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PATIENT SAFETY IN ANESTHESIA (A BARBEITO, SECTION EDITOR)

# Teamwork, Safety, and Non-Technical Skills

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**Abstract** Communication and team dynamics have been widely accepted as pillars of safety in the operating room setting and beyond, yet institutions still struggle with establishing a culture of safety that promotes these skills. Team training programs, prompted conversations embedded within workflows, and cognitive aids such as checklists can enhance communication and promote these non-technical skills. In this review, we describe the importance of non-technical skills in preventing patient harm and provide an overview of team training programs and checklists as methods to enhance patient safety.

**Keywords** Teamwork · Team dynamics · Communication · Checklists · Non-technical skills · Safety · Operating room · Performance · Team training · Team scoring · Simulation · Culture · Perceptions · Outcomes · Quality · Training program · Multidisciplinary · Skills · Strategies · Prevention · Medical errors · Assessment · Scoring · TeamSTEPPS

## Introduction

There are now more than four decades of literature on adverse events in medicine, but it is only in the past two decades that using these results to guide quality improvements and research efforts has been actively appreciated. The first large scale study of iatrogenesis was performed in the early 1970s, when the California Medical Association reviewed nearly 21,000 hospital admissions in the states of Colorado and Utah and found that the adverse event rate in medicine occurred 4.6% of the time [1]. In 1991, the Harvard Medical Practice Study analyzed 30,000 admission hospital records in the state of New York and found the adverse event incidence rate to be 3.7% [2, 3]. In both of these studies, over half of the adverse events resulted from medical errors that were preventable, and over half to 2/3 of these events were attributable to surgical care alone, stressing the importance of targeting and improving team dynamics in the operating room [4, 5].

In 1999, the Institute Of Medicine published the first public report on medical error in its manuscript, To Err is Human [6]. This raised public awareness about performance and quality outcomes in medicine. The authors estimated that among the over 33.6 million admissions to US hospitals in 1997, at least 44,000 to 98,000 deaths were due to medical errors, with communication failures identified as the leading cause of preventable medical errors. Two years later, the Center for Disease Control and Prevention (CDC) published that in 1997, medical errors were the eighth leading cause of death, which was more than motor vehicle accidents, breast cancer, or AIDS. The total national costs including lost income, lost household production, disability, and health care costs of preventable medical errors resulting in injury were estimated to be between 17 and 29 billion dollars. A recent report suggests that medical errors are now the third leading cause of death in the USA [7••].

These and other studies instigated a swing in focus away from medical malpractice examinations *after* events occur, to studying how to prevent occurrences of adverse events in the first place. Government task forces were assembled to tackle these issues. The US Department of Health and Human Services (HHS) and other federal agencies formed the

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Quality Interagency Coordination Task Force and issued a plan for reducing medical errors. In 2001, former HHS Secretary Tommy Thompson announced the creation of a Patient Safety Task Force to coordinate a joint effort to improve data collection on patient safety. The lead agencies on this task force are the Food and Drug Administration (FDA), the CDC, Centers for Medicare and Medicaid services (CMS), and the Agency for Healthcare Research and Quality (AHRQ).

Technological advancements and efforts towards targeted quality improvement have evolved harmoniously with each other to produce advances for surgical techniques and anesthetic practices that have greatly reduced the morbidity and mortality of even complex operations. Yet, despite this evolution of expertise, patients still experience preventable harm, and much of this harm comes from distractions and suboptimal team dynamics, rather than technical shortcomings or failures. Strategies such as checklists and team training programs are therefore valuable in minimizing or even eliminating preventable mistakes.

## Team Training Programs

There is a well-established body of literature that supports the use of team-based training programs and systems to improve medical outcomes. Although team dynamics and communication are recognized as vital components to safe patient care, few studies confirm the use of team-based systems to achieve this in the perioperative arena. Most of this information was first identified and published in the realms of business, aviation, and the military. There are different training programs available, and even culturally hierarchical and once rigid team environments such as those commonly seen in the operative setting are now understanding the need for improving communication and team dynamics to improve patient safety [8–13].

