find a willing partner in the other. Success in achieving our joint missions should follow.

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