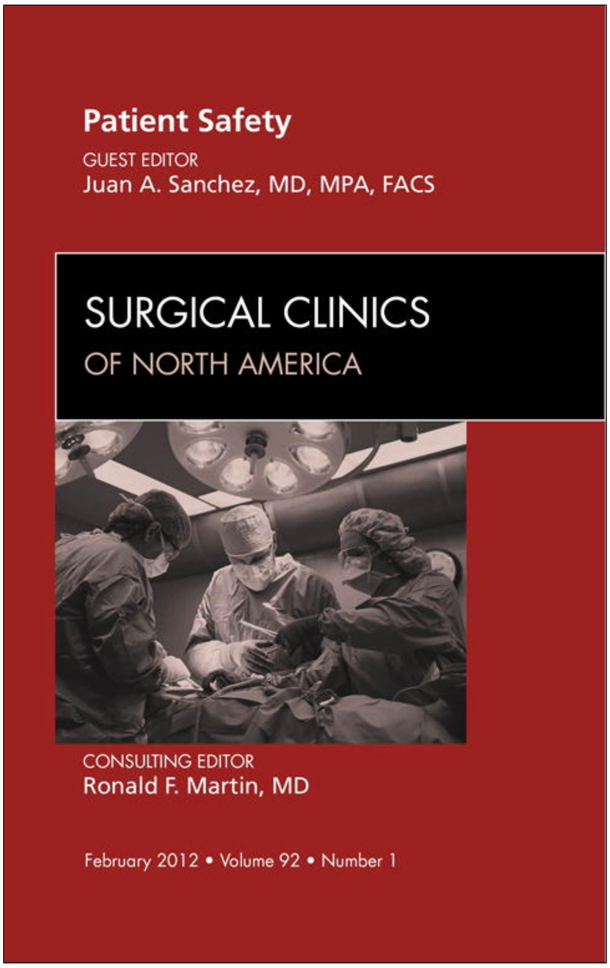
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High Reliability Organizations and Surgical Microsystems: Re-engineering Surgical Care

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KEYWORDS

• High reliability • Clinical microsystems • Teams • Patient safety • Safe culture • Normal accident theory

I would not give a fig for the simplicity this side of complexity, but I would give my life for the simplicity on the other side of complexity.

—Oliver Wendell Holmes Jr[1]

THE HIGH RELIABILITY ORGANIZATION

The surgical space, by its nature, is a high-risk environment where hazards lurk around every corner and for every patient. The patients who come to surgery are generally among the sickest and at more advanced stages of disease. The very act of treatment involves interventions that are often considerably invasive with vigorous and unpredictable physiologic responses. The level of complexity, both in task-oriented and cognitive demands, results in a dynamic, unforgiving environment that can magnify the consequences of even small lapses and errors.

Other complex sociotechnical systems, which operate in similar environments, have been able to redesign their operations such that they consistently perform at high levels of safety with reliable outcomes. These high reliability organizations (HROs) have characteristics that parallel many features of the surgical environment, including the use of complex technologies, a fast-paced tempo of operations, and a high level of risk, yet they manifest spectacularly low error rates. HROs are required to respond to a wide variety of situations under changing environmental conditions in a reliable and

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consistent way. Examples of HROs include aircraft carriers, nuclear power plants, and firefighting teams. Weick and Sutcliffe have studied these industries and found that they share an extraordinary capacity to discover and manage unexpected events resulting in exceptional safety and consistent levels of performance despite a fast-changing external environment.[2]

Resilience, Brittleness, and the Law of Stretched Systems

A challenge to HROs is the tendency to stretch systems to their capacity as they continuously strive to improve overall performance. It is the objective of an outstanding management team to enhance efficiency such that throughput is maximized for a given level of input. When financial outcomes are also under consideration, there is a corresponding downward pressure to minimize costs and, therefore, to limit resources and still achieve the desired outcomes in volume and quality. This Law of Stretched Systems, a property of complex and dynamic environments, occurs when exceptionally consistent improvement in performance is required and managed through human decision making without accounting for the possibility of errors and unanticipated variability.[3] This principle posits that every system is ultimately stretched to operate at its capacity as efficiency improves. Innovations such as new information technologies, and performance gains are exploited to achieve a new intensity, complexity of work, and tempo of activity. This coadaptive dynamic results in escalating pressure to do more, faster, and in more complex ways.[4] Health care delivery systems are thought to routinely function at the limits of their capacity. Managers and administrators tend to increase throughput up to efficiency maxima only to be thwarted by unanticipated operational constraints. Surgeons and anesthesiologists are all too familiar with the common bed crunch occurring each morning and the potential for delaying or even canceling scheduled operations.