The Veterans Health Administration (VHA) implemented a formalized medical team training program for operating room personnel on a national level. The program entailed the implementation of briefings, debriefings, and checklists in the operating room. Team training activities consisted of teaching over 2 months, a 1-day in-person conference, and four quarterly coaching interviews. Data was retrospectively obtained from the VHA surgical quality improvement project (VASQIP) from 2006 to 2008 and represented 182,409 procedures from 108 VHA facilities. Seventy-four facilities exposed to the team training program were compared to 34 facilities that had not undergone training. The risk-adjusted surgical mortality rate was 50% less in the trained group than in the untrained group. Interestingly, there seemed to be a dose-response relationship, with a reduction of 0.5 deaths per 1000 procedures for each subsequent quarter following the intervention ($p = 0.001$). This large and well-designed study provides strong evidence for the effectiveness of a multifaceted intervention consisting of medical team training, ongoing coaching, and checklists to trigger operating room briefings and debriefings. Moreover, this study demonstrated that patient safety studies can be robustly designed and adequately powered to detect changes in mortality. The investigators used a multiple time-series design with concurrent control, accounted for selection bias using propensity score matching and included an elegant dose-response analysis [14].

One widely used team training program with government funding is Team Strategies and Tools to Enhance Performance and Patient Safety, or TeamSTEPPS® (TS) [15, 16•, 17–20]. This evidence-based teamwork program, developed by the Department of Defense and the Agency for Healthcare Research and Quality (AHRQ) in 2006, is aimed at optimizing patient care by improving communication and teamwork skills among health care professionals. The program is based on over 20 years of research on team building and quality outcomes from the military, aviation, nuclear power, business, and medicine and is organized into four core competencies: team leadership, situational monitoring, mutual support, and communication. The TS mascot is a penguin from the book *Our Iceberg is Melting* [21], which metaphorically describes an eight-step change management strategy that teaches how complex organizations can face and solve challenges as a team. The book became popular in the business world and earned media headlines. This is important to recognize because the educational content in any training program alone will not make the program successful. Team training programs must be accompanied by a formal and dedicated rollout, continued coaching, and leadership support in order to be successful.

Several successful interventions using TS have been described in the literature. For example, one study showing team training success was described in an obstetrics department in Boston that saw a 47% decrease in adverse outcomes for preterm infants and a 50% reduction in malpractice claims over the subsequent 3 years following the implementation of TS [22]. A study in Nebraska rolled out TS over 2 months to all operating room staff including operating room technicians, nurses, anesthesiologists and nurse anesthetists, surgeons, and medical residents. A before and after team training comparison was associated with improvement in first case start times and Surgical Care Improvement Project (SCIP)-defined process measures related to deep vein thrombosis prophylaxis, beta blocker administration, and antibiotic administration. Most importantly, the investigators found statistically significant improvements in morbidity and surgical mortality. As is common with many quality initiatives, the investigators also describe worsening results after 1 year of training, which suggests the need for sustainability plans and continuous reinforcement [23].

While there is no ideal training program or methodology, several—including those referenced in this manuscript—have been described in detail. Institutions have taken portions of training programs they found most relevant to their environments and launched in piecemeal. It is important to note that inadequate implementation has been recognized as a barrier to success given the challenges with implementing comprehensive team training programs such as TS [24].

The active perception that teamwork is linked to outcomes is becoming more mainstream. A group in Denmark interviewed 21 participants from four different thoracic surgery centers. Respondents viewed a shared mental model, planning and preparation, and understanding the status of current resources as an important part of patient safety [25]. These perceptions are not always consistent across disciplines, and an understanding of the different perspectives of all team members is important to establishing proficient team dynamics. For example, a safety culture study found that surgery-attending physicians perceived their safety climate to be strong, but nurses and surgical technicians perceived significantly worse safety climates. A review of disruptive behavior found that fewer than 10% of clinicians display disruptive behavior; however, up to 98% of clinicians report witnessing disruptive behavior, and 36% report being bullied. The authors describe the importance of looking at one's own performance and recognizing self-responsibility and respecting the perceptions of others as a start to better understanding unconscious biases and improving team dynamics [26].

## Surgical Safety Checklists

Safety checklists work by reducing communication failures and promoting collaborative team dynamics. Implementation of these communication tools has been shown to reduce mortality and surgical complications [27]. A commonly used one is the Surgical Safety Checklist (SCC), which was widely promoted by the World Health Organization starting in 2008. Many variations of this checklist exist, as institutions and service lines have modified the document to meet their specific needs.

The World Health Organization's (WHO) checklist study, performed as part of the WHO's Safe Surgery Saves Lives campaign, was conducted between 2007 and 2008 at eight hospitals in eight cities across the world including Toronto, Canada; Auckland, New Zealand; London, England; and Seattle, Washington in the USA. Data from 3733 consecutively enrolled patients undergoing non-cardiac surgery was prospectively collected before implementation of the checklist and compared to 3955 consecutively enrolled patients following the introduction of the surgical safety checklist. They found statistically significant reductions in in-hospital death (up to 30 days) ($p = 0.003$), inpatient complications ($p < 0.001$), surgical site infection, and return to operating room following the introduction of the checklist. Subsequent studies have validated the potential for improving patient safety using checklists [28].

