Issue Brief

Simulation To Improve Patient Safety: Getting Started

Agency for Healthcare Research and Quality

PATIENT SAFETY

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Simulation To Improve Patient Safety: Getting Started

Can simulation really improve patient safety? The short answer is yes, simulation can be used to improve patient safety. The objectives of simulations can easily align with the objectives of healthcare quality and patient safety programs, making simulation an asset and simulationists valuable colleagues.

Simulation can be used to identify and mitigate latent safety threats.[1] Simulation can be used as a test of change to implement quality improvement projects and can reveal information during root cause analysis that would not have otherwise been discovered.[2] Simulation, coupled with debriefing, is a versatile tool that can be adapted to advance many quality and patient safety objectives.

Simulations allow learning without direct harm to patients and can be scheduled at the relative convenience of participants.[3, 4] Methods to support reflection or provide information, such as coaching, feedback, and debriefing, are essential components of learning from simulations. In many situations, learning from simulation, rather than during care for real patients, is an ethical imperative.[5]

This issue brief discusses practical strategies to advance patient safety through simulation and debriefing.

Leverage Patient Safety Infrastructure

If you have already invested both tangible resources and social capital to develop patient safety infrastructure, simulation can be an additional valuable asset. You may have already assembled committees, built processes, and organized meetings to advance patient safety. Incorporating simulationists into these structures can improve your ability to accomplish your goals and discover information uniquely revealed by simulation.

At the point of understanding how patient harm occurs, or how successful patient care occurs, simulations can be incorporated in root cause analyses (RCA) or the complementary process of success cause analyses (SCA). SCA investigates the conditions that supported safe, successful care despite unusual (or usual) challenges.[6] Simulation can take learning one step further by recreating an actual event to better understand factors that contributed to the outcome. Simulation can also serve as a risk mitigation strategy or can be designed to ascertain whether improvements have been sustained.

Simulation To Assess and Improve Response Protocols for Intraoperative Emergencies for Patients With COVID-19:

Reflections took place before, during, and after action. Activities addressed included:

- Pre-anesthetic preparation;
- Activation of emergency response teams;
- Management of personnel, information, and equipment; and
- Communication in the context of an emergency requiring respiratory contagion precautions.

Examples of barriers included difficulty managing cognitive aids while wearing personal protective equipment and inability of cold zone supplemental personnel to see intraoperative physiologic monitors. Examples of facilitators included the ability of responding staff to revert to core training despite the unfamiliar workflow and the availability of sanitizable metal tables to bring additional supplies into the room.[7]

During a postsimulation debriefing, participants can be encouraged to identify the actions or information other participants provided that contributed to management of the simulated patient. Often, experts

Simulation That Revealed an Equipment Malfunction

A patient safety event occurred when an infusion delivered 33.5 mg of medication to a patient rather than the intended 3.5 mg. Reenactment using simulation revealed that the infusion pump keypad "stuttered" and entered an extra digit into the dose. It is unlikely that this information would have been obtained from other types of investigations, such as interviews of event participants, or focus groups of experts.

contribute to patient care without consciousness of their underlying thought processes, and novices are not sure if their actions were, indeed, correct. Articulating what actions or information were beneficial can improve recognition of contributory actions and reinforce their importance.

Simulation in situ can be particularly useful; these simulations replicate patient care situations in actual patient care locations, using actual patient care equipment, with the participation of actual patient care team members.[8,9] Simulation in situ can surface differences between "work-as-imagined" and "work-as-done."[9] In many cases, differences exist between the idealized conceptual understanding of patient care and the realities of numerous conditions that could be problematic. These include resource limitations, missing equipment, unbalanced workloads, and many other local and systemwide conditions.

