DISSERTATION

HEARTS AND MINDS IN THE OPERATING ROOM:
CO-CONSTRUCTING A SHARED MENTAL MODEL WITH SURGERY TEAMS FOR MORE PREDICTABLE AND MORE HIGHLY RELIABLE COLLABORATIVE VOICE AND RESPONSE

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ABSTRACT

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FOR MORE PREDICTABLE AND MORE HIGHLY RELIABLE
COLLABORATIVE VOICE AND RESPONSE

Overview: This qualitative case study explored nontechnical human factors—values, beliefs, attitudes, and behaviors—that make it easier or more difficult for surgeons, as team leaders, to encourage team members to voice safety concerns, clinical opinions, and learning questions; for team members to actually speak up; and for surgeons to respond collaboratively.

Research site and participants: The research site was a major academic hospital in the western United States. Five surgeons and five anesthesiologists volunteered to participate. Perioperative nurses and surgical technologists were recruited but did not participate.

Purpose, methodology, and methods: The purpose of the study was to co-construct, with participants, a shared mental model for collaborative voice and response. The study followed the constructivist inquiry paradigm and methodology, which posits that individuals and groups construct, co-construct, and can reconstruct their social realities. Using adaptive work theory and methods, semi-structured interviews were used to gather data on what values, beliefs, attitudes, and behaviors participants perceived to be essential versus expendable for more collaborative, predictable, and highly reliable voice and response. Thematic content analysis identified six themes, from which a proposed shared mental model was constructed by the researcher. Member checking with participants confirmed that the themes accurately represented their perspectives; that the proposed shared mental model comprehensively reflected the themes; and that, used in practice, the shared mental model could help collaborative voice and response be more predictable and more highly reliable.

Results: Themes were *let's be best-in-class; respect and be kind to all; value patient safety and well-being of all team members; explicitly encourage and appreciate voice; do speak up*; and *am I really that approachable?* The proposed shared mental model constructed from the themes was represented by the mnemonic *REVAT*, the first letters of each component: *Respect and be kind to all, Encourage voice, Voice* (do speak up), *Appreciate voice, and Thrive* (all of us). The study also identified two subthemes—*hierarchical abuses of power* and *production pressures or time pressures*—that hinder collaborative voice and response and should also be understood and well-managed, so that patient safety and clinician well-being are less at risk.

Conclusion: Well-being is essential for clinicians' own sakes, for patient safety, and for clinical performance and outcomes. REVAT, the proposed shared mental model for collaborative voice and response, is simply stated as "respect, encourage, voice, appreciate, and thrive." As such, it is a "simple rule," much like "first do no harm," that could help caregivers better succeed in their goals and thrive.

Key words and phrases: collaborative, voice, speak up, shared mental model, patient safety, clinician well-being, complex adaptive systems, high reliability, safety culture, safety climate, physician approachability, hierarchy, hierarchical, abuse of power, production pressure, time pressure

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DEDICATION

To Laura and John

With love to my wonderful daughter and son, and for all you are and all you will become.

Healers, helpers, builders, and explorers, in life and in all the good you do.

You continue to inspire me, in all that matters most.

And Basia

With love also to my wonderful friend, like family, with me on this journey.

Adding life to our years, and years to our lives.

I could not have done it without you.

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CHAPTER 1: INTRODUCTION

This qualitative case study, with interviews of surgery team participants at a leading academic hospital, explored nontechnical human factors—values, attitudes, beliefs, and behaviors—that make it easier or more difficult for surgeons to first encourage team members to voice or "speak up" with safety concerns, opinions, and learning questions; for team members to then actually speak up; and for surgeons to then respond collaboratively and effectively. The purpose of the study was to co-construct, with surgery team participants, a shared mental model for more predictable and more reliable *collaborative voice and response,* that may contribute to improved clinical outcomes, patient safety, and clinician well-being, which are mutually influencing (Institute of Medicine, 2000; National Academy of Medicine, 2019). Stakeholders included patients, families, surgery team members themselves, and hospital leaders.

"The need for speaking up is pervasive in healthcare" (Weller & Long, 2019, p. 710). Effective communications by teams about internal safety risks, external threats, and human errors is a safety net for all concerned (O'Keefe et al., 2022; Sasou & Reason, 1999). And yet, for caregivers, "errors and the burden of errors" (Bognár et al., 2008, p. 1374) are compounded by the "perceived powerlessness of team members to prevent [harmful] safety events… [indicating] the need to address teamwork culture" (p. 1381).

It is a complex issue, with multiple interacting and overlapping organization culture factors and human factors that surround highly complex, complicated, and hazardous surgery. Organization culture factors include historic hierarchical barriers between and within healthcare disciplines, production pressures that can impact patient safety and clinician well-being, and the presence or absence of psychological safety that influence team communications (Edmondson, 2019; Hoyt & Ko, 2017; Morrison, 2014; Okuyama et al., 2014). Related human factors include varied and sometimes unpredictable surgeon leadership styles; plus individual and group

values, beliefs, attitudes, and behaviors, including team interactions and relationships (Hauenstein, 1998; Heifetz, 1994; Keebler et al., 2022; Salas et al., 2005).

The research site was an academic (teaching and research) hospital that is nationally recognized for patient safety and quality of care. It has enlightened and progressive leaders, high national rankings in medical specialties, and exceptional physicians, nurses, and surgical technologists. A former chief nursing officer at the hospital recommended this study topic, and the current chief nursing officer was a primary gatekeeper and major supporter of the study. The hospital has been awarded Magnet hospital designation four consecutive times, a rare distinction; meeting gold standard criteria of nursing excellence to attract and retain top nurses. The study recognized that some surgeons and team members at this hospital already may consistently practice collaborative voice and response, while others may experience suboptimal variations.

Medical care in general, and surgery in particular, are among the most challenging, complex, and honorable of all human endeavors, and they are profoundly personal for patients, families, clinicians, and hospital leaders. Hazardous technologies and procedures bring life-saving and healing to grateful patients and families, and deeply rewarding work for clinicians and hospital leaders; but also have inherent risks and high consequences for system flaws and human errors, both of which occur in virtually any industry. With or without breakdowns in a hospital's multiple systems to guard patient safety, frontline clinicians are the last lines of defense against system flaws, individual and team human errors, and patient harms.

In healthcare as in many fields, hierarchies and cultural barriers can inhibit collaborative communications, both within and between professional roles such as physicians and nurses, and between education and experience levels (Morrison, 2014; Peadon, 2020; Starr, 2017). "In the context of workgroups and professional hierarchies, raising safety concerns is a socially constructed phenomenon" (Peadon et al., 2020, p. 6), with sometimes suboptimal variations (Institute of Medicine, 2000, 2001, 2004). One result is a lack of *shared mental models* for collaborative team communications (Brown et al., 2017; Grade et al., 2018; Institute of

Medicine, 2001, 2004; Wakeman & Langham, 2018). Accordingly, this inquiry used the *constructivist paradigm and methodology*, which holds that individuals and groups construct, co-construct, and may reconstruct their social realities (Lincoln & Guba, 1985, 2013).

Methods used were one-to-one, semi-structured interviews to collect holistic qualitative data on values, beliefs, attitudes, and behaviors from the "hearts and minds" of participants; thematic analysis of the data; assimilation of the themes into a co-constructed, proposed shared mental model toward more predictable and more reliable collaborative voice and response; plus member-checking with participants, to refine and confirm the themes and proposed shared mental model were accurate. The inquiry also explored the challenges of production pressures (time pressures) and hierarchical abuses of power, while facilitating a transparent focus on values that inform the work and the worklives of surgery teams.

Following the axiological perspective articulated by Lincoln and Guba (2013), the study sought to generate knowledge which is the most valuable, the most truthful, and the most life-enhancing for all stakeholders: patients, families, surgery team members, and hospital leaders.

> In this shared and co-created reality, the values of the inquirer, the various value systems of research participants, the values which inhere in the context all must be uncovered and made transparent… ultimately, the values of stakeholders in the research—those who are not participants but for whom the research itself is important, or informs some part of their work or their lives—will come into play. (p. 41)

Complementing constructivist inquiry, the study used *adaptive work theory and methods*, which focus on intentional individual and cultural evolution (Heifetz, 1994). In adaptive work, individuals and groups determine the values, beliefs, attitudes and behaviors that are *essential* to preserve, modify, or create; and that are *expendable* to discard, and perhaps must be discarded, for them to succeed and thrive.

According to Bates and Singh (2018), dysfunctional variations in leadership and culture are obstacles to reducing surgical errors and patient harms. "Errors related to human cognition or behavior in or out of the operating room… [suggest] the need for more work to understand and address surgical safety" (p. 1). Along with values described above, this study holistically explored

beliefs, attitudes, and behaviors for collaborative voice and response. “One *behaves* or acts in relation to what one *knows* and *feels* and *can do*” (Hauenstein, 1998, p. 125).

This chapter presents the background and context of the study; the research problem, research purpose, and research questions; a brief overview of the research methods; the researcher’s positionality, assumptions, and biases; rationale and significance of the study, core constructs and definitions, and a summary. The literature review and conceptual framework, research design and methods, findings, and discussion chapters will follow.

Background and Context

People find collaborative voice and response difficult (Edmondson, 2019; Greenberg & Edwards, 2009; Morrison, 2014). Morrison’s (2014) review of voice and silence literature found two prevailing conclusions: *silence is pervasive* across industries, and *silence is dysfunctional*. Leaders may not even recognize that “voice is very important—perhaps even necessary—for an organization to function effectively” (p. 178).

Before choosing to speak up or not, it is common that people mentally weigh motivators and inhibitors that surround two key psychosocial factors: *efficacy:* whether speaking up will be effective; and *psychological safety:* whether speaking up will be safe, or risk negative consequences from the leader and/or group (Morrison, 2014). Because inhibitors often outweigh motivators, “the tendency toward silence often dominates the inclination to voice” (p. 177). In a more recent review of voice and silence literature, Morrison (2023) found practical advice for organizations: first, leadership matters, as do positive attitudes about one’s organization and work; second, organizations should purposely follow best practices for creating meaningful work, participation, and environments that foster more voice and less silence.

Healthcare is a *high-consequence industry,* where people’s safety and lives are at stake (Patankar et al., 2012). For good reasons, high-consequence industries are also called hazardous technology industries, or high-risk industries (Helmreich, 2000; Perrow, 1984; Reason, 1997; Weick & Sutcliffe, 2015). It is important to recognize that while healthcare,

aviation, space flight, oil and gas production, and nuclear power technologies bring lifesaving and/or life-enhancing benefits; the technologies also bring high risks, in which failures have high consequences. The challenge for leaders, staff, and frontline workers in high-consequence industries is to see, understand, and manage those risks (Griffith, 2023; Reason, 1997).