The ability of a team to activate a repertoire of actions and resources not normally used during standard operations to allow the work to continue through unexpectedly high demand or a failure can build resiliency into a system. This *margin of maneuver,* a concept that resonates with pilots and others in high-hazard environments, provides a cushion for an organization to recover toward normal operational levels. When all ICU beds are occupied in a hospital with a level I trauma program, for example, the system has little or no margin to accept a new major trauma patient. The organization is said to be solid, a condition that reflects its *brittleness*, a manifestation of a stretched system.

The ideas supporting the concept of HROs are germane to the surgical environment. The pace of operations, expectations of superior levels of performance and safety, and the degree of uncertainty in surgery require a systems-based approach. Additionally, high-hazard, safety-critical organizations can reach levels of complexity that result in failure due to data overload, hitting a wall of complexity. The concept of *resilience*, a term borrowed from materials engineering, refers to the properties of a system that allow it to absorb unusual amounts of stress without causing a failure, or a crack, in the integral function of the organization.[5] Two major themes emerge from the examination of HROs.[6] The first theme is anticipation, a state of mindfulness throughout the entire organization in which continuous vigilance for potential sources of harm is expected and practiced as a shared value. This state of mind focuses on preparedness for any and all process failures, surveillance for formal and informal signals, and planning contingencies. The second idea is containment and refers to those actions to be taken immediately when a system fails to advert or mitigate further damage and injury.

HROs Share 5 Key Principles

Preoccupation with failure
HROs treat each event, lapse, or near miss (NM) as a symptom of a system flaw that can have severe consequences, particularly when separate, seemingly insignificant events or violations coincide and produce a catastrophic failure. This is consistent with the human errors framework proposed by James Reason and his Swiss cheese model of accident causation.[7] This preoccupation with failure is coupled with the understanding that small violations and errors are not part of normal process variation and can conspire to cause patient harm.[8] It is difficult, for example, to view a break in the sterile field or a lack of closed loop communication during an operation as a major adverse event in the context of a complex surgical procedure. Yet these unsafe acts can contribute to a catastrophic outcome when combined with other violations and errors until a tipping point is reached. It is easy, alternatively, to develop complacency and a false sense of security when the incidence of patient harm is rare and thus continue to allow deviant behavior to go unchecked.[9] The high reliability culture responds vigorously to potential failures (NMs) and views them as gifts or opportunities to address system failures.

In the surgical realm, this concept is best illustrated by the practice of a preoperative checklist that enables a state of mindfulness before embarking on a high hazard undertaking, such as a surgical procedure.[10] A more complete approach is the practice of a preoperative briefing in which a discussion occurs among members of a team regarding what problems may arise during a particular case. At the completion of the operation, a debriefing is also of value not only for determining what could have been done differently but also for discussing the planned transition toward the next phase of a patient's care. The debriefing is meant to create a reflective pause to specifically anticipate what could potentially go wrong given what has transpired up to this point. It is this collective, persistent, and watchful search for potential hazards, particularly at transition points and during periods of high technical and cognitive overload, that characterizes a high reliability surgical microsystem.[11]

Reluctance to simplify
Complex systems like a surgical environment can be unpredictable and highly nuanced. Yet, when routines set in, safe and event-free operations can lead to cutting corners, reducing resources, and eliminating key steps as waste. Simple algorithms and heuristic rules are alluring but may not take into account the nonlinear requirements of judgments, anticipation, and insights needed for excellent surgical care. This tendency seems to be amplified during times of stressed operations. A reluctance to simplify, alternatively, contributes to an enhanced understanding, especially by management, that the environment is complex, unstable, and unpredictable. A systems approach to verifying sponge and instrument count requires, for example, at minimum, a 2-person independent check and takes into account that a simple process that relies on a single person without redundancy is fraught with the possibility of error in preventing retained foreign objects.