Some latent safety threats or patient safety hazards that are known to local participants, even when not formally reported, become evident during simulations. For example, simulations in situ may reveal that the oxygen supply does not have sufficient pressure to be used for two patients at the same time[1] or that members of a team have differing assumptions about the skills and responsibilities of team members with different scopes of practice. Learning designed to enable future responding teams to provide safe, successful patient care can be elicited during debriefing.[11-13]

In Situ Simulation To Reorganize Processes To Manage a Child With Airway Obstruction Presenting to the Emergency Department (ED)

A series of six simulations using iterative improvements to the existing protocol resulted in the death of two simulated patients (using prespecified criteria).
A series of six simulations after processes were reorganized resulted in no deaths of simulated patients. Modifications included developing a critical airway team, a written algorithm for the care of ED patients with critical airway obstruction, an airway cart with specialized equipment, and a critical airway paging system.[10]

To encourage participation and collaboration:

- Design introductory simulations that are supportive, engaging, and rewarding. As simulation has been integrated into formal training programs for a variety of healthcare roles,[14] participants may have some familiarity with simulation.
- Focus on improving healthcare systems, rather than improving healthcare providers. Ensure that potential participants are oriented to the objectives of the simulation.
- Optimize the direct and secondary benefits, such as designing and implementing simulations that address organizational priorities. Another option is to provide formal credit toward credentialing, maintenance of certification, mentoring, or other educational, research, publication, or administrative goals. Simulation can also be used to meet newer Joint Commission accreditation standards, such as the requirement for annual drills to determine system issues as part of ongoing quality improvement efforts in maternal safety.[15]

- Respect the concurrent clinical care responsibilities of participants by using "no-go" criteria to postpone simulations during periods of increased patient acuity, increased patient census, or limited staffing. Over time, as the benefits of simulation gain appreciation, fewer cancellations may occur.[16, 17]

Simulation To Identify Medication Errors, Latent Safety Threats, and Factors Contributing to Error Prevention and Recovery for Pediatric Anaphylaxis Treatment

A series of 37 in situ simulations across 28 healthcare institutions in six countries revealed that nursing experience with epinephrine administration for anaphylaxis was associated with fewer preparation ($p = 0.04$) and administration ($p = 0.01$) errors.

More than half (6 of 11) reported latent safety threats involved a cognitive aid. Hazards embedded in the cognitive aids included recommending an incorrect dose or route for epinephrine administration, failing to recommend a dose, and providing dosing information in milligrams without milliliter information, causing a delay in administration in order to calculate the volume to administer.[19]

Use Simulation To Adopt and Adapt Best Practices

The National Academy of Medicine (formerly the Institute of Medicine) has espoused the values of safety, effectiveness, patient-centeredness, timeliness, efficiency, and equity to optimize the quality of patient care. Simulation can be integrated into proactive processes designed to improve each of these goals. Areas appropriate for integration of simulation include failure modes and effects analysis (FMEA),[18] probabilistic risk assessment (PRA), responses to adverse event concerns, or other methods used to anticipate, identify, and mitigate hazards and prioritize interventions.

Clinical providers are often aware of hazards that could affect patients or themselves and many develop workarounds or protocol deviations to compensate and protect their patients or themselves. For various reasons, these hazards are not always reported, and sometimes the compensatory activities become so normalized that they are not even recognized as adaptive responses to perceived problems.

Simulations that involve care providers in their usual roles can identify bottlenecks and activities that require clarification, modification, or additional resources. For example, simulations involving trauma and blood bank personnel can be designed to focus on the processes involved in the initiation and response to activation of a massive transfusion protocol, including identifying barriers to rapid requisitioning and facilitators for prompt delivery of blood products.

Large-scale simulations, such as mass casualty simulations, may include a "table top" component that incorporates small physical objects representing patients, providers, equipment, and other resources being moved around a map of the healthcare delivery facility. Even routine patient care processes can be studied, and improving common processes may have greater cumulative positive impact on healthcare delivery than preparing for rare events.

Simulation, accompanied by skilled debriefing and integrated into improvement cycles, can provide information that can be used to surface recognition of compensatory activities, unmask hazards. assess potential solutions, inform revisions, and retest potential solutions.

Many organizations conduct emergency response simulations. These may be announced in advance, depending on the purpose of the simulation. The boundary of participation in the simulation can also vary. Some emergency response simulations involve only the local care unit, while some may integrate a broader range of potential respondents, such as the blood bank or the pharmacy. Some, such as mass casualty drills, may extend beyond the healthcare delivery organization. The breadth of involvement is determined by the purpose of the simulation.[20]

Simulation-Based Training for Emergency Responses by Practitioners in an Ambulatory Care Setting

After an actual event, a practitioner reported their appreciation for simulation's ability to prepare them for emergency responses: "Today we had quite a serious medical emergency and one of my medical assistants thanked me for the mock code experience. Patient ... was having an anaphylactic reaction... [we] knew what to do with the epi because of that drill."[20]

The scale and scope of the simulation should reflect the scale and scope of the questions and systems being addressed. These may range from a few people participating in a very discrete, specialized process to multiagency simulations of mass casualty events or full-scale simulations of floorplans and activities before building multimillion-dollar healthcare facilities.[21, 22] All care processes, from rare to routine, are candidates for simulation-based activities, depending on the questions that need to be answered.