While collaborative voice and response can be a safety net against system flaws and human errors, silence or ineffective response to voice can contribute to high consequence failures (Weick & Sutcliffe, 2015). Disasters often occur from snowballing chains of events, where if any one breakdown was prevented or countered, the disaster could have been avoided (Reason, 1997). Silence or ineffective voice and response can contribute to breakdowns in related organizational and human factors; such as *production pressures* that may prioritize production over safety (Reason, 1997), the *normalization of deviance* from standard safety protocols (Vaughan, 1996), and *risk denial:* circumventing safety protocols or disregarding weak signals of discrepancies, while thinking "it won't matter" (Besco, 1990, p. 1; 1991, p. 3).

Preventable disasters from high-consequence industries include the 1977 Tenerife Island jumbo jet collision, causing 583 deaths (Air Line Pilots Association, 1977); the 1986 Chernobyl nuclear power plant explosion, causing 30 or more deaths (International Nuclear Safety Advisory Group, 1992); the 1986 Challenger launch explosion, causing seven deaths (Vaughan, 1996); the 2003 Columbia space shuttle re-entry disintegration, causing seven deaths (Tompkins, 2005); and the 2010 Deepwater Horizon offshore oil rig explosion, causing 11 deaths (Deepwater Horizon Study Group, 2011). When people did speak up before these tragedies, it was not effective, and voiced concerns were unheeded. Even with people's safety and lives at stake, including their own, speaking up and responding effectively can be difficult.

Silence Among Healthcare Leaders

Even top physician leaders at U.S. medical schools face powerful psychosocial factors that can inhibit collaborative voice and response. "Elephants in Academic Medicine" (Souba et

al., 2011) reported a 2010 survey sent to the surgery chairs and medical department chairs (for non-surgeon faculty) at all 127 U.S. schools (254 chairs total) then granting medical degrees.

Of the 139 chairs who responded, 69% reported widespread failures to speak up about the elephants in the room, those big problems people see, but often avoid discussing and resolving. Although the chairs believed that ignoring problems led to low morale and not learning from mistakes, 67% believed it would be difficult to build a culture that openly confronts elephants in the room. While department chairs thought their own leaders should lead by example, 55% believed that the "actions of top leaders often fed, rather than dispelled, elephants" (p. 1492). According to Harvard organizational learning pioneer Chris Argyris (1980), the challenge is "making the undiscussable and its undiscussability discussable" (p. 205).

Silence on the Frontlines in Surgery and Other Healthcare Teams

On healthcare's frontlines, communication failures are "an insidious contributor to medical mishaps… the most common cause of preventable disability or death" (Sutcliffe et al., 2004). "Often, health care professionals hesitate to voice concerns… [and] often prefer silence to speaking up when patient safety is at stake" (Okuyama et al., 2014, pp. 1-2).

The following reports, published from 2017 to 2020, are from extensive literature reviews or empirical studies at leading academic medical centers and prominent hospitals. The studies, most of them with surgery teams, show how unmet adaptive challenges of hierarchical barriers, deficient cultures and team climates, and the lack of shared mental models can contribute to communication breakdowns that put patients and the well-being of clinicians themselves at risk.

Brown et al. (2017) studied how mental models vary among cardiac surgery team members. Researchers interviewed 41 cardiac surgery team members (at three major hospitals) from five disciplines: surgeons, anesthesiologists, perioperative nurses (for before, during, and after surgery), surgical technicians (who assist with sterile conditions and equipment), and perfusionists (who operate heart-lung machines that pump oxygenated blood for the body).

Participants identified 12 *pause points*, moments of time before critical activities, "which could be *practical and conducive* to a moment of team communication" [emphasis added] (p. 30). Critical activities included transporting the correct patients to operating rooms, anesthesia induction, major intraoperative procedures including surgical incision, and postoperative transfer to the post-anesthesia care unit (recovery room) or to the intensive care unit.

Using response variability to measure agreement in mental models, only one of the 12 pause points, before surgical incision, had low response variability, which indicated agreement that a moment of team communication before the critical activity was both practical and conducive. Three pause points had moderate response variability and eight pause points had high response variability, indicating "a lack of shared mental models within and between disciplines" (p. 36). The report concluded that "actively sharing mental models will be critical" (p. 36) as cardiac surgery increasingly becomes more complex.

A Stanford qualitative study (Grade et al., 2018) interviewed surgery team members and deductively coded the interview data, with codes then confirmed by surgery team focus groups. The study found that unclear role expectations, hierarchy, and traditional social structures inhibited communications and caused operating room (OR) problems. Notably, senior attending surgeons' perceptions of how *their* operating room attitudes and tones influenced team communications differed significantly from other team members' perceptions. Sixty percent of anesthesiologists, resident surgeons in training, perioperative nurses, and medical students believed that the senior attending surgeon's tone and mood "could drastically alter OR communication" (p. 109); while only 36% of attending surgeons believed that *they* set the operating room climate.

Wakeman and Langham (2018) argued that the absence of shared mental models in pediatric surgery teams jeopardizes teamwork, information sharing, and patient safety outcomes. "Central in creating a shared mental model is effective communication… lack of

teamwork and information sharing in the perioperative setting have been correlated with an increased risk of postoperative complications and death" (p.110).

A Johns Hopkins observational study, of speaking up during anesthesiology simulation training, identified self-efficacy, social outcome expectations, and assertiveness as *intra*personal factors influencing voice or silence (Daly Guris et al., 2019). The authors suggested future research on other intrapersonal factors—cultural upbringing, work experience, and pre-existing beliefs about power dynamics—to explore why some people speak up either more or less effectively than others.

Cooper et al. (2019) assessed retrospective data, from the American College of Surgeons' Surgical Quality Improvement Program, on 13,653 surgery patients at the Vanderbilt and Stanford medical centers. Patients of surgeons whose unprofessional behaviors were reported by colleagues, during the 36 months preceding each patient's surgery, had 11.9% to 14.3% higher complication rates, including previously unplanned hospital readmissions, follow-up operations due to the complications, and related deaths.

A literature-based editorial identified an imbalanced focus on people speaking up "rather than those who need to be spoken up to. It appears we are asking a group of people of perceived low status to confront a group of people of perceived high status" (Weller & Long, 2019, p. 712). The authors recommended that senior surgeons encourage and welcome speaking up, by "sharing the plans for patient care in a preoperative briefing, regularly updating the team on progress, inviting suggestions, admitting uncertainty, and acknowledging and valuing input" (p. 712).

In a subsequent qualitative study, Long et al. (2020), including Weller, conducted interviews and focus groups—with 79 New Zealand surgeons, anesthetists, nurses, and anesthetic technicians—to explore "the flip side of speaking up" (p. 1099). The study found seven variables that influenced whether surgeons invite voice and how they respond to it: awareness of their own human fallibility, potential impacts on patient care and team dynamics,

understanding the difficulties in speaking up, professional and cultural norms, content and tone of the voice, respect for the speaker's knowledge and experience, and the relationship with the speaker. Study authors concluded that the surgeon's response "can strengthen team cohesion and improve team function, or it can be a moment of distress and tension and a threat to effective teamwork" (p. 1105).

In April 2020, the *American Medical Association Journal of Ethics* published a special issue to examine historical and current perspectives on the "complex, interdependent—yet sometimes strained relationship" (Scarlet & Doerr, 2020, p. 264) between physicians with different training and perspectives: surgeons and anesthesiologists. Over time, the roles have shifted—from the surgeon as captain, assisted by a subordinate anesthesiologist—to "dynamic co-captains… [who] can *share, yield, or compete for leadership* in a variety of contexts and situations" [emphasis added] (Bryan & Kolarzyck, 2020, p. 336). ("Captain of the ship" and related "borrowed servant" doctrines, used in medical-legal arguments and court judgments, are beyond the scope of this study.)

"Patient Safety Over Power Hierarchy: A Scoping Review of Healthcare Professionals' Speaking-up Skills Training" (Kim et al., 2020) found that most studies "implicitly referred to positional power… few addressed other forms of power such as personal resources (e.g., expertise, information). *Almost none addressed the emotional and psychological dimensions of speaking up*" [emphasis added] (p. 249) in the affective domain, as this study has done.

A systematic review on the impacts of hierarchy on medical errors concluded that "in the context of workgroups and professional hierarchies, raising safety concerns is a *socially constructed phenomenon*" [emphasis added] (Peadon et al., 2020, p. 6); and that "future approaches to understanding how voice climate and shared beliefs about speaking up are formed or can be changed, should aim to explore the nuances of speaking up or choosing to remain silent" (p. 6). Many of those nuances, with categories graphically depicted in Figure 1.1, were explored in this study.

Figure 1.1 illustrates just some of the identified human factors that influence collaborative voice and response (Morrison, 2014; Okuyama et al., 2014; Long et al., 2020), even *while* surgeons and other team members are necessarily focused on vital clinical tasks. Arguably, all 11 interacting human factors can influence all disciplines and healthcare teams.

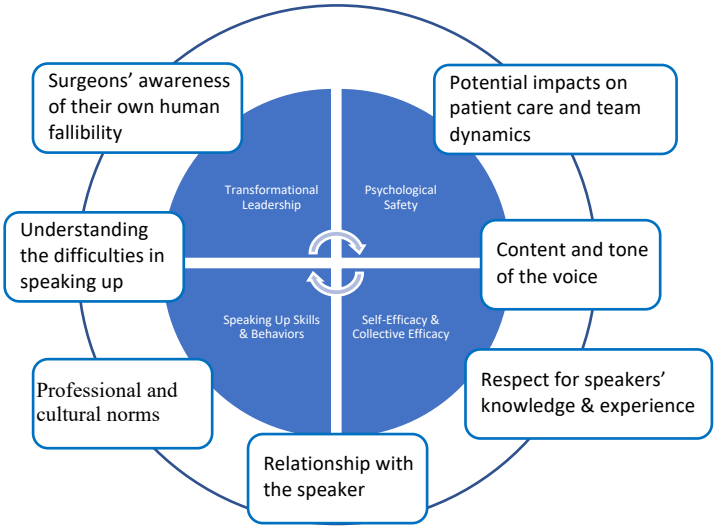

Figure 1.1

Human Factors in Collaborative Voice and Response

Shared Mental Models for Collaboration in Healthcare

Purdue nurse researchers McComb and Simpson (2014) developed, from the teamwork literature, a theoretically grounded concept analysis of shared models for collaboration in healthcare. The concept analysis identified four defining criteria for developing, refining, and assessing shared mental models. The criteria were used as such in this study.