Sensitivity to operations
HROs are highly sensitive to small deviations and interruptions in operations and allocate undivided attention to the relevant tasks affected. Unexpected events uncover loopholes in a system's defense barriers. Continuous interactivity and robust information sharing in tightly coupled systems occurs to ensure that all members of a team have a big picture view of operations. Complacency in a routine environment is a threat to maintaining sensitivity to operations. Suboptimal information sharing and a lack of

awareness of other operational functions reduce redundancy and result in poor coordination. Systems are organized around the idea of creating and maintaining situational awareness by an entire team. There is an emphasis on having access to the most current and accurate information available and using it quickly in decision making particularly when unexpected deviations are detected.

Committed to resilience

The development of capabilities to recover from a failure and to contain its effects is an important characteristic of HROs. In tightly coupled systems, this resilience allows organizations to keep errors small when they occur. Hospital units exhibit resilience when they can identify and respond to smaller system failures quickly before problems escalate into significant events. To accomplish this goal they must be prepared to improvise quickly and to respond rapidly to unplanned events using preplanned routines. The inability to recover from small lapses results in brittleness, a sort of organizational failure to rescue.

Deference to expertise

Organizational units encourage decisions to be made at the front line and yield decision making to those individuals with the most expertise to fix the problem, regardless of rank. These HRO systems have developed a culture where managers and executives support the concept of deferring judgments and actions to those with the most immediately relevant knowledge and skill set. This entrusting characteristic builds immense social capital, which helps build a more honest and transparent relationship between management and clinicians.[12,13]

The hierarchical group models commonly found in health care settings contain dynamics that insist on deference given to rank and educational level among various members of the health care team. This distribution of roles, although useful during normal operations, can often be a barrier to critical decision making and information exchange during times of duress and system failure. This is not to say that coordination and other leadership tasks should not be preserved by senior leaders during these periods. In the presence of a perceived threat or an unexplained variation, however, lower ranking members of a surgical team should be able to express their concern without the risk of being subjected to ridicule or shame. Mature leaders recognize the advantage of this approach and promote relationships within teams during normal operations that allow those with the most accurate information and relevant roles to act decisively and quickly to resolve a problem. The absence of psychological safety among any member of a team can suppress potentially critical information in identifying and mitigating a threat. Edmondson[14] studied learning in interdisciplinary teams and the adoption of new technology in cardiac surgical teams, and demonstrated that the most successful teams were those with leaders who promoted speaking up as well as other coordination behaviors. Furthermore, in this study, the most effective leaders helped their teams learn by minimizing concerns about power and status differences to promote speaking up by all team members.

The relationships among the individual components of a system are critical, particularly during a catastrophic event. The robustness, resiliency, and redundancy in the physical or workflow design of these interdependencies refers to their coupling. A major distinction between high reliability theory and normal accident theory (NAT) pertains to ideas regarding the coupling between system components (**Table 1**).[15] NAT holds that accidents in complex, tightly coupled technologic systems are inevitable. Errors and failures escalate rapidly throughout a system's interdependent components.[16] Tightly coupled processes have little or no slack in this relationship.

Table 1
Comparison of the High Reliability Organizational theory and the theory of normal accidents

High Reliability Theory	Normal Accidents Theory
Accidents can be prevented through good organizational design and management.	Accidents are inevitable in complex and tightly coupled systems.
Safety is the priority organizational objective.	Safety is one of several competing values.
Redundancy enhances safety: duplication and overlap can make a reliable system out of unreliable parts.	Redundancy often causes accidents; it increases interactive complexity and opaqueness and encourages risk taking.
Decentralized decision making is needed to permit prompt and flexible field-level responses to surprises.	Organizational contradiction: decentralization is needed for complexity, but centralization is needed for tightly coupled systems.
A culture of reliability enhances safety by encouraging uniform and appropriate responses by field-level operators.	A military model of intense discipline, socialization, and isolation is incompatible with [American] democratic values.
Continuous operations, training, and simulations can create and maintain high reliability operations.	Organizations cannot train for unimagined, highly dangerous, or politically unpalatable operations.
Trial-and-error learning from accidents can be effective and can be supplemented by anticipation and simulations.	Denial of responsibility, faulty reporting, and reconstruction of history cripples learning efforts.

