The Joint Commission Journal on Quality and Patient Safety 2017; ■■:■■–■■

Using Simulation to Improve Systems-Based Practices

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Background: Ensuring the safe, effective management of patients requires efficient processes of care within a smoothly operating system in which highly reliable teams of talented, skilled health care providers are able to use the vast array of high-technology resources and intensive care techniques available. Simulation can play a unique role in exploring and improving the complex perioperative system by proactively identifying latent safety threats and mitigating their damage to ensure that all those who work in this critical health care environment can provide optimal levels of patient care.

Methods: A panel of five experts from a wide range of institutions was brought together to discuss the added value of simulation-based training for improving systems-based aspects of the perioperative service line. Panelists shared the way in which simulation was demonstrated at their institutions. The themes discussed by each panel member were delineated into four avenues through which simulation-based techniques have been used.

Results: Simulation-based techniques are being used in (1) testing new clinical workspaces and facilities before they open to identify potential latent conditions; (2) practicing how to identify the deteriorating patient and escalate care in an effective manner; (3) performing prospective root cause analyses to address system weaknesses leading to sentinel events; and (4) evaluating the efficiency and effectiveness of the electronic health record in the perioperative setting.

Conclusion: This focused review of simulation-based interventions to test and improve components of the perioperative microsystem, which includes literature that has emerged since the panel's presentation, highlights the broad-based utility of simulation-based technologies in health care.

Simulation involves re-creating medical tasks and environments to allow learners to develop and hone both technical and nontechnical skills. Work demonstrating the success of simulation-based curricula has not only led to requirements of its inclusion in residency training curricula,[1] but simulation has also been chosen as the modality for national certification exams in surgery.[2,3] Outside its role within training programs, though, simulation can be a critical tool to better understand and refine the larger health care system. Simulation is particularly conducive to helping address challenges in this way because it re-creates rare, yet high-risk events and conditions in which providers can practice their responses;[4] it provides a safe learning environment in which learners can try and fail without consequences to patients; and—because of its experiential nature—it creates an immersive learning environment in which learners can suspend disbelief, allowing for better retention of knowledge, skills, and attitudes learned in the setting.

Simulation likely has unique value in improving complex systems, such as perioperative pathways. The perioperative clinical microsystem is a highly dynamic, fast-paced work environment in which multiple professions and disciplines come together to care for patients with a wide array of acuity levels, ranging from outpatient walk-ins to the critically ill in multisystem organ failure (Figure 1).

Ensuring the safe, effective management of this wide range of patients requires efficient processes of care within a smoothly operating system in which highly reliable teams of talented, skilled health care providers are able to use the vast array of high-technology resources and intensive care techniques available. Unfortunately, the perioperative microsystem does not always function in this ideal manner, leading to breakdowns at the service line and system level that can produce catastrophic failures and patient harm. These breakdowns are particularly difficult to identify because the latent safety threats[5]—those errors in design, organization, training, or maintenance that may contribute to medical errors—that predispose them are often masked by the workings of the system itself, only exposed at the last minute before an adverse event.[6] Simulation can be used in diverse ways to proactively identify these threats and mitigate their damage to ensure that all those who work in this critical health care environment can provide optimal levels of patient care. Unfortunately, though, comprehensive review of how simulation can be used in this way has occurred in a piecemeal fashion, with published studies serving as single-institution case reports that describe how simulation helped fill a specific gap.

To provide a broader perspective on this topic, an international group of five experts joined together on a panel, moderated by one of the authors [J.T.P.], at an international simulation conference in 2015 to discuss their own experiences