"Shared mental models are individually held knowledge structures that help team members function collaboratively… and are comprised of four attributes: *content, similarity, accuracy,* and *dynamics*" (McComb & Simpson, 2014, p. 1485). For content, individual team members simultaneously hold and use mental models for both taskwork and teamwork. Surgical taskwork—clinical or technical steps of surgical procedures—is beyond the scope of this study. This study addresses teamwork and nontechnical human factors—values, beliefs, attitudes and behaviors—that influence individual actions and team interactions. Similarity in mental models

allows taskwork and teamwork knowledge structures, while held individually, to be shared and used collaboratively. Accuracy refers to usefulness, in terms of team interdependence and goal attainment, in how well shared mental models accurately represent reality. Accurate representations of reality are essential to a surgery team's shared awareness of the presence or absence of patient safety (taskwork), and the presence or absence of team member psychological safety and well-being (teamwork). Dynamic refers to the capacity to integrate new information and collaboratively adapt shared mental models as conditions change.

Shared mental models can be developed explicitly and/or evolve over time, similar to the constructivist concepts of constructions, co-constructions, and reconstructions (Lincoln & Guba, 2013) used in this study. Developing and evolving shared mental models for teamwork can be difficult adaptive work, also used in this study, challenging people to examine and potentially change (adapt) their accustomed values, beliefs, attitudes, and behaviors for the better (Heifetz, 1994). Adaptive work thus requires the active engagement and committed efforts of individuals and teams, and the willingness to give up part of what they have been, for the best of what they could become (Heifetz, 1994; Kalisch, 2009, as cited in McComb & Simpson, 2014).

First Do No Harm, To Err is Human, and the Burden of Errors

The groundbreaking report, "Error in Medicine" (Leape, 1994), called for changing systems and cultures, reducing variations, and standardizing processes wherever possible. As a Harvard-trained pediatric surgeon at Boston Children's Hospital who had moved into health policy, Leape and others led the modern day patient safety movement in 1996, when the first of three Annenberg Conferences gathered leaders concerned about medical errors (Leape, 2021).

The Institute of Medicine was renamed in 2015 as the National Academy of Medicine, a branch of the National Academies of Sciences, Engineering, and Medicine. The National Academies are preeminent organizations of peer-elected researchers and leaders in their fields, who study and make recommendations on issues of national and global importance. Reports from the Institute of Medicine era remain cited and referenced as such.

The Institute of Medicine's (2000) often-cited seminal report, *To Err Is Human: Building a Safer Health System*, "converted an issue of growing professional awareness to one of substantial public concern" (Leape et al., 2002, p. 501). That issue was, and remains, that preventable medical errors have caused alarming numbers of patient deaths, and permanent or temporary injuries. From two large studies in the 1980s, *To Err Is Human* estimated that in U.S. hospitals alone, 44,000 to 98,000 patients were dying every year from medical errors.

On the cover of *To Err Is Human* is a longstanding moral belief and code of conduct in healthcare, "First, do no harm." Together, "to err is human" and "first do no harm" capture the paradoxical and daunting challenge that frontline clinicians accept and confront with every patient, in every treatment and procedure, most of which have multiple potential failure points. The following compound definition of medical error illustrates some of the complex challenges:

> An unintended act (either of omission or commission) or one that does not achieve its intended outcome (Leape, 1994); failure of a planned action to be completed as intended (an error of execution), the use of a wrong plan to achieve an aim (an error of planning) (Reason, 1990); or a deviation from the process of care that may or may not cause harm to the patient (Reason, 2001). (Makary & Daniel, 2016, p. 1)

Makary and Daniel (2016) reviewed several U.S. patient mortality studies that were conducted with more recent data and more accurate methods, and reported since *To Err is Human.* From estimates in the combined studies, Makary (a professor of surgery) and Daniel (then a research fellow) calculated an estimated mean rate of 251,454 patient deaths a year, almost 700 deaths a day, from medical errors in the U.S. alone. While even those numbers are underestimates due to systemic underreporting, they would rank medical errors (before COVID-19) as the country's third leading cause of death, after only heart disease and cancer.

Additional harms from medical errors include 10 to 20 times more permanent or temporary patient injuries than deaths (Classen et al., 2011; James, 2013), losses of physical and mental functions, psychological distresses for patients and families, 17 to 29 billion dollars every year in financial costs, regulatory sanctions and legal actions, damaged reputations, and lost opportunity costs for all concerned (Institute of Medicine, 2000; James, 2013).

Well-meaning clinicians suffer, too, with alarming rates of work-related stress, burnout, depression, moral distress, and even suicide (National Academy of Medicine, 2019). Burnout can occur when job demands repeatedly overwhelm job resources, resulting in exhaustion, cynicism and detachment from others, and feelings of ineffectiveness (Maslach & Leiter, 1997). Dean et al. (2019) argued that clinician burnout is a symptom of the underlying cause, *moral injury,* which "occurs when we perpetrate, bear witness to, or fail to prevent an act that transgresses our deeply held moral beliefs" (Dean et al., 2019, p. 400). Maslach and Leiter (2022) argued that organizations need to help people manage their relationships with their jobs.

Every day and night, countless individual and collective efforts by expert frontline clinicians and teams, dedicated hospital leaders, safety and quality specialists, educators, and researchers combine to bring healing and comfort to grateful patients and families. And yet, even experts and expertise have their limits (Dismukes et al., 2007). Imperfect humans work in imperfect human systems and cultures, which can and often do have latent flaws that generate error-prone conditions for active frontline errors (Reason, 1997). Risk management expert Fiona Lawton has consistently maintained that, regardless of any illusions of being perfect, "We are all perfectly fallible human beings" (personal communication, September 16, 2021). High reliability researcher and theorist Weick (2002) argued that the "perfection mindset… is laudable, admirable, and unworkable… [and that] given an organization of fallible human beings, the issue is… why wasn't the error corrected?" (pp. 187-188).

Institute of Medicine and National Academy of Medicine Reports

To Err is Human: Building a Safer Health System (Institute of Medicine, 2000) and the follow-up report, *Crossing the Quality Chasm: A New Health System for the 21st Century* (Institute of Medicine, 2001), were calls to action for ongoing efforts to systemically improve patient safety and overall healthcare quality. They were the first two reports in the Institute of Medicine's 12-volume "Quality Chasm" series of consensus, peer-reviewed reports that addressed, on a wide range of issues, "not just a gap, but a chasm" (Institute of Medicine, 2001,

p. 1) between what healthcare was, and what it could be. As indicated in their subtitles, both reports emphasized that safety and quality should be addressed as healthcare *system* properties, not just the sole responsibilities of individual clinicians.

To Err is Human: Building a Safer Health System (Institute of Medicine, 2000) was a call to action to make patient safety a national priority and for healthcare organizations to make patient safety a system property. It focused industry attention on, and increased public awareness of, patient harms from medical errors. *Crossing the Quality Chasm: A New Health System for the 21st Century* (Institute of Medicine, 2001) soon followed, identifying systemic issues that influence overall healthcare quality. The report noted outmoded healthcare systems and called for research and practice to improve six overall quality measures, for healthcare to be more safe, effective, patient-centered, timely, efficient, and equitable. The report recognized that all team members' contributions are essential, and recommended new principles and "new rules" for how clinicians relate to each other. One new rule was to replace the then-current approach, "preference is given to professional roles over the system" (p.67) with "cooperation among clinicians is a priority" (p. 67). The report called for 21st century healthcare organizations such as hospitals, and their microsystems such as surgery teams, to be redesigned and, by implication, to be understood and operated as *complex adaptive systems.*

Complex adaptive systems are composed of multiple agents or individuals who are simultaneously independent and interdependent, and whose actions and interactions influence each other, in often unpredictable ways, that may change the work and the work environment for others (Institute of Medicine, 2001).

> The unpredictability of behavior in complex adaptive systems can be seen as contributing to huge variation in the delivery of health care. If such a system is to improve its performance—that is, improve the quality of care it provides—*some of these actions need to be specified to the extent possible so they are predictable with a high level of reliability* [emphasis added]. (p. 64)

Positive variations can lead to creativity and innovation when desired; but negative variations can lead to dysfunctional cultures and deviations from safe practice, including errors

and harms—unless and until individuals and teams in complex adaptive systems *do in fact adapt*. This study aimed to specify what surgery team participants perceive will help voice and response actions and interactions be more predictable and highly reliable; and to help them conceptualize and operationalize the principles and practices of complex adaptive systems.

A third Quality Chasm series report, *Keeping Patients Safe: Transforming the Work Environment of Nurses* (Institute of Medicine, 2004), called for changes in the work environment "from the vantage point of the largest component of the heath care workforce and a critical element of our health care system—nurses" (p. ix). The report cited "evidence on inconsistent interprofessional collaboration" (p. 12); and that "70 to 80 percent of health care errors are caused by human factors associated with interpersonal interactions" (Schaefer et al., 1994, as cited in Institute of Medicine, 2004, p. 342). Recommendations to transform the work environment included reducing traditional hierarchical communication that "can negatively affect a safety culture" (p. 289); research to identify interpersonal and group interactions that enhance safety; and research to develop and evaluate models of collaborative care by teams.

Taking Action Against Clinician Burnout: A Systems Approach to Professional Well-Being (National Academy of Medicine, 2019) is a fourth consensus report that informed this study. This systems approach was another call to action, this one for a national priority of reducing burnout and promoting the well-being of frontline clinicians who deliver care to patients. Burnout, then found among 35 to 54 percent of U.S. nurses and physicians, is "a syndrome characterized by high emotional exhaustion, high depersonalization (i.e., cynicism toward others), and a low sense of personal accomplishment from work" (p. 1). The report recommended that healthcare organizations transform the work environment to better align with organizational, professional, and humanistic values; improve psychological safety and learning environments; and support research and practices for clinician well-being.

In summary, the major factor informing the background and context of this study is the perpetual challenge amidst healthcare's countless potential failure points, to "first do no harm,"

even while “to err is human.” Collaborative team communications are necessary to detect, convey, and correct errors—thus avoiding and preventing, one at a time, as many errors as possible; and preventing or minimizing patient harms from those errors that inevitably still occur. Sharing knowledge and awareness of the presence or absence of safety is a safety net for all.

Medical errors and patient harms can result from unpredictable variations and breakdowns in individual and team human factors that impact patient safety and clinician well-being. Literature reviews and studies in academic medical centers and prominent hospitals have found that suboptimal hierarchical practices and the lack of shared mental models contribute to human factors breakdowns.