Use Simulation To Improve Healthcare Delivery Systems

Simulation can be used to develop and serially test and enhance a process improvement. Repeating simulations with multiple groups of participants will demonstrate themes of information or resource needs. Simulations can expose workarounds that providers may not even recognize as workarounds because they are so common, providing evidence of processes that need improvement. Simulations can also be used to adapt a process that is a "best practice" in one organization, or under one set of circumstances, so that it fits a local context, resources, and culture.

Simulations can be used to support patient and family engagement. Patients, their families and support people, and community organizations can help inform the design and content of simulations relevant to their experiences. With appropriate preparation, they can actively participate in simulations and add valuable perspectives and insights during debriefings.[25, 26]

Lessons learned from simulations can and should be shared beyond the direct participants. In one organization, simulation was used during the COVID-19 pandemic to test the effectiveness of processes designed to protect providers. Lessons learned were shared with multiple units so that solutions could be spread more quickly, and processes that were not practical or effective were discarded more quickly.

Simulation-Based Preparation for Emergencies in Outpatient Settings

An article focusing on pediatrics notes, "The best way to ensure readiness for an emergency is to practice regularly in the office setting, with as many office staff members as possible participating. Simulated exercises, or mock codes, provide a good opportunity for staff members to practice the steps of an emergency."[23]

Simulation to advance antiracist culture

Simulations were developed in response to racist behavior by patients toward a clinical team member[24]: One participant commented, "This simulation opened my eyes to strategies I can use to better support my friends and colleagues in times of need."

Information about hazards identified during simulation should be collected and addressed with the same seriousness and using the same data collection processes as information about unsafe conditions or near-miss events involving real patients. Organizations should ensure that lessons learned from simulation are tracked, trended, and reported at the same meetings as quality and safety indicators.

Debriefing All Surgical Cases

Rose and Rose found that debriefing 54,003 consecutive cases revealed 4,523 defects. Addressing these reported defects was associated with a significant reduction in 30-day unadjusted surgical mortality, improved operating room efficiency, and a better safety climate.[27]

Additional Benefits of Simulation

Simulation provides additional benefits that can improve clinical care. Debriefing simulations provides opportunities to learn debriefing skills that can be applied to actual clinical events. Debriefing sessions may be "hot," consisting of short discussions immediately after a clinical event, or "cold," consisting of reviews that occur after a period of reflection.

Cold debriefings may be regularly scheduled (e.g., monthly) and may include additional investigation or followup related to the patient care event. Lessons can be learned from thoughtful review of patient care events that were successful, as well as those that were not.

The affective lessons learned in simulation can also benefit your organization's culture of safety and potentially provider well-being.[29] Several different approaches are available to conduct debriefings, but most include respectful curiosity and attention to psychological safety. Cultivating supportive team behaviors in simulation helps to cultivate supportive behavior in clinical care.

Simulation to decrease "door-to-needle" time for thrombolysis from a median of 27 to 13 minutes in patients suspected of having strokes

Times remained consistent at reevaluation in 13 months: Using a series of simulations, a hospital improved their management of patients with possible acute strokes. Improvements were based on bringing patients directly to the computed tomography scanner for preliminary assessment, providing interventions in that location, and refining the team's shared mental model, thereby expediting treatment.

Of note, actual previous stroke patients participated as the simulated patients and provided input from the patient's perspective, such as recommending that preparatory information be provided to patients during transport to the hospital.[28]

Getting Started

Simulation does not have to cost a lot of money or require expensive equipment. Effective, engaging simulations can be created with low-tech resources, such as creating a conjoined twin simulator from two store-bought baby dolls attached to each other.[30] Simulations conducted in situ take advantage of settings and equipment that are inherently realistic.

Many organizations have invested in simulators and simulation centers. Elaborate or specialized simulators may be useful, but only if they align with the goals of the simulation. Simulation centers may not fully replicate patient care conditions, but they allow more reliable control of the physical environment, scheduling, and replicability.