1553-7250/$-see front matter

http://dx.doi.org/10.1016/j.jcjq.2017.05.006

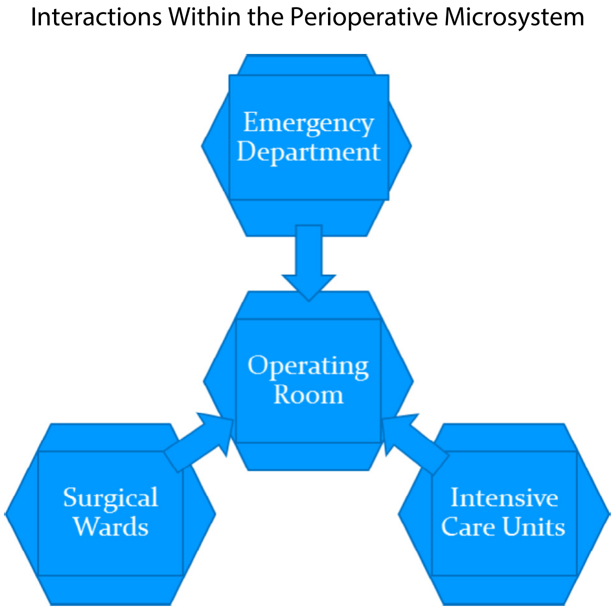

Figure 1: Interactions of clinical areas that contribute to the complex perioperative microsystem are shown. Each of these interactions reflects situations in which health care providers from numerous specialties must join together to care for patients with varying acuity levels. Intensive Care Units refer to postanesthesia care unit and surgical intensive care unit.

and the associated opportunities, challenges, and considerations of using simulation in this manner.[7] In this article we provide an overview of the themes discussed by each panel member, which we have delineated into four avenues through which simulation-based techniques have been used to improve systems-based aspects of the perioperative service line, as follows:

1. Simulation for Workplace Readiness: Testing new clinical workspaces and facilities before they open to identify potential latent conditions [A.K.G.]
2. Simulation to Improve Escalation of Care: Practicing how to identify the deteriorating patient and escalate care in an effective manner [M.J.]
3. Simulation to Re-Create Adverse Outcomes: Performing prospective root cause analyses (RCAs) to address system weaknesses leading to sentinel events [J.R.K.]
4. Simulation to Evaluate Negative Impacts of the EHR: Evaluating the efficiency and effectiveness of the electronic health record (EHR) in the perioperative setting [I.H.].

Literature that has emerged since the panel's presentation is cited in this article, as appropriate.

AVENUE 1. SIMULATION FOR WORKSPACE READINESS

"Error-Proofing" of New Clinical Workspace

Making the transition to a new clinical workspace can be an extremely challenging endeavor. In situ simulation (that is, simulation activities that occur within an actual clinical space), though, can be invaluable for this process. By realistically playing out patient care scenarios in the actual clinical environment before it opens, a unique opportunity emerges to systematically analyze human, technical, and system performance. Simulation-based training (SBT) can not only make health care workers more comfortable with their new setting but can help hospital staff preemptively identify weaknesses in technologies or processes that may otherwise lie dormant until facility opening.

The use of SBT for error-proofing has been studied in a number of ways. The beginning of this application of simulation began with a group of emergency medicine physicians who sought to investigate if workers who actually participated in SBT within a new workspace would benefit more than individuals who participated in a standard facility orientation to the new space.[8] The researchers had a small group of emergency department (ED) staff participate in a medical resuscitation scenario four days before opening, and they evaluated the following: (1) the SBT group's preparedness reactions compared to those individuals who only participated in the standard orientation, and (2) latent safety threats identified by the SBT participants who completed the simulated scenario. From this exercise, they were able to identify 18 latent safety threats from this one SBT activity and were able to correct most of them within the next few days before the facility opened. The threats identified ranged from seemingly small issues such as not knowing the location of switches within the space and less-than-ideal placement of monitors to more serious concerns such as a faulty communication system that was for all intents and purposes unusable. More recently, another group of researchers assessed the readiness of two new trauma bays within another workspace by placing ED and surgery staff in a situation in which they had to manage a critically ill patient with trauma (patient simulator) who presented with multisystem injuries and then regroup to distribute resources and personnel to manage another arriving patient (standardized patient actor) complaining of severe, crushing chest pain.[9] From this work, the researchers were able to recognize quickly that the trauma bays were lacking crucial components that could have a significant effect on actual patient care if the bays were used to treat trauma victims. For example, the researchers noted that lights were striking team members in the head, resuscitation equipment was absent, monitors were missing, and paths to the operating room (OR) were unmarked and unclear. In addition to identifying these important latent safety threats, the researchers were able to demonstrate that in situ SBT enhanced perceptions of readiness, self-efficacy, communication, and workspace satisfaction among the staff. Of note, these SBT exercises took place after a standard staff orientation and a "scavenger hunt" of the new workspace, typical standard techniques to familiarize workers to a new workspace. Thus, these improvements demonstrate that in situ SBT for new workspaces contributes unique value to clinical workers above