Looking Forward—Infection Prevention in 2017

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Health care is often compared with the aviation industry because errors in each of these industries can lead to serious harm or death. Both industries are invested in improving safety; however, the commercial air travel industry has been more successful at improving safety and reducing the annual death rate than the health care industry.[1] We can argue that health care is more complex and has more moving people and parts; however, it is increasingly difficult to defend our quality of care outcomes when evidence-based practices are not implemented uniformly and some commonly used practices remain unreliable.[2]

Most infection prevention practices designed to prevent negative outcomes, such as surgical site infections (SSIs), are evidence based. Perioperative nurses know how to prevent infections; however, these critical practices are often not performed in a standardized and consistent manner across all health care settings. High reliability organizations (HROs) have consistent systems in place to achieve and maintain high levels of safety.[3] The airline and nuclear power industries are examples of industries that are highly reliable under hazardous conditions.[1] Personnel at HROs look for and report unsafe conditions and accomplish their goals consistently to avoid catastrophic outcomes. These organizations rarely have significant accidents because personnel perform careful analyses of errors and near misses and create safety protocols to reduce the risk of future accidents.[1] They do not tolerate or perpetuate safety processes that are successful only 40% of the time, as one systematic review of 96 studies found when assessing health care workers' hand hygiene practices.[4]

Weick and Sutcliffe[3] identified five traits that lead to successful HROs: sensitivity to operations, reluctance to oversimplify problems, preoccupation with failure, commitment to resilience, and deference to expertise. Table 1 provides examples of actions that personnel at a successful HRO may take to achieve these traits. As perioperative personnel work toward our goal of preventing health care–associated infections in surgical patients, there is much to learn from these HRO characteristics.

IMPROVING PERIOPERATIVE COMMUNICATION

In 2014, The Joint Commission ranked ineffective communication as one of the top three causes of reported sentinel events.[5] Health care providers who are highly skilled in technical tasks may not be naturally gifted communicators. A variety of communication styles coupled with the challenges of working in a highly complex, stressful, and rapidly paced environment can result in inconsistent practices, near misses, and potentially a sentinel event.

Health care leaders who are seeking to hardwire high reliability behaviors at their facilities should focus on ensuring that staff members have situational awareness, openly speak up with concerns, and report deviations from expected performance. TeamSTEPPS (Team Strategies and Tools to Enhance Performance and Patient Safety)[6] provides a comprehensive approach to improving communication and is one way to foster high reliability behaviors. This program consists of tools and techniques to support a sustainable and transparent culture of communication with the ultimate goal of optimizing patient outcomes. Tibbs and Moss[7] demonstrated that proper team training, standardized protocols, and algorithms used in TeamSTEPPS can improve surgical optimization, communication, and work relationships.

Medical Team Training (MTT) is a program that facilitates structured communication in the OR. It is based on crew resource management, a theory used in the aviation industry. In an MTT program, personnel are trained to work together

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Table 1. Five Traits of High Reliability Organizations[1]

Trait	Action
Sensitivity to operations	• Speak up with concerns • Report deviations from expected performance • Make no assumptions
Reluctance to oversimplify problems	• Dig deeply to identify the real source of a problem • Question explanations that may seem reasonable or obvious
Preoccupation with failure	• Be alert to the smallest signal that a new threat may be developing • Report and explore reasons for near misses
Commitment to resilience	• Be relentless • Respond to failures and constantly seek new solutions
Deference to expertise	• Experience does not always translate to expertise • Have a mechanism in place to identify the people with the greatest expertise relevant to managing a new situation • Place the decision-making authority in the hands of experts • Do not assume the person with the most seniority, title, or rank is the best person to handle the problem

Reference

1. *Weick KE, Sutcliffe KM.* Managing the Unexpected: Sustained Performance in a Complex World. *3rd ed. Hoboken, NJ: John Wiley & Sons, Inc; 2015.*

to perform briefings and debriefings and are taught to challenge each other when safety issues arise.[8] A study by Young-Xu et al[8] found a 15% reduction in surgical morbidity across 42 facilities that adopted an MTT program. In addition, the rate of deep wound infections decreased at these facilities from 9 per 1,000 operations to 6 ($P = .02$), and all infections decreased from 26 per 1,000 operations to 19 ($P = .004$). Wolf et al[9] found that the appropriate use of prophylactic antibiotics significantly improved from 85% (n = 4,863) to 97% ($P < .0001$) after the implementation of MTT. These studies demonstrate that improving OR team communication can be an important step toward decreasing surgical infections.

SKIN DECOLONIZATION

Despite general agreement that a chlorhexidine gluconate bath or shower can reduce bacterial colonization of the skin, data suggesting that this practice reduces SSIs are limited.[10] A 2015 Cochrane review appraised seven clinical trials and suggested that existing evidence does not justify promotion of chlorhexidine gluconate preoperative showering.[11] A recent meta-analysis evaluated 16 clinical trials involving 9,980 patients and found that whole-body bathing with chlorhexidine showed no benefit in preventing SSIs.[12] A key flaw of some of the reviewed studies was the lack of a standardized practice for the preoperative shower. Patients were often not monitored for adherence and were not provided written or adequate instructions in several cases. Edmiston et al[10] conducted a study to evaluate the effect of providing patients with a standardized process of dose, duration, and timing to maximize the antiseptic skin surface concentrations of chlorhexidine gluconate applied during preoperative showering and found that this resulted in concentrations of chlorhexidine sufficient to kill surgical wound pathogens. Although evidence supports the practice of preoperative patient bathing because the benefits outweigh the risks, the evidence regarding the products and practices that are the most effective at reducing microbial flora and SSIs is conflicting.[13]

In another study, Edmiston et al[14] examined the effect of an electronic patient alert system on patient compliance with the prescribed preadmission protocol. Alerts were effective in enhancing patient compliance with a preadmission showering protocol, resulting in an increase ($P < .007$) in skin surface concentration of chlorhexidine gluconate compared with the nonalerted controls.[14] The researchers also analyzed the volumes of returned or unused chlorhexidine gluconate, revealing a wide variation in the volume of biocide used by both groups. Electronic alerts may be one solution to the problem of ensuring that preoperative bathing occurs appropriately.