From Sagan SD. The limits of safety. Organizations, accidents, and nuclear weapons. Princeton (NJ): Princeton University Press; 1993. © 1993, 1995 paperback edition. *Reprinted by* permission of Princeton University Press.

As an example, the transfer of a patient from an operating room to a postanesthesia care unit is a tightly coupled process requiring a just-in-time framework of service delivery.[17] Incongruities in the magnitude, duration, and intensity of information exchange at this transition point, as reflected in postoperative orders or incomplete handoff practices, can result in critical informational gaps, creating blind spots and other opportunities for failure later in the patient journey.[18]

Highly coupled organizations value the learning opportunities provided by a continuous cascade of unsafe acts, NMs, and even full-blown adverse events because the same etiologic patterns and relationships precede both adverse events and NMs.[19,20] Only the presence or absence of recovery mechanisms determines the actual outcome. It could be argued that focusing on NM data can add significantly more value to quality improvement than a sole focus on adverse events. Schemes for reporting NMs, close calls, or sentinel (ie, warning) events have been institutionalized in aviation, nuclear power, petrochemicals, steel production, and military operations.[21,22] In health care, efforts are being made to create medical NM incident reporting systems to supplement the limited data available through mandatory reporting systems focused on preventable deaths and serious injuries.[23]

In contrast to adverse outcomes, the analysis of NMs offers several advantages: (1) NMs occur 3 to 300 times more frequently than adverse events, enabling quantitative analysis; (2) fewer barriers to data collection exist, allowing analysis of interrelationships of small failures; (3) recovery strategies can be studied to enhance proactive interventions and de-emphasize the culture of blame; (4) hindsight bias, the human tendency to see events that have already occurred as more predictable than they really were, is more effectively reduced[24]; and (5) NMs offer powerful reminders of system hazards and retard the process of forgetting to be afraid.

TEAMWORK AND HIGH RELIABILITY ORGANIZATIONS

Much of health care is performed by interdisciplinary teams—individuals with diversely specialized skills focused on a common task in a defined period of time and space (see the article by Harry C. Sax elsewhere in this issue for further exploration of this topic). These teams must respond flexibly together to contingencies and share responsibility for outcomes. This is particularly true of surgical care. Traditional specialty-centric clinical education and training are remiss in their assumption that individuals acquire adequate competencies in teamwork passively without any formal training. Moreover, the assessment practices used in selecting health care personnel do not explore the abilities of potential hires to work collaboratively or in a multidisciplinary fashion. Furthermore, performance incentives in health care are targeted at individuals and not at teams or other functional groups. With a few exceptions, risk management and liability data, morbidity and mortality conferences, and even quality improvement projects have not systematically addressed systems factors or teamwork issues. Substantial evidence suggests that teams routinely outperform individuals and are required to succeed in today's complex work arenas where information and resources are widely distributed, technology is becoming more complicated, and workload is increasing.[25,26] Nevertheless, an understanding of how medical teams contribute to HRO-like success and coordinate in real-life situations, especially during time-constrained and crises situations, remains incomplete.[27]

Surgical Teams

Teams make fewer mistakes than do individuals, especially when each team member knows his or her responsibilities as well as those of the other team members. Simply bringing individuals together to perform a specified task, however, does not automatically ensure that they will function as a team. Surgical teamwork depends on a willingness of clinicians from diverse backgrounds to cooperate toward a shared goal, to communicate, to work together effectively, and to improve. Each team member must be able to (1) anticipate the needs of the others, (2) adjust to each other's actions and to the changing environment, (3) monitor each other's activities and distribute workload dynamically, and (4) have a shared understanding of accepted processes and how events and actions should proceed.[28]

