Teamwork and Communication Skills in Cardiothoracic Surgery

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Teamwork and communication skills are essential for the safe practice of cardiothoracic surgery. In this article, we will summarize the literature on teamwork and the culture of safety, and discuss how surgeons may directly improve the outcomes of their patients by addressing these factors.

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Cockpit Culture

In a 2008 interview with *Fortune* magazine, Malcolm Gladwell discussed a phenomenon known as "cockpit culture" [1]. He stated, "Korean Air had more plane crashes than almost any other airline in the world for a period at the end of the 1990s. When we think of airline crashes, we think, Oh, they must have had old planes. They must have had badly trained pilots. No. What they were struggling with was a cultural legacy, that Korean culture is hierarchical. You are obliged to be deferential toward your elders and superiors in a way that would be unimaginable in the U.S."

As in aviation, errors in the field of cardiothoracic surgery may lead to significant injury and death. In addition, errors in cardiothoracic surgery are often attributed to breakdowns in communication and ineffective teamwork. As in the aviation field, equipment failure and technical errors are rarely the sole cause of poor outcomes. Increasingly, the association between leadership, communication skills, and surgical outcomes have been demonstrated. In this review, we summarize the literature on teamwork and the culture of safety, and discuss how surgeons may directly improve the outcomes of their patients by addressing these factors.

Culture of Safety

The importance of developing and maintaining a "culture of safety" is common to all high-risk industries, including commercial aviation, the military, and health care. This concept is based on studies of organizations that "consistently minimize adverse events despite carrying out intrinsically complex and hazardous work" [2]. Common to these organizations is an emphasis on open communication, a commitment to safety, and fostering an atmosphere in which "near-misses" can be analyzed in a blame-free environment to prevent catastrophic failures [3].

It is important to contrast that with an alternative model that may be familiar to cardiothoracic surgeons: that errors are unacceptable, that the surgeon is solely responsible for the outcome of his or her patient, and that a discussion of patient safety by anyone other than the senior surgeon is discouraged or discounted. That is not to suggest that the surgeon is not concerned with patient safety in this model. What should be emphasized is the concept that safety, whether measured in an operating room, a military unit, or a nuclear power plant, is not dependent on perfect, error-free performance by a single person. Rather, reducing error and improving safety requires a culture in which error is acknowledged, and the mechanisms by which errors occur are openly discussed by all members of the team with the intention of reducing their prevalence. Using survey data, a strong correlation between patient safety climate and patient safety has been established [4–6].

Just Culture

The mandate for surgeons to take personal responsibility for the care of their patients is a core value of our profession [7]. Consequently, a "blame-free environment…without reprimand" may not always be consistent with the ethos of surgical training and practice [3]. Surgeons place extraordinary value on work ethic and personal accountability, and expect the same from colleagues and trainees. Therefore, it is fair to ask whether the culture of safety paradigm is relevant to surgical practice, and can be accepted as valid by practicing surgeons. Health care providers should also note that other industries with an emphasis on safety have mechanisms for punitive measures, if necessary. For example, the airline industry would not allow a pilot who willfully disregards safety checklists to continue to fly.

The concept of a "just culture" was described to address these limitations. In this construct, accountability is balanced with the need to openly acknowledge and address errors. This was initially described by David

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Marx in his study of the airline industry, and applied to health care in 2001 [8]. In this model, three patterns of behavior are addressed [9]. So-called human error may be likened to a system error, in which prevention can be affected by changes in processes, training, or device design. In contrast, a person may participate in at-risk behavior. An example may be a physician who does not consistently participate in the timeout checklist, believing that it is not time efficient. That may be managed by outlining incentives or disincentives to promote appropriate behavior. Finally, Marx acknowledged reckless behavior. Here, a person willfully disregards guidelines or accepted safety practices. A physician who consciously and repeatedly refuses to go to the bedside to examine critically ill patients, and instead manages the problem from a distance, would be a relevant example. In this instance, punitive or remedial measures would be appropriate and expected.

In a just culture, punishment of human errors is counterproductive [10]. Punishment of those who commit human errors would have two unintended consequences: (1) individual punishment does not allow others in the organization to learn from, and potentially prevent, a similar error in the future; and (2) the threat of punishment will be a disincentive for many to come forward and acknowledge an error, or potentially worse, acknowledge a near-miss. However, individual accountability is also important, and persons who repeatedly engage in such behavior should face appropriate consequences [11].