Experienced simulationists can optimize the planning and conduct of simulations. Simulationists come from diverse professional backgrounds and are often individuals who are passionate about healthcare education, research, and systems improvement and seek tools to advance those objectives.

In Situ Team Training in Primary Care Emergency Teams

Brandstorp and colleagues found that challenging, monthly emergency in situ team trainings organized by local health personnel, including a review, realistic simulations, and debriefings, facilitated many types of learning. "In situ team training was experienced as challenging, engaging, and enabling."[31]

As the field is relatively young and rapidly evolving, developmental pathways for simulationists include both experiential learning and formal training ranging from multiday courses to master's degrees. Many simulationists have backgrounds in clinical care, and some have backgrounds in educational theory, human factors, systems and other types of engineering, psychology, technology, theater, and patient safety. Many draw from more than one field of expertise.

Much can be accomplished and learned even with limited resources and some creativity. The literature is now full of examples of ways simulation can improve patient safety in a variety of practice settings.[1, 8, 11, 12, 20-22] What may be most important are:

- **Clarity about the purpose and goals** of individual simulations or the simulation program as a whole,
- **Thoughtful design** of simulations and selection of simulators,
- **Proper preparation** of potential participants before simulations, and
- **Skilled debriefing** after simulations, with lessons regularly shared to inform quality and safety activities.

While implementing simulation requires time, an advocate or champion, and skilled facilitation, its benefit to healthcare quality and patient safety makes it an **invaluable resource**.

Resources

Selected AHRQ Resources

PSNet Collection search for "simulation" (contains more than 600 references)

Healthcare Simulation Dictionary

AHRQ Simulation Research

Simulation Training Primer

Simulation-Based Surgical Education

Health Care Simulation To Advance Safety

Simulation in Health Care: Setting Realistic Expectations

Use of Simulation To Test Systems and Prepare Staff for a New Hospital Transition

Simulation-Based Clinical Systems Testing for Healthcare Spaces: From Intake Through Implementation

Foundational Articles

These groundbreaking articles have defined many of the principles underlying the use of simulation to enhance patient safety.

Simulation Benefits and Implementation	Citation
Better patient outcomes and cost savings associated with investment in simulation training	Cohen ER, Feinglass J, Barsuk JH, Barnard C, O'Donnell A, McGaghie WC, Wayne DB. Cost savings from reduced catheter-related bloodstream infection after simulation-based education for residents in a medical intensive care unit. Simul Healthc. 2010 Apr;5(2):98-102. https://pubmed.ncbi.nlm.nih.gov/20389233/.
The ethical imperative to use simulation, rather than experience with patients, for aspects of healthcare education	Ziv A, Wolpe PR, Small SD, Glick, S. Simulation-based medical education: an ethical imperative. Simul Healthc. 2006;1(4):252-256. https://pubmed.ncbi.nlm.nih.gov/19088599/.
Focusing simulation debriefing to address system improvement	Bajaj K, Meguerdichian M, Thoma B, Huang S, Eppich W, Cheng A. The PEARLS Healthcare Debriefing Tool. Acad Med. 2018 Feb;93(2): 336. https://debrief2learn.org/pearls-debriefing-tool/.
Applying debriefing skills honed during simulation to support learning from patient care experiences	Purdy E, Borchert L, El-Bitar A, Isaacson W, Bills L, Brazil V. Taking simulation out of its "safe container"—exploring the bidirectional impacts of psychological safety and simulation in an emergency department. Adv Simul (Lond). 2022 Feb 5;7(1):5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8818167/.
Implementing in situ simulation while respecting the patient care responsibilities of potential participants	Bajaj K, Minors A, Walker K, Meguerdichian M, Patterson M. "No-go considerations" for in situ simulation safety. Simul Healthc. 2018 Jun;13(3):221-224. https://pubmed.ncbi.nlm.nih.gov/29621037/.
Early proof of the capability of simulation-based education to improve patient outcomes	Draycott T J, Crofts JF, Ash JP, Wilson LV, Yard E, Sibanda T, Whitelaw A. Improving neonatal outcome through practical shoulder dystocia training. Obstet Gynecol. 2008 Jul;112(1):14-20. https://pubmed.ncbi.nlm.nih.gov/18591302/.

Note: Web pages were accessed May 17, 2024.

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