High reliability organizations are sensitive to operations, which means health care professionals must pay close attention to practices and be aware of what is or is not working. Health care professionals should not assume that patients have access to a shower or even a bathtub. Instructions with clear

directions for application technique, contact time, frequency, and warnings are ideally listed on a step-by-step decolonization patient checklist that provides dates and checkboxes for the patient to indicate the activity was performed. This type of document is an example of being preoccupied with failure, another characteristic of HROs, because it will highlight small inefficiencies and major failures.

TRAFFIC CONTROL

Traffic in and out of the surgical suite during surgical procedures varies widely. The negative effects of OR traffic include air flow disruptions, distraction, and reduced productivity and can contribute to SSIs.[15,16] One study identified that unnecessary door openings accounted for 32% of OR traffic flow.[17] Another reported that the most frequent reason given for OR traffic was information requests.[18] A recent study of foot traffic during total joint arthroplasty revealed that doors opened for no identifiable reason 47% of the time out of 9,813 occurrences.[19]

Personnel at HROs are reluctant to accept simple explanations for problems. Future studies should dig deeply into data to identify process improvements. Examples of potential approaches to reduce traffic include intercom systems, real-time video monitoring systems, glass windows, mobile phones, storage of frequently used supplies inside the room, pass-through windows, door signs, and automatic door counters.[20] Casual traffic control in surgical suites reflects a weakness in sensitivity to operations and provides an opportunity to improve awareness of how processes and systems affect an organization.

ENHANCED ENVIRONMENTAL DISINFECTION

Surfaces in hospitals have been the focus of increasing attention as potential sources for acquisition and spread of pathogens among hospitalized patients. Bacteria such as methicillin-resistant *Staphylococcus aureus*, vancomycin-resistant enterococci, and *Acinetobacter* species may persist on environmental surfaces for days or weeks.[21-23] *Clostridium difficile* spores can persist on environmental surfaces for up to five months.[22] The organism's ability to survive in the environment has been connected to transmission, particularly when a patient is admitted to a room from which a patient colonized or infected with these organisms was recently discharged.[24,25]

Studies have shown that the routine cleaning and disinfection of the surgical environment may not be consistently adequate or effective. In one study that evaluated the thoroughness of manual terminal cleaning practices, on average, only 25% (n = 946) of targeted surfaces in 71 ORs had been properly cleaned.[26] Munoz-Price et al[27] found that approximately 15% of objects (n = 427) in 35 ORs that were cultured for pathogens after terminal cleaning were positive for pathogens, including *Pseudomonas* species, *S aureus* (45% of the 11 isolates were methicillin resistant), *Enterococcus* species, and *Acinetobacter* species.

The effectiveness of cleaning OR surfaces and equipment depends heavily on the technique and thoroughness of the individual who is performing the task. Efficacy requires reinforcement, education, performance feedback, and persistent monitoring. Carling et al[28] found that the thoroughness of surface environmental cleaning in intensive care units improved significantly from 49.5% (n = 1,748) to 82% after establishing performance expectations and re-educating environmental cleaning staff members. The OR environment presents a unique challenge because the pressure to turn over ORs after a surgical procedure may result in substandard cleaning if environmental service staff members are not afforded adequate time to disinfect the room and equipment. The recognition of the inadequacies of manual cleaning and disinfection of the surgical environment has led to interest in automated surface decontamination systems. These systems are intended to complement, not replace, the manual disinfection of environmental surfaces and equipment in hospitals.

Currently, several automated surface decontamination systems are commercially available. Researchers are studying the effectiveness of automated systems such as ultraviolet-C, pulsed xenon ultraviolet, and hydrogen peroxide vapor, and research has suggested that the technologies may be effective.[29-31] Much of the current research focuses on inpatient hospital rooms, however, rather than ORs. Additional research needs to be performed regarding the efficacy of these methods in the unique perioperative setting (ie, effect on sterile supplies; heating, ventilation, air conditioning systems; practicality of use during OR turnovers). When evaluating whether to use these technologies in the OR, facility leaders must consider key factors such as the cycle time, the distance the ultraviolet light travels, and the effect on staff members needed to perform the process. Ideally, the product should provide the highest level of organism destruction in the shortest period of time and with the least amount of disruption to process flow. The technology also must be easily accessible and user friendly. Cost is an important piece of the device evaluation, and the return on investment must be measured to justify the cost associated with the purchase, maintenance, and operation of the device.

A key characteristic of HROs is to defer to expertise. It is critical that we listen to the experts who are knowledgeable

about the task that is assigned to them. Input from environmental service staff members who are responsible for not only cleaning and disinfecting surgical suites but who also are pressured to perform their tasks in the shortest amount of time is critical and respectful of their expertise.

CONCLUSION

Infection prevention strategies must remain focused on hardwiring characteristics and behaviors that produce high reliability. Standardization of SSI prevention practices depends on a culture of safety that promotes sensitivity to operations and effective communication. Despite all best efforts and previous safety successes, errors will occur and safety will be threatened. The hallmark of an HRO is not that it is error free but that errors do not disable it.

Editor's note: *TeamSTEPPS is a registered trademark of the US Department of Defense, Falls Church, VA, and the US Department of Health and Human Services, Bethesda, MD.*

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