Consensus reports from the Institute of Medicine and National Academy of Medicine recommended that the healthcare industry make safety and quality system properties in addition to individual and team responsibilities. Healthcare systems can reduce unwanted variation and unpredictability by designing, understanding, and operating hospitals and their microsystems, such as surgery units and teams, as complex adaptive systems, with multiple simultaneously independent and interdependent team members, whose actions and interactions influence each other’s work and work environments, in ways that should be made more predictable and more highly reliable to the extent possible. Helping hospital units and teams be more predictable and reliable involves reducing hierarchical barriers to communications, developing and using shared mental models of collaborative care, and prioritizing the well-being of frontline clinicians.

This study holistically addressed the nontechnical cognitive, affective, and behavioral elements of human factors—what people cognitively know and think, how they affectively feel about their working relationships and teamworking climates, and their behavioral dispositions (prevailing tendencies) and habits (what they repeatedly do). The research problem and purpose of this study, presented in the next two sections, identified and addressed the ongoing needs to expand human factors knowledge and practices, and to create shared mental models for more highly reliable collaborative voice and response.

Research Problem

The research problem is that unpredictable and suboptimal variations in nontechnical cognitive, affective, and behavioral human factors can inhibit surgery team members from communicating about safety concerns, opinions, and learning questions. Individual and collective human factors include cultural norms, team climates, values, beliefs, attitudes behaviors, dispositions (prevailing tendencies), habits (repeated behaviors), surgeon leadership, psychological safety, self-efficacy and collective efficacy, and voice and response skills. Similar human factors can inhibit surgeons, as team leaders, from fostering an inclusive voice and learning climate, and responding effectively to voice (Long et al., 2020; Morrison, 2014; Okuyama et al., 2014; The Joint Commission, 2015; Weller et al., 2019).

Unpredictable and suboptimal variations in human factors hinder outcome goals of patient safety and clinician well-being, which are mutually influencing (Bates & Singh, 2018; Hauenstein, 1998; Hall et al., 2016; Institute of Medicine, 2000, 2001; National Academy of Medicine, 2019; Swensen & Shanafelt, 2020; The Joint Commission, 2015; Welp et al., 2016). Increasingly, the healthcare industry and hospital organizations are being called to action to develop systems approaches that improve patient safety and clinician well-being. This study focused on nontechnical human factors at the individual, team, and unit levels in those systems.

Research Purpose

The purpose of this study was to co-construct, with surgery team participants, a shared mental model for collaborative voice and response. The resulting model was based on what interview participants identified as essential versus expendable cognitive, affective, and behavioral human factors, in terms of values, beliefs, attitudes, and behaviors. The proposed shared mental model or adaptations of it, when used in practice, may help reduce unwanted variation and unpredictability, and increase reliability, of collaborative voice and response; which in turn may contribute to the mutually influencing goals of patient safety and the well-being of clinicians themselves.

The study built on Institute of Medicine (2004) recommendations for research to develop "models of collaborative care, including care by teams" (p. 20) and to help transform the work environment and reduce traditional hierarchical communications that "can negatively affect a safety culture" (p. 289). This study was itself collaborative, co-constructing a collaborative care shared mental model not *for* teams, but *with* teams; by doing adaptive work with frontline surgery team participants, who themselves determined the essential versus expendable values, beliefs, attitudes and behaviors for collaborative voice and response.

Research Questions

Research questions one and two were designed to discover surgery team participants' most collaborative experiences with voice and response; and what cognitive, affective, and behavioral human factors they perceive to be essential versus expendable. Research question three, using themes from interview data on participant perspectives, sought to co-construct a consensus or near-consensus shared mental model of collaborative voice and response.

Research question 1: What are participants' most collaborative experiences with voice and response?

Research question 2: What cognitive, affective, and behavioral human factors, in terms of values, beliefs, attitudes, and behaviors, do participants perceive to be essential to preserve, modify, or create; and expendable to discard, and that perhaps must be discarded, for collaborative voice and response?

Research question 3: What consensus or near consensus shared mental model could participants and the inquirer co-construct, that when used in practice, may reduce unwanted variation and unpredictability, and increase reliability of collaborative voice and response?

Research Design and Methods Overview

This study followed the constructivist inquiry paradigm, which posits that individuals and groups construct, co-construct, and may reconstruct their social realities (Lincoln & Guba, 2013). The study also followed Lincoln and Guba's (2013) constructivist methodology, which

has two stages: discovery and assimilation. Discovery seeks to identify and consider the range of perspectives held in a group. From those perspectives, assimilation seeks a consensus or near consensus co-construction that may eliminate or alleviate the problem studied.

The constructivist approach fits with adaptive work theory and methods (Heifetz, 1994) used to develop research question two and related interview questions. In adaptive work, people first consider the variety of perspectives held in the group. From those perspectives, individuals and groups determine consequences in terms of what values, beliefs, attitudes and behaviors are essential to preserve, modify, or create; and those that are expendable to discard, and perhaps must be discarded. From that, individuals and groups select or adapt the values, beliefs, attitudes and behaviors that will help them succeed in their goals and thrive.

Constructivist inquiry methodology and adaptive work methods together were used to develop research questions and interview questions. The ultimate aim of the inquiry was to co-construct, with participants, a consensus or near consensus shared mental model for collaborative voice and response.

Semi-structured interviews were the method used to collect data to discover participants' perceptions of essential versus expendable values, beliefs, attitudes, and behaviors. Thematic content analysis, member checking, and the researcher as instrument were methods used to assimilate the perceptions into a proposed shared mental model. Thematic analysis of the interview data identified themes that grounded the co-constructed proposed shared mental. The model in turn was submitted for member checking, during which one minor refinement of the model was suggested, and made. Participants confirmed the proposed shared model for collaborative voice and response was accurate, comprehensive, and likely to be useful in practice.

The research design and methods are described in further detail in chapter three. The next section addresses the importance of qualitative researchers being explicit about their positionality, assumptions, and biases (Bloomberg & Volpe, 2016; Ravitch & Carl, 2021).

Researcher Positionality, Assumptions, and Biases

My former professional work in aviation, and my volunteer work in healthcare at the time of this study, drove my positionality and assumptions. As a career frontline air traffic controller, I was the first national training committee chair for the National Air Traffic Controllers Association, and was on a Federal Aviation Administration (FAA) national work group that redesigned system-wide air traffic control (ATC) *technical training* for the first time in 30 years. I advocated for and helped initiate, research, develop, facilitate, and lead ATC *human factors training*, known as crew resource management (CRM), at local, regional, and national levels. CRM is used globally in aviation, and increasingly in healthcare and other high-consequence industries.

In CRM workshops around the country, air traffic controllers, supervisors, and managers discussed and recorded ways they could use CRM principles and practices in daily operations; identified and recorded local safety issues and solutions; and developed follow-up action plans. Two national human factors experts (PhDs) separately attended the program and evaluated it highly. Ninety percent of workshop participants reported that they liked CRM, learned it, and intended to use it. A major western radar facility implemented CRM and follow-up as designed and reduced controller errors by 75% in two years, winning a national quality award in 2009. In 2010, the last year before extreme budget cuts ended the CRM program as we knew it, FAA air traffic controllers nationwide met safety criteria (required distances between aircraft) in 99.999% of 134 million takeoffs, landings, and radar operations, each with multiple possibilities for error.

Threat and error management at the local system level was a cornerstone of CRM workshops, for which we adopted and taught the FAA Air Traffic Chief Operating Officer Hank Krakowski's principle, "Find Truth. Facilitate Change." It remains a guiding principle in my work.

My volunteer work in healthcare focused on human factors in patient safety and clinician well-being. I contributed to hospital-wide quality and safety matters, and in particular to magnetic resonance imaging (MRI) safety, emergency department physician leadership, early development of intensive care unit human factors training, a national work group developing a

new diagnostic safety framework, and a published medical journal article about the framework. I am a certified master facilitator for a healthcare nontechnical human factors course, Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS).

My assumptions and biases are that frontline clinicians who take people's safety and lives in their hands want, need, and deserve current knowledge and the best possible support—from leaders, colleagues, educators, and researchers—to help them understand and manage the nontechnical human factors that influence patient safety and their own well-being. Just as airline passengers and families depend on pilots and air traffic controllers to communicate about safety, hospital patients and families depend on all clinicians whose care they are in to communicate about safety. I believe that at best, people want to purposefully contribute, evolve, and thrive in their work and work lives, which helps them do the same in their personal lives.

Rationale and Significance of the Study

According to Bloomberg and Volpe (2016), the rationale describes justification for the study, and significance describes the benefits that may result. The rationale is that in healthcare teams, widespread and unpredictable variations—such as in voice and response that can hinder collaboration—can lead to suboptimization: achieving some goals at the cost of other goals that may be more important (Institute of Medicine, 2001). Because patient safety and well-being of caregivers should not be suboptimized, "some of these actions need to be specified to the extent possible so they are predictable with a high level of reliability" (p. 64).

Paradoxically, "simple rules can guide complex behavior toward a goal" (Institute of Medicine, 2001, p. 64) in complex adaptive systems (such as hospitals) and microsystems (such as surgery units and teams). "First, do no harm" is a simple rule. The Institute of Medicine recommended 10 interrelated simple rules or *new rules* to replace then-current approaches. Recommendations relevant to this study were to replace "Do no harm is an individual responsibility [with] Safety is a system property" (p. 67); and to replace "Preference is given to professional roles over the system [with] Cooperation among clinicians is a priority" (p. 67).

> Cooperation in patient care is more important than professional prerogatives and roles. The new rule emphasizes a focus on good communication among members of a team, using all the expertise and knowledge of team members and, where appropriate, sensibly extending roles to meet patients' needs. (p. 83)

This study's shared mental model, co-constructed with surgery team participants, specifies "simple rules" for how they can value and practice collaborative voice and response. It can extend roles and more reliably obtain knowledge and expertise of *whoever* on the team has the most current, accurate, and complete awareness of the presence or absence of safety.

Significance of the study (benefits that may result) are that a shared mental model for more reliable collaborative voice and response could help improve patient safety and clinician well-being, which are mutually influencing (Institute of Medicine, 2000, 2001, 2004; National Academy of Medicine, 2019). The methods and findings may help other surgical and medical teams better understand and manage the human factors and adaptive challenges they face.