For surgeons in particular, the premise of a just culture may find resonance. Unintended errors, such as a technical error in the operating room, may be remediated by further training. However, for the same error repeated by a surgeon who disregards training and remediation, it should not be assumed that he or she is practicing in a blame-free environment.

Hallmarks of a Safe Surgeon

Explicit in models of safety is the understanding that errors are not entirely preventable, and that no person is immune from potential error. When applied to surgical practice, the correlate is that a safe surgeon is not one who never makes mistakes, but rather one who identifies potential problems and works to mitigate their effect. As stated by Philip Custer, "The physician must recognize that she or he is susceptible to the same missteps usually ascribed to others. It also may require shedding the mantle of infallibility that some physicians acquire over time. An assumption or presumption of safety puts patients in harm's way because it blinds one to unanticipated risks" [12].

A safe surgeon is, therefore, one who is able and willing to acknowledge his or her own errors, whether in private or in public, in a continuing effort to improve patient outcomes. The role model in cardiothoracic surgery for this behavior is Mark de Leval, a congenital surgeon from the United Kingdom. In 1994, Dr de Leval published his experience with the arterial switch operation [13]. Notably, the analysis focused on the cluster of high mortality that was observed in the mid portion of the series. In response to this, Dr de Leval described his process of retraining. That involved visiting other institutions and adopting "best practices" that he observed. After retraining, the mortality rate was significantly reduced.

However, the work of Dr de Leval would be misinterpreted to suggest that retraining was a purely technical endeavor. He also identified systems factors, such as communication barriers between members of the operating team, that had a direct impact on mortality rates. This pioneering work led to large body of subsequent research on the intersection of human factors and congenital heart surgery [14, 15]. As will be discussed, this research highlights the importance of nontechnical skills that are critical to the safe conduct of complex cardiothoracic procedures.

Nontechnical Skills

Analyses of surgical malpractice claims reinforce the impact that nontechnical skills have on adverse events. For example, the American College of Surgeons undertook a review of 460 closed claims malpractice suits involving general surgeons, the results of which were published in 2008 [16]. The seminal finding of this study was that 78% of claims involved "failures in practice patterns of behavior." These included failure of communication, failure to properly pursue and diagnose a postoperative complication, and failure to properly enlist the aid of consultants. In this study, the most common behavioral failure was inadequate communication with patients and their families. Notably, only 50% of cases involved a technical error. In another study of the same closed claims database, the investigators concluded that deficiencies in care provided outside the operating room accounted for the majority of malpractice claims [17]. Further studies have confirmed the importance of communication failures in the genesis of adverse events [18, 19].

As a result of this research, efforts to improve surgical safety have focused on these nontechnical skills. These endeavors are similar to strategies accepted in the aviation, nuclear power, and oil exploration industries, and fall under the umbrella term "crew resource management" (CRM) [20, 21]. Notably, similar CRM programs have been utilized for decades in anesthesia training programs [22]. A key component of CRM programs, which has been difficult to translate to surgery, is the validation of "behavioral marker systems." Such systems are used to train and evaluate personnel, require accepted and validated terminology, and must be specifically developed for the field in question [23].

Notably, one such behavioral marker system has been developed and validated for surgeons. The Non-Technical Skills for Surgeons (NOTSS) system was developed by a multidisciplinary group including surgeons, anesthetists, and psychologists from the United Kingdom [24]. This system was constructed using cognitive interviews of attending surgeons, and validated using

video review of simulated surgical procedures [25, 26]. The taxonomy of this system includes four categories of skills, with three elements within each category (Table 1). The NOTSS system has been utilized by the Royal College of Surgeons in Edinburgh, adopted by the Royal Australasian College of Surgeons as part of their competence assessment, and recommended by the Accreditation Council for General Medical Education for workplace assessment [27]. Introductory videos for trainees are also available, in which specific examples of these skills are presented [28].

Leadership and Teamwork in the Operating Room

Communication and teamwork is a crucial component of a surgeon's skill set. Not surprisingly, the leadership style of the attending surgeon will have a significant impact on the function of the entire operating room team. As surgical team behavior has a direct impact on patient outcomes, exploring leadership styles has become an important aspect of surgical safety research [29, 30].

