Using Simulation to Improve Systems

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KEYWORDS

• Simulation • Systems • Surgery • Six Sigma • Team STEPPS

KEY POINTS

- Simulation technology provides an important opportunity to prospectively identify systemic problems with minimal risk to patient safety and quality.
- Health care systems are implementing simulation-based exercises on a more regular basis, especially in high-risk settings such as the emergency department and operating room.
- The adoption of simulation-based and other system-oriented improvement strategies by the health care industry, especially regarding quality and safety, was preceded by its development in the manufacturing and aviation sectors.

INTRODUCTION

> *"Simulated disorder postulates perfect discipline; simulated fear postulates courage; simulated weakness postulates strength."*
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> —*Sun Tzu, The Art of War*[1]

The notion that a simulated action, whether routine or rare, can improve the eventual real performance of that action has existed since the ancient Chinese strategist and philosopher, Sun Tzu,[1] applied it to warfare. What makes this idea transcendent for its time, and relevant to surgical safety, is its application beyond the idea that practice makes perfect and into the simulation of adverse circumstances (disorder, fear, weakness) wherein a person may confront adverse contingencies with no real consequence. Thus, when such adversities arise, they might be met with paradoxic discipline, courage, and strength, respectively, thanks to learning and experience empowered by simulation.

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Although Sun Tzu's[1] simulation was largely a mental one, the technological advances of the last several decades have enabled tangible implementation of this 2500-year-old idea. Its application to health care systems, particularly surgical systems, is best considered in light of simulation's sentinel adoption in other fields. Two decades after the introduction of Resusci-Anne for cardiopulmonary resuscitation in the 1960s, health care simulation entered the modern age with the development among anesthesiology departments of simulation-based systems training clinical management and teamwork.[2] Other early work addressed patient throughput following emergent and nonemergent admissions.[3] Correctly using simulation now requires it to be designed to answer particular questions about the system; common points of review are listed in **Box 1**.

When applied to improving system performance, simulations provide a venue for the combined practice of technical skills, decision making, communication, and leadership. In addition, team-based simulation affords instantaneous feedback and self-reflection among complementary individuals. Challenges to existing systems can thus be more quickly identified and improved, and the adoption of new systems can be streamlined.

This article reviews the evolution of simulation as a safety measure in the aviation industry, the process of team building and streamlining production that has gained popularity in industry and manufacturing, and the adoption of these measures into health care systems, particularly surgery.

QUALITY IMPROVEMENT THROUGH SIMULATION

The last several decades have seen a profound reemphasis on the quality of care and safety within the health care industry, driven by changing market forces and government policy as much as internal forces. Health care is not unique in this regard, because other industries have used the practice of self-reflection for the sake of error reduction. A notable example is the development of the Six Sigma program by Motorola in which tolerance limits for defective products were set very high in order to limit defects to 3.4 events per million observable units (ie, a rate at 6 standard deviations from the mean). Motorola and others, notably General Electric, achieved considerable success simply by setting standards higher for quality. Some have advocated for the adoption of this policy within other industries,[4] including medicine. However, medical error rates are currently at levels that would represent a serious deterioration in the performance of other high-reliability industries. Applying this concept to medicine carries the dilemma of comparing apples with oranges. At a defect rate of 20%, for

Box 1
Target issues in applying simulation to health care systems

Patient safety focus points

Continuity of safety and quality throughout patient experience

Simultaneous demands for patient safety and worker safety, efficiency, environmental sustainability, and disaster contingencies

Adopting new medical devices, technology, and facility designs before their implementation?

Checkout procedures to ensure clinician proficiency with new systems

Diagnostic performance and patient throughput

Stressful situations and decision making that mirror those of a clinical setting