Surgical teams outperform individuals especially when performance requires multiple diverse skills, time constraints, judgment, and experience. Teams with clear goals and effective communication strategies can adjust to new information with speed and effectiveness to enhance real-time problem solving. Individual behaviors change more readily on a team because team identity is less threatened by change than individuals are. Behavioral attributes of effective teamwork, including enhanced interpersonal skills, learned as a byproduct of membership on the team, can extend to other clinical arenas. Cardiac surgical and trauma teams, among many other teams, often manifest some of these behaviors without being aware of them. Turning surgical care experts into expert surgical teams requires substantial planning and practice. There is a natural resistance to moving beyond individual roles and accountability to a team mindset. This commitment can be facilitated by (1) fostering a shared awareness of each member's tasks and role in the team through cross-training and other team training modalities; (2) training members in specific teamwork skills, such as communication, situation awareness, leadership, follower-ship, resource allocation, and adaptability; (3) conducting team training in simulated scenarios with a focus on both team behaviors and technical skills; (4) training surgical team leaders in the necessary leadership competencies to build and maintain effective teams; and (5) establishing and consistently using reliable methods of team performance evaluation and rapid feedback.[29]

Evaluating Team Performance

Assessing surgical team dynamics is a prerequisite to improving performance and increasing patient safety (**Box 1**). There is a persistent argument in the literature that team process and outcomes must be distinguished. Process is defined as the activities, strategies, responses, and behaviors used by a team during task accomplishment, whereas outcomes refer to those clinical outcomes of the patients cared for by the team.[30] Process measures are important for training when the purpose of measurement is to diagnose performance problems and to provide feedback to trainees. Until recently, the medical community has focused more on outcomes than on process. Medical educators have begun to appreciate the competencies that define an effective team process.[31] The key to clinical alignment is to identify and measure processes that are directly related to patient outcomes (eg, successful resuscitation). Measurement tools must be reliable and valid, and they must distinguish between individual and team-level deficiencies (**Table 2**).[32–34] Perhaps most importantly, the results of the assessment must be translatable into specific feedback to team members that can help enhance their team performance.[35]

CLINICAL MICROSYSTEMS

Several models of care delivery have emerged as health care institutions face challenges in providing safe, reliable, and effective health care in a complex regulatory and financially burdened environment.[36] Many organizations have struggled to design operational units that can best incorporate reliable and service-oriented performance into their daily work. Microsystems, based on work of intelligent enterprises by Quinn[37] applies systems thinking to organizational design and represent the smallest replicable organizational unit of change. Quinn studied companies that achieved consistent growth, high quality, and high margins as well as exceptional reputations with their customers. He found that these smallest replicable units were the key to implementing effective strategy, leveraging information technology, and embedding

Box 1
Questions to ask when assessing a surgical team's performance

- Is the team the right size and composition?
- Are there adequate levels of complementary skills?
- Is there a shared goal for the team?
- Does everyone understand the team goals?
- Has a set of performance goals been agreed on?
- Do the team members hold one another accountable for the group's results?
- Are there shared protocols and performance ground rules?
- Is there mutual respect and trust between team members?
- Do team members communicate effectively?
- Do team members know and appreciate each other's roles and responsibilities?
- When one team member is absent or not able to perform the assigned tasks, are other team members able to pitch in or help appropriately?

Table 2
Individual and team-level training strategies

	Definition	Level
Assertiveness Training	Uses behavioral modeling techniques to demonstrate both assertive and nonassertive behaviors; provides multiple practice and feedback opportunities for trainees	Individual
Metacognitive Training	Targets trainee's executive monitoring and self-regulatory cognitive processes for development; training develops metacognitive skills that regulate cognitive abilities, such as inductive and deductive reasoning	Individual
Stress Exposure Training	Provides information regarding links between stressors, trainee affect, and performance; provides coping strategies to help trainees deal with stressors	Individual and team

Data from Refs.[32–34]

other performance-enhancing practices into the service delivery process. Health care microsystems consist of a small group of people who provide care to a defined set of patients and for a particular purpose, such as a surgical ICU (**Table 3**). They have both clinical and business aims, tightly coupled processes, and a shared information environment. Clinical, service, and financial outcomes are measured systematically and with a view toward continuous improvement.