As noted by Hu and colleagues [28] in a seminal paper on leadership styles: "Surgeons clearly value leadership. During the past few years, the American College of Surgeons has dedicated several Bulletins to surgical leadership, stating, 'It is the surgeon's responsibility to lead the team. Basic principles of leadership transcend the OR and are important in all aspects of a surgeon's professional life' " [28]. However, the type of leadership displayed, and what differentiates an effective from an ineffective surgeon leader, have not been as well studied.

In the Hu study [28], five complex oncologic procedures were video recorded and subsequently transcribed and reviewed by both surgeons and organizational psychologists using a variety of instruments including a multifactor leadership questionnaire. Surgeons were rated on independent leadership scales, specifically "transactional" and "transformative" styles. A transactional leader will focus on assigning individual tasks, responsibility, and blame, whereas a transformational leader will emphasize fostering an environment of enthusiasm, cooperation, and collective mission. It is important to note that these styles are not mutually exclusive; a person may exhibit both styles when appropriate.

Table 1. Taxonomy of Nontechnical Skills for Surgeons

Category	Element
Situational awareness	Gathering information
	Understanding information
	Projecting and anticipating future state
Decision making	Considering options
	Selecting and communicating options
	Implementing and reviewing decisions
Communication and teamwork	Exchanging information
	Establishing a shared understanding
	Coordinating a team
Leadership	Setting and maintaining standards
	Supporting others
	Coping with pressure

Reproduced from Yule, et al. Surgeons' non-technical skills in the operating room: reliability testing of the NOTSS behavior rating system. World J Surg 2008;32:548–56, with permission of Springer.

In this study, surgeons with a low transformational rating were observed to speak clearly and directly to members of the operating team, but often with a focus of blame and unilateral communication. For example, a surgeon might blame an anesthesiologist for ordering blood to be available when that was required by the hospital protocol. In contrast, surgeons with a high transformational rating were adept at generating enthusiasm for the procedure. For instance:

Surgeon: "You know what we're looking at? We are looking at the vessels, just sitting underneath us."

Anesthesia attending: "It's beautiful."

Medical student: "Yeah, it's cruising right along."

The key point is that this leadership style is not tangential to the conduct of the operation. Effective surgeons can be task oriented and also foster an environment of cooperation and teamwork. As expected, a higher level of teamwork and information-sharing were observed when the surgeon scored higher on the transformational leadership scale.

This observation has direct relevance to cardiac procedures, in which multiple specialties must work together. In a noteworthy study from the Harvard Business School published in 2003, researchers interviewed 16 cardiac surgical teams who were in the process of adopting minimally invasive cardiac procedures [31]. A strong correlation was found between the leadership style of the surgeon and a willingness for other members of the operating room to speak up. Teams in which members were willing to speak more freely were led by surgeons who "minimized power status rather than endorsed them" [32]. Crucially, the successful adoption of the minimally invasive approach was directly linked to surgeons' behaviors and leadership styles. This observation is even more relevant today, as cardiac surgeons are challenged to work within multidisciplinary teams to safely adopt new technology, such as transcatheter aortic valve replacement and endovascular stent grafting.

Communication Outside the Operating Room

Surgeons implicitly understand that care of a surgical patient mandates conscientious decision making in the preoperative and postoperative period, as well as technical skill and teamwork in the operating room. However, transitions of care from one phase to another represent a high-risk period for a communication breakdown. That may be a direct cause of patient harm, and has been well documented in studies of adverse surgical events.

As an example, researchers specifically examined 60 malpractice claims in which communication errors were believed to be the primary cause of harm to the patient [23]. These errors were evenly distributed through the preoperative, intraoperative, and postoperative periods. Importantly, 43% of communication breakdowns

occurred with handoffs and 39% with transfers in the patient's location. Common failures of communication involved residents failing to notify attending surgeons of critical events, and also improper transfer of information during handoffs from one attending physician to another. The researchers recommended common-sense interventions, including (1) read-back protocols for hand-offs, and (2) trigger events to mandate attending surgeon notification.

In a subsequent study by the same group, residents and patients were randomly interviewed on weekends to understand communication patterns on four academic surgical services [33]. The results placed the challenges of communication in an academic medical center in stark relief. Nearly a third of critical events were not communicated to attending physicians, and when queried, residents thought that attending physician communication was not necessary for safe patient care in 76% of these events. However, attending physicians would have directly altered the care of their patients in 33% of these cases. The onus should not be entirely placed in the hands of the trainees, however. The researchers also noted that 58% of patients were not seen by their attending physician over the weekend, and 21% were not visited for two or more days. An important point made by the researchers was that the culture of a specific service had a strong impact on communication patterns. Interviews with trainees suggested that frequent communication with faculty was, in fact, discouraged on certain services.