Core Constructs and Definitions

Table 1.1 contains core constructs, "central aspects that guide and are at the center of a research study" (Ravitch & Carl, 2021, p. 36), with definitions, descriptions, and examples. The core constructs are conceptually grouped according to overlapping system, organization, unit and team, and individual levels of analysis; values and goals of patient safety and clinician well-being; and the constructivist inquiry and adaptive work theory and methods used to develop a consensus or near consensus shared mental model for collaborative voice and response.

Table 1.1

Core Constructs

Core Constructs	Definitions – Descriptions – Examples	References
Complex adaptive systems (CASs)	CASs have multiple agents who are both independent and interdependent, and whose actions and interactions can change the work and work environment for others; thus requiring more predictability for higher reliability. Examples: hospitals and their microsystems such as surgery units/teams.	Institute of Medicine (2001)
High-consequence industries	Industries where people's safety and lives are at stake; also called hazardous technology or	Patankar et al. (2012) Reason (1997)

	high-risk industries. Examples: healthcare, aviation, air traffic control, space flight, nuclear power, oil drilling, and firefighting.	
Highly reliable organizations/teams (HROs/HRTs)	HROs/HRTs practice individual and collective mindfulness and heedful interrelating to anticipate, avoid, and reduce risks, threats, and errors; and minimize those that still occur—with exceptionally high rates of success—even in hazardous technology, high-risk, high-consequence industries.	Martelli et al. (2018) Weick & Sutcliffe (2015)
Safety culture – organizational level	Safety is the sole first priority of everyone at all levels of an organization. A safety culture is *informed* about the "human, technical, organizational, and environmental factors that determine the safety of the system as a whole" (Reason, 1997, p. 195)	International Nuclear Safety Advisory Group (1991)* Reason (1997)
Safety climate – unit, team & clinician level	Current snapshot of frontline perceptions of safety, and the atmosphere and support for it	Mearns & Flin (1999)
Patient safety (as a value and goal)	"Freedom from accidental injury" – requires a healthcare systems approach, including that of frontline clinicians and teams, to minimize errors and mitigate those that still occur.	Institute of Medicine (2000, p. 211)
Quadruple Aim: care of the caregivers (as a value and goal)	Frontline clinician well-being, resilience, and thriving are valued goals among all leaders and team members, for their own sakes, and for patient safety and clinical outcomes.	Bodenheimer & Sinsky (2014) Dzau et al. (2018) (Nundy et al., 2022)
Human factors	Applied science in technical and nontechnical factors that influence human performance and outcomes. Examples: nontechnical cognitive, affective, and behavioral factors in the following eight rows.	International Ergonomics Association (n.d.)* Yule et al. (2008)
Cognitive	What people know and think about their work	Hauenstein (1998) Keebler et al. (2022)
Affective	How people feel about themselves, their colleagues, and their work environment	
Behavioral	How people act and interact in their work	
Transformational leadership	Focuses on effective task completion and leader-team member contribution and thriving	Institute of Medicine (2004)
Psychological safety	People perceive it is safe to be themselves and to speak up without risks of professional harm, or being criticized or demeaned.	Edmondson (1999, 2019)
Self-efficacy and collective efficacy	People perceive they have agency to produce desired outcomes. Example: that both voice and response will be effective	Bandura (1995, 2000) Morrison (2014)
Physician approachability	A dynamic state where physicians repeatedly and consistently show "tangible actions of signaling availability through presence, uncertainty through thinking aloud, and vulnerability through debriefing" (p. 8).	Pack et al., (2022)

Voice and response skills and behaviors	Formal team leaders explicitly invite and appreciate voice. Team members (including formal and informal leaders) know how to speak up and do speak up. Communications are timely, accurate, frequent enough, and focused on problem-solving, not blame.	Nembhard and Edmondson (2006) Gittell (2009, 2016)
Constructivist inquiry paradigm and methodology	Individuals and groups construct, co-construct, and may reconstruct their social realities. Methodology discovers and assimilates various perspectives – or clarifies values and surfaces unresolved issues.	Lincoln & Guba, (1985, 2013)
Adaptive work theory and methods (based on biological evolution)	Personal and cultural evolution work by individuals and groups to determine values, beliefs, attitudes and behaviors that are essential vs. expendable for them to succeed	Heifetz (1994) Heifetz & Linsky (2017)
Shared mental models in healthcare	Similar, accurate, and dynamic knowledge structures—held simultaneously by individuals and teams for both taskwork and teamwork contents—to help teams function collaboratively, safely, and effectively	McComb & Simpson (2014)

Chapter Summary

This chapter presented an overview of the qualitative case study, with surgery team participants at a major academic hospital. The study explored nontechnical human factors that influence collaborative voice and response about patient safety concerns, clinical opinions, and learning questions; and that influence the well-being of clinicians themselves. Surgeons and anesthesiologists participated in interviews and member checking sessions, but recruited perioperative nurses or surgical technicians did not participate. Patients, families, hospital leaders, and surgery team members themselves are stakeholders.

Studies and accident investigations show that collaborative voice and response are commonly difficult across industries and throughout organizations, from leaders to the frontlines—even when people's safety and lives, including their own, are at stake. Preventable medical errors cause patients harm (death, permanent or temporary injury, prolonged lengths of stay in hospitals, unplanned hospital readmissions and surgeries, financial loss, loss of physical function, emotional burdens, lost opportunity costs). Clinician well-being harms (second victims, burnout, moral distress, moral injury, job dissatisfaction, and turnover) are at epidemic levels.

The research problem was that breakdowns in individual and team human factors such as leadership, psychological safety, self-efficacy and collective efficacy, collaborative communications (voice and response), and the lack of shared mental models prevent surgery teams from detecting, conveying, and correcting actual and potential errors. The purpose of the study was to co-construct, with participants, a consensus or near consensus shared mental model for more predictable and more highly reliable collaborative voice and response, that may help improve patient safety and clinician well-being, which are mutually influencing. Research questions inquired about participants' most collaborative experiences with voice and response; about what values, beliefs, attitudes, and behaviors participants perceived to be essential versus expendable for collaborative voice and response; and about what shared mental model of collaborative voice and response could be co-constructed that may reduce unwanted variation and unpredictability, and increase reliability.

The study followed the constructivist inquiry paradigm, which posits that individuals and groups construct, co-construct, and may reconstruct their social realities; and the two-stage constructivist methodology of discovery and assimilation, articulated by Lincoln & Guba (2013). For the discovery stage, semi-structured interviews collected data on participants' perspectives and existing constructions. For the assimilation stage, thematic content analysis of the interview data was used to first identify provisional themes (Green & Thorogood, 2018); which were then assimilated into a proposed shared mental model by the researcher. The provisional themes and proposed shared mental model were then submitted to participants for member checking—"the most crucial technique for establishing credibility" (Lincoln & Guba, 1985, p. 314)—to confirm the themes were accurate and representative of their perspectives; to refine the model (a small but significant change was made); and to confirm that participants believed that using the proposed shared mental model in practice could help collaborative voice and response be more predictable and more highly reliable, which in turn could improve patient safety and the well-being of all team members themselves.

CHAPTER 2: LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

Chapter one presented empirical studies and literature reviews from 2017 through 2020 on adaptive challenges in collaborative voice and response. “A key element that makes for good scholarship is integration… making connections between ideas, theories, and experience… thereby providing a new way of looking at that phenomenon” (Hart, 1998, p.8). This chapter integrates key research, theories, and human factors concepts from the literature, along with my own human factors experience, that informed the study’s research topic and implications: that suboptimal human factors and the lack of shared mental models for team communications can and do inhibit collaborative voice and response in surgery teams.

A conceptual, systems-focused approach was used to define human factors, and describe how underaddressed nontechnical human factors can manifest as individual and team human errors in surgery, risking both patient safety and clinician well-being. Core constructs at the organization system and culture levels, then the unit and team levels, provide a foundation for the research purpose of co-constructing, with surgery team participants, a shared mental model for more predictable and more highly reliable collaborative voice and response.

This chapter, in two parts, presents the literature review (part one) and the conceptual framework (part two). The literature review explored human factors challenges to shared goals of patient safety and clinician well-being, which are mutually influencing (Institute of Medicine, 2000, 20001, 2004; National Academy of Medicine, 2019; Nundy et al., 2022). It reviewed some of the ways surgery is both complicated and complex—complicated, with many difficult clinical and technical elements; and complex, with many interacting system factors, cultural factors, and individual and team nontechnical human factors. The literature review leads to the conceptual framework that guided the research and is “an argument as to why the topic of a study matters and why the theoretical and methodological tools for conducting the study are rigorous and appropriate” (Ravitch & Riggan, 2017, p.193).

Part I: Literature Review

As a discipline, *human factors* is also known as or paired with *ergonomics*, a term derived from the Greek words *ergo* (work) and *nomos* (laws, and by extension, natural laws) (International Ergonomics Association, n.d.). As with terms in other fields, there are many definitions of human factors, or human factors and ergonomics (HF/E), some of which attend only to technical aspects of how humans interface with technology. This study addresses how people think, feel, act, and interact—intrapersonally and with each other—the also important, less understood, and too often avoided human side of human factors. The challenge is "making the undiscussable and its undiscussability discussable" (Argyris, 1980, p. 205).

Both the Human Factors and Ergonomics Society, based in Washington, DC., and the International Ergonomics Association, a Geneva-based global federation of HF/E societies, have adopted this definition of human factors and ergonomics: "the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data, and methods to design in order to optimize human well-being and overall system performance" (Human Factors and Ergonomics Society, n.d.; International Ergonomics Association, n. d.).

Human factors is thus a human-centered, multidisciplinary field that includes psychology, sociology, biomechanics, design, engineering, and other disciplines through a complementary, holistic, systems approach to the science of work. The fields address human interfaces with technology, such as medical equipment, surgical devices, information technology, and physical work environments such as operating rooms. Human factors disciplines also address, as this study does, the nontechnical individual, team, and cultural values, beliefs, attitudes, and behaviors that also influence frontline performance and outcomes.

> HF/E has a wide variety of applications spanning the organization and systems level, including macroergonomics and systems safety, to the more specific design and analysis of individual tools and tasks, physical ergonomics and layouts of surgical suites and patient rooms, human-technology integration, teamwork, and human error. (Holden et al., 2015, as cited in Keebler et al, 2022, p. 251)

Human factors publications in healthcare have increased substantially since the early 21st century (Keebler et al., 2022); while nontechnical human factors remain underaddressed in practice. A seminal article by Leonard et al. (2004), "The Human Factor: The Critical Importance of Teamwork and Communication in Providing Safe Care," argued that "teaching people how to speak up and creating the dynamic where they will express their concerns is a key factor in safety. Frequently, the lack of a common mental model or hierarchy gets in the way" (p. 85).