Real-time collection, analysis, and sharing of information are key features of these groups that generally function within a larger organization providing a clear financial, regulatory, and legal framework. A microsystem's developmental journey toward maturation and improved performance entails 5 stages of growth (**Box 2**).[38] The role of senior leaders in a microsystem is to look for ways in which the meso-organization, working within the macro-organization's legal and regulatory framework, connects with and facilitates the work of the microsystem. The meso-organization, in turn, supports the needs and facilitates coordination among varying microsystems to accomplish the organization's overarching goals. The clinical microsystem approach emphasizes identifying and promoting the strengths of both the team and individuals. It maintains a focus on continuous improvement rather than externally imposed targets and initiatives that members think do not directly have an impact on their work. Many organizations using this approach have demonstrated high levels of staff

Table 3
The 5 essential goals (5 Ps) of the microsystem

5 Ps	What are the Implications for Effective Microsystem Functioning?
Purpose	What is the purpose of the clinical microsystem and how does that purpose fit within the overall vision?
Patients	Who are the people served by the microsystem?
Professionals	Who are the staff who work together in the microsystem?
Processes	What are the care-giving and support processes the microsystem uses to provide care and services?
Patterns	What are the patterns that characterize microsystem functioning?

From Barach P, Johnson JK. Understanding the complexity of redesigning care around clinical microsystem. Qual Saf Health Care 2006;15(Suppl 1);10–6; with permission.

Box 2
Clinical microsystems: 5 stages of growth

- Awareness as an interdependent group with the capacity to make changes
- Connecting routine daily work to the high purpose of benefiting patients
- Responding successfully to strategic challenges
- Measuring performance as a system
- Juggling improvements while taking care of patients

Data from Batalden PB, Nelson EC, Edwards WH, et al. Microsystems in health care: part 9. Developing small clinical units to attain peak performance. Jt Comm J Qual Saf 2003; 29(11):575–85.

satisfaction, an enhanced level of empowerment, and increased commitment toward established goals as well as a passion for continuous learning and innovation.[39]

In addition, the microsystem incorporates the experience and perceptions of patients and their families in the strategic development to deliver the most desirable service from the point of view of the end user.[40] A surgical microsystem can involve, for example, a pediatric cardiac surgical team that includes the corresponding critical care team, wards, or perhaps a large surgical critical care unit providing services in a defined geographic space.[41,42] The microsystem will include patients and their family members given that there is a convergence of purpose in a patient's full recovery.

Microsystems and Patient Safety

Safety is a fundamental property of the microsystem. It can only be achieved through thoughtful and systematic application of a broad array of process, equipment, organization, supervision, training, simulation, and teamwork changes. Characteristics of high-performing microsystems—leadership, organizational support, staff focus, education and training, interdependence, patient focus, community and market focus, performance results, process improvement, and information and information technology—can be linked to specific design concepts and actions to enhance patient safety in microsystems.[43]

Leadership and Patient Safety

Leaders directly contribute to the performance of microsystems. The role of senior leadership within an organization changes in scope and focus and is more externally focused provided that each microsystem in an organization has a tight alignment with the overall mission and vision of the organization.[36] The result is that each microsystem possesses the flexibility to achieve its specific performance goals while ensuring the safety and reliability of the care it provides. This strategy allows for the creation of each unit's climate of safety. Previous work in the field of organizational behavior, highlighted by the Michigan Keystone ICU Project to reduce central line infections, have demonstrated that positive deviance is well at work at the unit level, and that unit-based culture can have an impact on those other microsystems with which they interface.[44] Equally important, Dixon Woods and colleagues[45] have demonstrated that the checklist's key impact was to shape a culture of commitment by leadership and clinicians to doing better in practice around reducing central line infections as the major driver for success.

RECOMMENDATIONS AND 6 PRINCIPLES FOR DESIGNING SAFE SURGICAL MICROSYSTEMS

Based on the authors' experience with multiple microsystems across diverse settings and with an understanding and interpretation of the safety literature, several safety principles that can be used as a framework for embedding patient safety concepts within clinical surgical microsystems are discussed.[46]

Principle 1—Errors are Human Nature and will Happen Because Humans are not Infallible

Errors are not synonymous with negligence. Medicine's ethos of infallibility leads wrongly to a culture that sees mistakes as an individual problem or weakness and remedies them with blame and punishment instead of looking for the multiple contributing factors that can only be solved by improving systems.

Principle 2—the Microsystem is the Optimal Unit of Intervention, Analysis, and Training

Microsystem staff can be trained to include safety principles in their daily work through rehearsing scenarios, simulation, and role-playing. The goal is for a microsystem to behave like a robust HRO, that is, preoccupied with the possibility for failure or chronic unease about safety breaches.