Operating room to intensive care unit handoffs are a particularly vulnerable area for communication breakdown, with a clear risk for direct patient harm. That is especially the case for cardiothoracic surgical patients, for whom a detailed understanding of events in the operating room is mandatory for appropriate intensive care unit care. As one would expect, the frequency of miscommunication and subsequent errors in this context has been well documented [34].

In these studies on communication, the emphasis was on developing and maintaining a culture of open communication. Although that is also relevant for intensive care unit transitions, studies of best practices have focused on the use of handoff templates developed by multidisciplinary teams, and often make extensive use of computerized and other technologic aids. Randomized studies in both pediatric and adult cardiac intensive care units have demonstrated that improvements in communication can be achieved with a standardized protocol [35, 36]. In another study of handoffs in a pediatric cardiovascular intensive care unit, use of a standardized protocol was associated with a significant reduction in ventilator time as well as in unplanned extubations [37].

Interventions to Improve Communication, Teamwork, and Patient Outcomes

Many of the studies on surgical safety and communication are descriptive: specific behavior patterns are associated with specific outcomes, whether those are primary endpoints (the incidence of adverse events) or secondary (for example, changes in information sharing). However, it should be noted that specific interventions have been described that aim to change the safety culture at the institutional level, and potentially improve patient safety.

For example, a training program for health care organizations—Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS)—has been created by the Department of Defense and the Agency for Healthcare Research and Quality to improve the quality, safety, and efficiency of health care [38]. TeamSTEPPS uses a team training curriculum that focuses on four core competencies: leadership, situational monitoring, mutual support, and communication. After implementation of TeamSTEPPS, a decrease in retained foreign body counts as well as wrong-site surgery have been reported [39]. In the intensive care unit, the TeamSTEPPS program was associated with increased monitoring of antibiotics and invasive catheters [40].

A similar multidisciplinary program was reported from 74 Veterans Health Administration facilities [41]. The intervention focused on operating room teams, and used techniques from aviation CRM programs to improve communication and conduct standardized postoperative debriefings. The training included a 2-month preparation period, a 1-day conference, and 1 year of quarterly follow-up interviews. The investigators reported a 50% reduction in risk-adjusted mortality in the centers that participated in the training compared with centers who had not yet undergone the program. Interestingly, sites with the most quarterly coaching reviews continued to decrease their mortality rate, suggesting that ongoing review and education was valuable. Other benefits such as improved operating room efficiency and first case start times were also reported by participating institutions.

A final high-yield intervention is "multisource feedback," more commonly known as the 360-degree review. In this model, feedback from medical colleagues, consultants, patients, and trainees as well as self-evaluations are collected. Multisource feedback has been demonstrated in a number of studies to have a positive effect on clinical practice and to improve communication skills and teamwork [42–44].

Conclusion

The demands on cardiothoracic surgeons are significant. An increasingly older patient population, public reporting of outcomes, and the ever-changing landscape of technologic advancements add pressure to an already demanding field. Nonetheless, cardiothoracic surgeons should continue to assume a leadership role in patient safety, both at a national level and within their own institution. Minimizing adverse events to our patients requires more than technical excellence. A focus must be on cultivating a just culture, in which both accountability and an openness to discuss errors are necessary. While improving technical skills, we must also refine our nontechnical skills, including situational awareness, decision-making, teamwork, and leadership.

In his Presidential Address to the American Association of Thoracic Surgeons in 1999, Dr Cohn addressed the topic of "What the cardiothoracic surgeon of the twenty-first century ought to be" [45]. He discussed several important characteristics: technical excellence, a knowledge of physiology, emerging technology, and the history of our specialty. A key characteristic emphasized by Dr Cohn was humanism. The cardiothoracic surgeon of the 21st century should demonstrate compassion, introspection, and a collaborative spirit. The years since this address have witnessed an explosion in the science of patient safety [46]. Although our understanding of patient safety has improved dramatically, the core values required of surgeons to lead these efforts were clearly outlined nearly 20 years ago.

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