To co-construct a shared mental model for collaborative voice and response with surgery team participants, this study explored nontechnical human factors of individuals and teams, in terms of what Keebler et al. (2022) (including Salas, see below), called the ABCs: attitudes, behaviors, and cognitions, defined as follows:

> *Attitudes* refers to the way members of a team feel about each other, their capabilities, and their ability to reach their goals. *Behaviors* refers to the various things that teams do to achieve their goals, be it communicating, coordinating, or making decisions. *Cognitions* refer to the things teams think about and know, and how well this information is shared and understood among various members. (p. 253)

Salas et al. (2009) identified nine attitude factors, 16 behavioral factors, and five cognitive factors, each with observable and measurable behavioral markers, in the ABCs of teamwork human factors, some of which are in the findings and discussion chapters of this paper. The literature review first addresses human factors and human errors in surgery, and challenges that frontline surgery teams face in patient safety and their own well-being. The review then takes an organizational systems view, followed by teamwork and individual human factors that lay the groundwork for a shared mental model of collaborative voice and response.

Human Factors and Human Errors in Surgery

"Human Factors and Cardiac Surgery: A Multicenter Study" (de Leval et al., 2000) focused early 21st century attention on human factors in surgery, reporting how major and minor human errors or failures, and defense mechanisms against them, impact patient outcomes. A surgeon researcher (de Leval) and United Kingdom human factors experts (including James Reason, a global pioneer in safety psychology) studied 243 arterial switch operations in children

born with transposition of the great arteries, a critical congenital condition causing oxygen-poor blood to recirculate between the heart and body without going to the lungs; while oxygen-enriched blood recirculates between the heart and lungs without going to the body.

Arterial switch operations can be lifesaving, but have high risk and complexities, with low tolerance for error. This report listed 34 variables and 20 contextual factors. Surgical outcomes of 243 cases were grouped into four categories: 16 patients died (6.6% mortality rate); 43 patients (17.7%) had near misses, with serious complications such as postoperative cardiac arrest, major infections, and permanent neurologic damage; 65 patients (27%) had less serious complications, such as minor infections and temporary neurologic issues; and 119 patients (49%) recovered well within 72 hours, with no intraoperative or postoperative complications.

Human factors experts documented intraoperative observations of individual and team performance and communications, plus major and minor events (failures or errors). From the 243 surgery cases studied, observational data from 173 cases were considered reliable. Analyses of the 173 surgeries found 167 major events and 1,033 minor events. Ninety-five surgeries had no major events, 38 surgeries had one major uncompensated event, 16 surgeries had two major uncompensated events, 10 surgeries had three uncompensated events, three surgeries had four major uncompensated events, seven surgeries had five major uncompensated events, and four surgeries had six major uncompensated events.

> Major and minor human failures were extracted from the written report. Major negative events were potentially life-threatening failures, whereas minor events were failures that, in isolation, were not expected to have serious consequences.
>
> Major events were closely related to death ($P < .001$) and death and/or near misses ($P < .001$). Appropriate compensation, however, sharply reduced the risk of death ($P = .003$). The total number of minor events was also closely related to both death and death and/or near misses ($P < .001$). (p. 661)

De Leval et al. (2000) described cardiac surgery as a highly complex sociotechnical system in which “performance and outcomes depend on complex individual, technical, and organizational factors and their interactions” (p. 662); with human factors research being “a

major contributor to safety and reliability enhancement" (p. 662). The study concluded that a single uncompensated major failure *and/or* the accumulation of uncompensated minor errors (that may be more difficult to detect and thus go unnoticed) can lead to patient death or permanent harm. However, greater understandings, awareness, and use of "human factors defense mechanisms can lead to a successful outcome" (p. 661).

A Mayo Clinic observational study of 31 cardiovascular (heart and blood vessel) surgeries identified 155 intraoperative technical errors, averaging five errors per operation (Wiegmann et al., 2007). The researchers (surgeons and human factors experts) distinguished between errors that were caught immediately (immediate capture) and errors that were detected later (delayed capture). While 60% of the surgical errors were captured immediately, most often by the person who made the error; *40% were delayed capture errors, that were 2.7 times more likely to be detected by team members other than the surgeons.* "Delayed capture errors are 'near misses' and most susceptible to result in an adverse event… poor teamwork may predispose to surgical errors; however, good teamwork… may facilitate the detection and remediation of errors when they do occur" (pp. 663-664).

Turner, in his seminal book *Man-Made Disasters*, argued that *incubation periods* often precede disasters, and that inadequate information handling during incubation periods are *failures of foresight* (Turner, 1978, as cited in Flin, 1998). And yet, "failures of hindsight" (Flin, 1998, p. 91)—unknown, unlearned, or unheeded lessons from past disasters—have continued to allow new preventable disasters to occur across high-consequence industries.

Minor surgical errors that accumulate and major errors that are uncompensated, and delayed capture (during incubation periods) errors that are almost three times more likely to be detected by team members other than surgeons, accentuate the need for a shared mental model to help surgery teams detect, convey, and correct errors, and avoid preventable patient harms. When teams do not detect, convey, and correct errors initially made by individuals, the individual errors can become team errors (Sasou & Reason, 1999; Weick & Sutcliffe, 2015).

Patient Safety

Patient safety and clinician well-being are mutually influencing, shared goals in healthcare (Institute of Medicine, 2000, 2001, 2004; National Academy of Medicine, 2019; Nundy et al., 2022). With the myriad of treatments and procedures each having multiple potential failure points, keeping every patient safe from every potential harm is a daunting challenge. Every year in the United States alone, surgery teams perform over 50 million operations, each with clinical and human factors challenges, a wide range of complications among patients, and multiple possibilities for latent system flaws and active frontline human errors that can harm patients (Hempel et al., 2015; Reason, 1997). Families, surgery team members, and healthcare leaders and organizations are also harmed.

Patient harms that result from preventable system flaws and human errors occur in a small percentage but large numbers of U.S. surgeries and other medical treatments; and each preventable harm matters greatly to all concerned. A leading study at 11 Massachusetts hospitals by prominent researchers (Bates et al., 2023) used a weighted random sample to conclude that at least one preventable adverse event occurred during seven percent of all 2018 hospital admissions. Harms from preventable adverse events were serious, life-threatening, or fatal for one percent of patients. In many U.S. hospitals, voluntary reporting of adverse events "results in substantial underreporting and, in some cases, misleading reports of zero harm" (p. 152). Reflecting on progress in the last three decades, Bates et al. concluded that "despite stunning advances in medical science, we still have important gaps in patient safety" (p. 152).

The daunting challenges are to avoid or reduce preventable errors, and to mitigate errors and avoid or reduce harms that may still occur. These challenges are confronted one procedure or treatment at a time, every time, with every patient. The following subsections describe four of the most common preventable adverse events in surgery: unintentionally retained foreign objects, wrong surgeries, surgical site infections, and surgical fires and burns.

Unintentionally Retained Foreign Objects

Johns Hopkins Medicine researchers reported that unintentionally retained foreign objects (surgical sponges, instruments, needles, or parts of them left in the body when the incision is closed), also known as retained surgical instruments, occurred more than 1,500 times a year in the United States (Pham et al., 2012). Since then, ongoing safety efforts have included Association of Perioperative Registered Nurses guidelines, which stipulate that the entire surgery team shares responsibility for surgical instrument counts (Fencl, 2016; Cochran, 2022).

An extensive, collaborative, multicenter (114 health care facilities) project addressed culture change along with readiness for change; technology aids such as radiofrequency identification, radiographic imaging, and computer software; and process reliability such as an "evidence-based best practice bundle with five elements: surgical stop, surgical debrief, visual counter, imaging, and reporting of deviations" (Carmack, 2023, p. 3). Significant improvements over two years included a 14.3% reduction in patient harms, and increased bundle compliance from 51% to 70.5%, although bundle compliance fell short of the 80% goal.

The Joint Commission is the preeminent national and global organization that certifies and accredits healthcare organizations for patient safety and quality of care. In large part because reporting is voluntary, only a small percentage of sentinel events—patient deaths, permanent injuries, or severe temporary injuries—are reported to The Joint Commission (which prefers "the" to be capitalized even within sentences). Unintentionally retained foreign objects were in the top five most frequently reported causes of sentinel events between 2019 and 2023; and also in the top five were wrong-site, wrong-procedure, wrong-patient surgeries (The Joint Commission, 2024).

Wrong Surgeries

W*rong-site, wrong-procedure,* and *wrong-patient* surgeries are performed on the wrong side or part of the body, or with the wrong surgical procedure, or on the wrong patient (Pham et al., 2012). There are also *wrong-implant* surgeries, such as an artificial left knee implanted in

the right leg; and *wrong-level* surgeries, such as in the spinal column's 33 vertebrae and 31 pairs of spinal nerves.

Wrong surgeries have estimated rates of 0.09 to 4.5 per 10,000 surgeries in the United States (a wide range due to underreporting, lack of real-time data, and various retrospective data methods). Each occurrence has profound consequences for everyone involved. Multiple contributing causes at system, team, and individual levels include production pressures and deficient safety cultures; not confirming the correct patient, procedure, surgical site, or implant part; improper patient positioning; not taking prescribed time-outs to verbally reconfirm the correct patient, site, and procedure; flawed intraoperative decisions and techniques, and team communication breakdowns (Hempel et al., 2015).

Speak Up is at the top of a poster displaying The Universal Protocol, a prescribed set of standard procedures based on expert consensus, introduced by The Joint Commission in 2004 to prevent wrong surgeries. The protocol includes a time-out before the incision, with all team members confirming they have the correct patient, procedure, and surgical site. And yet, approximately 40 wrong-site surgeries occur every week in the United States alone (American College of Surgeons, 2022).

Surgical Site Infections

Surgical site infections can be caused by bacterial microorganisms that exist naturally inside patients' bodies, and by inadequate incision site care by patients or home caregivers after hospital discharge (Anderson et al., 2014; Beldi et al., 2009). However, surgical site infections are also caused in hospital perioperative areas by inadequate patient skin and body hair preparation, inadequate clinician hand hygiene and body coverings (masks, gowns, gloves, caps, and shoe covers), and contaminated surgical instruments and operating room surfaces.

Surgical site infections are the most common and costly type of hospital acquired infection (Anderson et al., 2014). They occur in two to five percent of surgical inpatients; and account for 20% of all hospital acquired infections, with 160,000 to 300,000 surgical site

infections reported annually in the United States. Surgical site infections (SSIs) can prolong patient hospital stays by seven to 11 days, and can increase risks of patients dying by two to 11 times. “Seventy-seven percent of deaths in patients with SSI are directly attributable to SSI” (p. 2). Estimated financial costs from SSIs range from $3.5 billion to $10 billion annually.