Principle 3—Design Systems to Identify, Prevent, Absorb, and Mitigate Errors

Identify errors by establishing effective sustainable reporting systems that encourage and support transparency, freedom from punitive actions, and empowering workers to feel comfortable speaking up, even if speaking up means that they challenge the authority gradient. Design work, technology, and work practices to uncover, mitigate, or attenuate the consequences of error. There are many ways to reduce the impact of errors by simplifying systems and processes. For example, tools, such as checklists, flow sheets, and ticklers, to reduce reliance on memory all address deficiencies in vigilance and memory. Improve access to information and information technology. Systems must be designed to absorb a certain amount of error without harm to patients. Key buffers might include time lapses (built-in delays, when appropriate, to verify information before proceeding), redundancy, force functions, and so forth.

Principle 4—Create a Culture of Safety

A safety culture is one that recognizes that the cornerstone to making health care safer is a transparent climate that supports reporting errors, NMs, and adverse events; feeds this information back quickly and clearly to clinicians; and holds clinicians accountable for their actions (**Box 3**).[47]

Principle 5—Talk to and Listen to Patients

Patients have much to say about surgical safety and how they can add to the resilience of a system. Embrace and celebrate storytelling by patients and clinicians—that is where safety is made and breached and much learning occurs. When a patient is harmed by health care, all details of the event pertaining to the patient should be disclosed with the patient and/or the family (see the article by Eaves-Leanos and Dunn elsewhere in this issue for further exploration of this topic). Elements of disclosure include[48]:

- A prompt and compassionate explanation of what is understood about what happened and the probable effects

Box 3
Characteristics of safety-focused teams

- Ongoing organizational learning
- Transparency in discussing errors
- Respect for the value and response to NMs
- Supporting communication among team members
- Members function as part of a team
- Culture that supports questioning the leader or more senior team members
- Prioritizing task demands
- Aligning occupational cultures
- Establishing and maintaining clear roles and goals
- Experienced team members
- Adequate number of dedicated surgical team members
- Establishing and maintaining consistent supportive organizational infrastructure
- Leaders with the right stuff
- Peer-to-peer assessment tools

Data from Barach P, Weinger M. Trauma team performance. In: Wilson WC, Grande CM, Hoyt DB, editors. Trauma: emergency resuscitation and perioperative anesthesia management, vol. 1. New York: Marcel Dekker; 2007. p. 101–13. ISBN: 10-0-8247-2916-6.

- Assurance that a full analysis will take place to reduce the likelihood of a similar event happening to another patient
- Follow-up based on the analysis and an apology to the patient and family

Principle 6—Integrate Practices from Human Factors Engineering into Surgical Microsystem Functioning

Design patient-centered health care environments that are based on human factors principles and constraints; design for human cognitive failings and the impact of performance-shaping factors—fatigue, poor lighting, noisy settings, and so forth.

SUMMARY

This article explores the applicability of high reliability and microsystems theories to the surgical environment. Safety is a fundamental property of both. It might be argued that improving safety in surgical systems does not require an entire restructuring of organizations and workflow; however, despite intense attention to this subject over the past decade, incremental improvement in safety has not been forthcoming with the existing models of care. Moreover, current systems have failed to address the patients' overall needs.

Health care institutions continue to face challenges in providing safe patient care in increasingly complex and demanding technical, organizational, and regulatory environments. Both high reliability theory and clinical microsystems provide conceptual and practical frameworks for approaching the delivery of safe care. Although many ambiguities and conflicts arise from the implementation of these theoretic constructs, they should guide the development of work processes and stimulate innovation in designing ways to provide safe and effective care within health care systems.

Organizing surgical care around the pursuit of safety as an overarching priority is a professional obligation for all members of the health care team. This goal can be accomplished by organizing around and shaping a culture focused on reliable performance but requires substantial investments in human capital. Readily accessible communication and information sharing are essential components for creating high reliability. A clinical microsystem concept involving surgical personnel can be an effective vehicle for achieving these goals.

Facilitating the design of systems to identify, prevent, absorb, and mitigate errors can provide remarkable opportunities for improving safety. The authors think these concepts are complementary and can be synergistic. Each can embed safety into surgical processes, not as an add-on value but as an integral element. Incorporating these broad concepts provides an ideal framework for capturing opportunities to improve surgical care. It is in this context that movement toward safer care can take place.

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