A 13-month prospective study looking at outcomes before and after implementation of a surgical briefing checklist focused on communication failures (late, inaccurate, unresolved, or exclusive communication) as the outcome. The number of communication failures per procedure declined following the intervention ($p < .001$). Practitioners identified that 34% of the briefings demonstrated utility specifically around identification of problems, resolution of critical knowledge gaps, decision-making, and follow-up actions. More importantly, the number of communication failures that was associated with at least one visible negative consequence declined by 64% [29].

There are several other examples of improved patient safety in the perioperative period associated with the use of checklists to improve patient care. For instance, a prospective cohort study in a 16-bed surgical oncology intensive care unit where investigators implemented a "daily goals" sheet found that the number of residents and nurses who understood the goals of patient care increased from 10 to 95%, and the average ICU length of stay decreased from 2.2 to 1.1 days following the intervention [30]. More recently, the use of the WHO trauma checklist in 11 centers showed improvements in several process measures including the chance of having an abdominal examination, chest auscultation, and distal pulse examination [31•].

The use of a checklist was found in one study to be perceived positively by patients during awake cesarean sections [32], but the existence of a checklist in and of itself is not sufficient to produce outcome improvements. Although checklists provide a structured conversation within the workflow and can prompt discussions about important information, they are only successful if providers engage in these safety conversations properly. One single center report described a negative result after revising their surgical safety checklist and measuring post-intervention performance of the checklists as well as safety climate. The investigators identified an insufficiently structured rollout and inefficient implementation as the likely reasons for the ineffectiveness of the intervention. Adequate implementation of a surgical safety checklist is resource intensive and includes coaches, audits, and continued feedback. Any study that reports 100% compliance with a checklist should be looked upon with caution, because the proper use of a checklist requires active engagement, relevant conversation, and participation of the necessary team players rather than merely "checking the boxes" [33–35].

## Measuring and Improving Non-technical Skills

Recognizing the importance of teamwork and communication skills suggests the need for a metric to assess the status and

progress of practitioner performance for these skills. The Anesthetists' Non-Technical Skills system, the Ottawa Global Rating Scale, the Trauma Management Skills scoring system, the non-technical skills assessment, and the Crisis Resource Management checklist may be used to evaluate teamwork, leadership, situation awareness, and other behaviors that contribute to safe and efficient task performance. These tools are typically used to evaluate trainees during simulated scenarios. Team training and non-technical skills assessment tools should be incorporated into resident training in order to establish the importance of their application early on in a physician's career [36].

Simulation has traditionally been used to help trainees acquire technical skills, but it can also be used to successfully teach team building [37–40]. The ability to simulate an operating room environment provides opportunities to practice non-technical skills under supervision. For example, trainees may serve in the role of an operating room manager, which may help them improve non-technical and leadership skills [41]. Additionally, senior members of departments can serve as role models for junior attendings and trainees to emphasize the importance of non-technical skills [42]. One investigation used a multidisciplinary operating room simulation program implemented nationally throughout New Zealand to tech team training. The intervention showed long-lasting effects on reported attitudes and behaviors in clinical practice, reflecting improved communication and teamwork [43].

Non-technical skills are being recognized by all stakeholders as important targets for quality improvement interventions. For example, payers have partnered with hospitals to develop programs that include team training for their staff. An example of such partnership is the Federation of Jewish Philanthropists (FOJP) corporation in New York City, which partnered with Mount Sinai Medical Center to develop safety conversations and team training [44]. The Massachusetts-based insurance company CRICO collaborated with four Harvard-affiliated hospitals to develop a team training curriculum and surgical safety checklist initiative [45].

## Summary and Conclusions

Reducing medical error has become the cornerstone of modern healthcare. Hospitals are motivated by their responsibility to prevent patient harm, more transparency with publically reported data, and reimbursements tied to quality outcomes. Failures of communication and team-based dynamics play a crucial role in preventing medical errors. Thus, we must realign our thinking to dedicate teaching and resources to develop providers' non-technical skills in addition to knowledge and technical expertise. Team training and checklists, when properly implemented, have been shown to improve important outcomes such as mortality and major morbidity. As hospitals and safety organizations strive to find innovative ways to promote a culture of safety, each hospital's climate requires structured solutions that fit the workflow and culture of its environment. Thus, hospitals must explore the different available options and choose those tools that would be most effective in their own situations as we move forward towards reducing preventable error in medicine.

**Compliance with Ethical Standards**

**Conflict of Interest** Amanda J. Rhee declares that she has no conflict of interest.

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- • Of importance
- •• Of major importance


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