Surgical Fires and Burns

Surgical fires, with an estimated 550 to 600 U.S. surgical fires annually, are less common but devastating adverse events that can result in death, third degree burns, airway damage, scarring, disfigurement, and psychological trauma (Choudhry et al., 2017; Hempel et al., 2015). A study of 103 surgical fires found that 93 (90%) were caused by electrocautery, in which an electrically heated, pen-shaped instrument is used to destroy and remove damaged or harmful body tissues, to close blood vessels to stop bleeding, and to prevent infections (Hempel et al., 2015). Laser treatments, especially around the head, neck, and chest, are also a fire and burn risk. Chemical solutions and other sources can also cause burns.

Lack of individual and shared situation awareness of risks, along with communication breakdowns, can result in surgical fires and burns (Herman et al., 2009, as cited in Hempel et al, 2015). A retrospective review of 139 surgical fire and burn malpractice lawsuits (from 1982 to 2015) found that two patients had died from airway fires, and 29 patients had permanent, serious, and disabling injuries (Choudhry et al., 2017). Choudhry et al. concluded that fire and burn prevention should begin with preoperative briefings and checklists, and that surgery teams should “continue intraoperative communication… with great attention to minor details” (p. 562).

In summary, each surgical procedure has multiple challenging possibilities for error. Adverse events such as unintentionally retained foreign objects, wrong surgeries, surgical site infections, and surgical fires and burns require the active collaboration of surgery team members to achieve the shared goal of patient safety. Unpredictable variations in leadership, collaborative communications, and human factors interfere with highly reliable performance and

outcomes (Bates & Singh, 2018; Institute of Medicine, 2000, 2004; The Joint Commission, 2015).

In 2008, the highly-regarded Institute for Healthcare Improvement (IHI) introduced the Triple Aim, which became a widely-adopted model for industry goals of: (1) safer and higher quality patient care, (2) lower healthcare costs, and (3) better population health in the communities served by hospitals (Berwick et al., 2008). A shared mental model of collaborative voice and response could help teams detect, convey, and correct errors (Sasou & Reason, 1999); reduce errors and the burdens of errors for clinicians (Bognár et al., 2008); reduce harms to patients (Institute of Medicine, 2000, 2004); and enhance the well-being of all surgery team members, including surgeons (National Academy of Medicine, 2019).

Clinician Well-Being

Clinician well-being has received increasing attention in the healthcare industry (National Academy of Medicine, 2019). Since the IHI Triple Aim was introduced in 2008, other healthcare leaders, clinicians, and researchers have advocated for "care of the caregivers" as a *quadruple aim*—a fourth aim to explicitly include clinician well-being as a prerequisite for achieving the Triple Aim (Bodenheimer & Sinsky, 2014; Privitera, 2018; Sikka et al., 2015; Swensen & Shanafelt, 2020). Arguably, people who care for the health of others should themselves be well.

However, the COVID-19 pandemic placed extraordinary stresses on frontline clinicians, while further revealing and exacerbating existing health inequities among population groups. Kedar Mate, MD, who in 2020 became the IHI's president and chief executive officer, and two physician colleagues since proposed a *quintuple aim*—with clinician well-being the fourth aim and health equity the fifth aim, and the model as a five-point North Star (Nundy et al., 2022).

Clinician well-being and patient safety are mutually influencing; and yet, mounting pressures in the healthcare environment have led to an imbalance of job demands over job resources, increased burdens, and chronic stresses on frontline clinicians—leading to a clinician burnout crisis with serious and wide-ranging consequences (Dzau et al., 2018; National

Academy of Medicine, 2019; Swensen & Shanafelt, 2020). Epidemic levels of clinician burnout have increased since 2020 and the COVID-19 pandemic (Institute for Healthcare Improvement, 2020; Nundy et al., 2022). The following two sections describe clinician burnout, moral distress, and moral injury, contrasted with clinician well-being and thriving.

Burnout, Moral Distress, and Moral Injury

Burnout is an insidious syndrome in organizations, in which chronic job stressors build up so that people are emotionally and physically exhausted; cynical, alienated, and depersonalized (cold toward and distant from other people); and feel reduced self-efficacy (ineffective and inadequate) (Maslach & Leiter, 1997). Notably for collaborative voice and response or its absence, job burnout is also caused by the "*social environment* in which people work… how people interact with each other and how they carry out their jobs. When the workplace does not recognize the human side of work, then the risk of burnout grows" (p. 18). "Burnout is a gradual process of loss during which the mismatch between the needs of the person and the demands of the job grows even greater" (p. 24), resulting over time in gradual erosions of positive emotions and less discretionary engagement in work. Worse yet, burnout can be contagious in groups, creating a downward spiral of emotional and physical stress for teams, disengagement from colleagues and the work, negative communications, and non-collaborative teamwork, leading to poor performance and poor outcomes.

"To Care is Human: Collectively Confronting the Clinician Burnout Crisis" (Dzau et al., 2018) was co-authored by the three physicians leaders of the National Academy of Medicine, the Association of American Medical Colleges, and the Accreditation Council for Graduate Medical Education (which oversees residents' specialty training and fellows' subspecialty training). The article described growing healthcare culture problems, team dysfunctions, and clinicians' loss of meaning. It was a call to action make clinician well-being a national priority, which followed previous calls to action to make patient safety and overall healthcare quality national priorities (Institute of Medicine, 2000, 2001). The article called attention to a National

Academy of Medicine initiative started in 2017—the Action Collaborative on Clinician Well-Being and Resilience—to focus on the multiple system and cultural issues that influence well-being.

The subsequent consensus report, *Taking Action Against Clinician Burnout: A Systems Approach to Professional Well-Being* (National Academy of Medicine, 2019) reported that "between 35 and 54 percent of U.S. nurses and physicians have substantial symptoms of burnout" (p. 1). The report called attention to chronic imbalances of overwhelming job demands exceeding job resources. Contributing to burnout is *moral distress*, "the anguish experienced when clinicians perceive that they have participated in a morally undesirable situation or been unable to act in accord with their professional ethical values" (pp. 94-95)

"Clinician burnout is a complex and multifaceted problem and consequently there is no single solution" (National Academy of Medicine, 2019, p. 285). The report called again for a systems approach of coordinated actions across the external environment, internal hospital cultures, and the frontlines of care; and recommended six actions against clinician burnout. First, and most relevant to this study, is to *create positive work environments* that enhance and facilitate "meaning and purpose… interprofessional teamwork, collaboration, communication, and professionalism… culture that supports psychological safety and facilitates participatory decision making and peer support" (p. 288). Further related to this study's aim of co-constructing a shared mental model of collaborative voice and response with participants, "the most meaningful and sustainable improvements often involve the active participation of those closest to the work… translating their insights, experiences, and expertise into… developing and implementing solutions… to exert greater control over their work environment" (p. 156).

Similar to moral distress, Dean et al. (2019) argued that clinician burnout should be reframed as *moral injury.* In this view, burnout is but a symptom of the underlying cause, moral injury: "when we perpetrate, bear witness to, or fail to prevent an act that transgresses our deeply held moral beliefs" (p. 400). Moral beliefs are reflected in the caregivers' oath to "put the needs of the patient first… the lynchpin of our working lives and our guiding principle when

searching for the right course of action" (p. 400). Caregivers can be in a double bind, knowing what patients need but facing significant barriers in providing it. Healthcare systems, at worst, can "take emotionally healthy, altruistic people and methodically squeeze the vitality and passion out of them" (Swenson and Shanafelt, 2020, p. 3). In some of the world's most challenging professions, highly intelligent and dedicated people, who willingly take responsibility for people's safety and lives in their hands, should instead be thriving.

Beyond Well-Being to Thriving

Beyond reducing burnout and moral injury for clinician well-being, transforming healthcare work environments can help people thrive, as described by Spreitzer et al. (2012):

> *Thriving* is a crucial mechanism for increasing job performance, while also mitigating burnout and improving health… Thriving is indicated by the joint experience of *vitality* and *learning* [emphasis added]… Vitality denotes the sense that one is energized and feels alive at work. When thriving, people feel passionate about what they do. They produce their own energy through excitement for their work… a spark that fuels energy in themselves and others… Learning is about growing through new knowledge and skills. When thriving, people believe they are getting better at what they do… self-learners who actively seek out opportunities to learn new things and develop. (p. 155)

Thriving, vitality, and learning can be difficult for caregivers to achieve and sustain. The many obstacles include the constant emotional challenges of caring for struggling patients and families, keeping up with the explosive growth of medical science and technology, job demands (including production pressures) that exceed job resources, detrimental effects of suboptimal leadership styles, and ongoing gaps in understanding and attending to these and other human factors that influence the quality of work and work lives (Institute of Medicine, 2004; Leape, 2021; National Academy of Medicine, 2019).

According to Swenson and Shanafelt (2020), leading physician researchers in clinician well-being, frontline care teams themselves should create and maintain their own local, standardized protocols. "Professionals will thrive when they are treated as respected team members who are asked to co-design the work environment rather than as just workers whose thoughts and ideas don't matter" (p. 139). The purpose of this study was to help surgery teams

co-construct their own shared mental model of collaborative voice and response to help them thrive. The following sections address system and team level approaches to inform such efforts.

Organization and Unit-Team Level Systems Approaches

The Institute of Medicine (2000, 2001, 2004) and, as it was renamed in 2015, the National Academy of Medicine (2019) called for systems approaches to meet healthcare challenges. Three related systems approach theories are integrated core concepts for this study: complexity theory, high reliability theory, and safety culture theory.

First, the Institute of Medicine (2001) recommended that 21st century healthcare systems should be designed as *complex adaptive systems*. Second, the healthcare industry seeks to achieve *high reliability* in performance and outcomes, with increasingly fewer errors and adverse harm events, relative to the endless possibilities for them to occur (Chassin & Loeb, 2011, 2013; McKeon et al., 2006). Third, essential for high reliability are effective organizational *safety cultures* that prioritize safety over other goals such as production and hierarchy; and the unit and team *safety climates:* snapshots in time of how frontline team members feel about current safety practices (Dekker, 2019; Mearns & Flin, 1999; Reason, 1997). Relevant features of these three organization level and unit-team level system approaches are reviewed below.

Complex Adaptive Systems

The Institute of Medicine's seminal report, *Crossing the Quality Chasm: A New Health System for the 21st Century* (2001)*,* recommended that 21st century healthcare organizations, and their microsystems such as surgery teams, should be designed—and by implication, understood and operated—as *complex adaptive systems*, a systems thinking model derived from complexity science and theory. Understanding complex adaptive systems thinking can help the frontlines and leaders conceptualize and operationalize how individual and team actions, reactions, interactions, and relationships, plus other elements of hospital systems, influence each other and can be better designed and managed as to how well they do so.

A complex adaptive system is a “collection of individual agents with freedom to act in ways that are not always totally predictable, and whose actions are interconnected so that one agent’s actions changes the context for other agents” (Plsek & Greenhalgh, 2001, p. 625). As described by the Institute of Medicine (2001):

> A health care *system* can be defined as a set of connected or interdependent parts or agents… bound by a common purpose and acting on their knowledge. Health care is *complex* because of the great number of inter-connections… health care systems are *adaptive* because unlike mechanical systems, they are composed of… clinicians who have the capacity to learn and change as a result of experience.
>
> Their actions in delivering health care are not always predictable, and tend to change both their local and larger environments. The unpredictability of behavior in complex adaptive systems can be seen as contributing to huge variation in the delivery of health care. If such a system is to improve its performance—that is, improve the quality of care it provides—*some of these actions need to be specified to the extent possible so they are predictable with a high level of reliability*. [emphasis added] (pp. 63-64)

Like other healthcare teams, surgery teams have interdependent agents from multiple disciplines (surgeons, anesthesiologists, nurses, and technologists) who act, interact, adapt, and co-evolve in varying and sometimes unpredictable ways that change the work and the context of work contexts for each other. Even hearts and minds are complex adaptive systems, made of simultaneously independent and interdependent, mutually influencing parts; which, in surgery and other teams, interact with the hearts and minds of other team members, in sometimes unpredictable ways.

Team members who consider speaking up are influenced by at least four human factors: surgeon leadership styles, the perceived presence or absence of psychological safety, self-efficacy and collective efficacy, and voice and response skills and behaviors (Edmondson, 1999, 2019; Morrison, 2014; Okuyama et al., 2014). Surgeons, as team leaders, may or may not genuinely invite voice and respond collaboratively to it. They may be influenced by at least seven human factors: awareness of their own human fallibility, potential impacts to patient care and team dynamics, professional and cultural norms, understanding how difficult speaking up

can be for others, respect for the speaker's knowledge and experience, content and tone of the voice, and the relationship with the speaker (Long et al., 2020).

In the complex adaptive systems of surgery teams, multiple human factors overlap, interact, and influence each other. In turn, team members' actions, reactions, and interactions influence their work and work environments in sometimes unpredictable and suboptimal ways. Along with the extraordinarily complex human endeavors of surgery and anesthesia, rapidly expanding medical science and technology, skilled but still fallible human clinicians working in foundational but still fallible human systems, and variations in patient conditions—these factors necessitate conceptualizing and operationalizing healthcare, and its microsystems such as surgery teams, as complex adaptive systems (Institute of Medicine, 2001).

"Reframing Surgical Care: Understanding Complexity and Promoting Teamwork" (Dillon, 2015) reported how multidisciplinary surgery teams at Pennsylvania State College of Medicine conceptualized and operationalized a complex adaptive systems approach. Their goal was to transition from the traditional culture of professional silos "that impede development of high functioning teams; [from] hierarchy and authority gradients that interfere with shared goal setting and problem solving; and [from] intimidating behaviors and demeaning communications that create disrespect" (p. 907). Dillon, the surgery department chair at the time, maintained that a surgery team's success "depends upon and emerges from the interactions of interconnected and interdependent individuals… [that] must result in an outcome that is greater than the sum of the parts" (p. 907). Complex adaptive systems principles were used to transition from the "classic physician-focused hierarchical structure to a patient-centered matrix" (p. 908).

Collaborative Care Rounds were instituted, with physicians, nurses, and therapists making the rounds of patients together, sharing information, and coordinating care (Dillon, 2015). All perioperative disciplines met in weekly 30-minute Collaborative Care Forums to reinforce positive practices and address negative practices. The proactive, multidisciplinary forums contrasted with reactive morbidity and mortality (M&M) conferences, traditionally

attended only by physicians to retrospectively review what went wrong and what could have been done better in specific patient cases.

Conceptualizing and operationalizing complex adaptive systems principles and methods resulted in better patient outcomes and satisfaction, lowered hospital-acquired infection rates, reduced lengths of hospital stays, and improved relationships and communications among physicians and nurses. With intentional designs that are understood, managed, and operated as complex adaptive systems, along with more informed human factors, it was a culture shift of hearts and minds, and practices.

High Reliability Organizations and Teams

High consequence industries, where people's safety and lives are at stake, are complex adaptive systems that must understand and manage the complexity of hazardous technologies and high risks, with multiple possibilities for system breakdowns and human errors, often around the clock, every day and night. Among them, highly reliable or high reliability organizations are those that consistently achieve high levels of safety and performance with remarkably low rates of error (Roberts, 1990; Rochlin et al., 1987; Weick & Roberts, 1993; Weick & Sutcliffe, 2015). Supported by organization leaders, highly reliable frontline units and teams prioritize and keep *safety first*, with production as efficient as possible under the circumstances at the time.

According to Weick and Sutcliffe (2015), they do so by maintaining *intelligent wariness* through *individual and collective mindfulness* toward *heedful attentiveness,* to detect weak signals of system flaws, human errors, and potential or actual harms; and toward *heedful interrelating,* to convey and correct system flaws and human errors, and avoid or minimize harms. "Relationships and continuous conversation are essential" (p. 79) as highly reliable organizations and teams consistently adhere to three *principles of anticipation* to prevent system breakdowns (and flaws) and avoid human errors; and two *principles of containment* to avoid or minimize harm from flaws and errors that still occur. The principles of anticipation are:

Preoccupation with failure – High reliability organizations and teams are heedfully attentive to see and avoid *known* potential failures and *unexpected* internal risks (inside the team) and external threats (outside the team). They are intelligently wary of large red flags and small weak signals—signs of what could go wrong—and do not disregard, underestimate, simplify, or normalize them. “Near misses” that narrowly avert dangers and harms—through “good catches” where someone intervened just in time, or just good luck—are not considered as signs of system safety; but rather, opportunities to learn and improve safety. Long periods without errors or failures are signs to increase rather than relax attention to safety.

Reluctance to simplify – Highly reliable organizations resist simplifying and rationalizing “unwanted, unanticipated, unexplainable details” (p. 64). Team members scrutinize *discriminatory details,* by asking themselves and each other what is different from what is expected—being mindful of anomalies that could lead to unreliable performance and outcomes. Taking advantage of *requisite variety,* people with different perspectives notice different things, and speak up with concerns, opinions, and questions. “In a varied, complex environment... people need varied, complex sensors to register the environmental complexities” (p. 67).

Sensitivity to operations – Recognizing their interdependence in complex operations, highly reliable teams mesh their contributions to system safety by proactively sharing current situation awareness and knowledge of changing conditions, challenges, and solutions. Through heedful interrelating, they construct, maintain, and adjust shared mental models in real time, during both routine and dynamic operations. Highly reliable teams share situation awareness of the presence or absence of safety, and take appropriate actions to keep safety first.

Even as high reliability organizations and teams collaborate to anticipate, avoid, and prevent errors so fewer occur; they remain mindful that some errors will inevitably still happen, and seek to contain them (Weick and Sutcliffe, 2015). The two principles of containment to avoid, prevent, or minimize harms from breakdowns and errors that still occur are:

Commitment to resilience – Highly reliable team members cross-monitor situations, and each other, to identify internal risks, external threats, and errors—acting swiftly, "keeping errors small… while persisting" (p. 97) toward operational goals. Highly reliable teams detect, convey, and correct errors early—when there are more and simpler solutions available; rather than later, when solution options are fewer, more difficult, and more safety-critical.

Deference to expertise – Highly reliable teams recognize, value, and trust that all team members have expertise; and they defer to the team member with the greatest situation awareness of the current presence or absence of safety—who in any moment is *not necessarily the person with the highest professional status or seniority.* "Expertise... is a co-production" (p. 116); and system safety is "bigger than any one individual can comprehend. All of this is the opposite of hubris, which shuts down emergent expertise" (p. 124). Deferring to expertise deemphasizes siloed hierarchical barriers, to emphasize interdependence, generate team trust and mutual respect, and build authentic relationships, with effective team communications.

In conclusion, consistent with calls for system approaches to improve patient safety and clinician well-being (Institute of Medicine, 2000, 2001, 2004; National Academy of Medicine, 2019), the preceding sections presented three related and overlapping system approaches, in which taking actions on individual and team human factors are significant: (1) conceptualizing and operating hospitals, and microsystems such as surgery units and teams, as complex adaptive systems; (2) practicing high reliability principles and methods; and (3) improving hospital safety cultures and team safety climates. Wide variations in understandings, mental models, and practices remain.

"It is highly likely that theorizing of high reliability is not matching the speed of change in practice" (Martelli et al., 2018, p. 685). Adding to system challenges, the following section describes how team leaders and team members influence, and are influenced and sometimes constrained by, additional challenges, including the organizational culture and safety culture, and the safety climates within units and teams.

Safety Culture and Safety Climate

The Joint Commission (Chassin & Loeb, 2011, 2013) has long advocated that strong safety cultures (and by extension, safety climates) are one of three components, along with leadership commitment to zero harm and robust technical process improvements, that are essential for more highly reliable healthcare. According to pioneering safety researcher James Reason, an informed culture is one in which "those who manage and operate the system have current knowledge about the human, technical, organizational, and environmental factors that determine the safety of the system as a whole. In most important respects, an informed culture *is* a safety culture" (Reason, 1997, p. 195). This study focused on helping surgery team members who operate the system co-create an informed culture and shared mental model of individual and team human factors that help determine patient safety and their own well-being.

Safety culture as a concept gained broader awareness though a series of reports from the International Atomic Energy Agency investigation of the 1986 Chernobyl nuclear reactor explosion in then-Soviet Ukraine. *INSAG-4: Safety Culture* (International Nuclear Safety Advisory Group, 1991) defined safety culture as "that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority… safety issues receive the attention warranted by their significance" (p. 4). *INSAG-4* posited that safety culture has two components: "The first is the necessary framework within an organization and is the responsibility of the management hierarchy. The second is the attitude of staff at all levels in responding to and benefitting from the framework" (pp. 4-5). Leaders, including surgeons on the frontlines, must first establish frameworks for staff to respond and benefit from prioritizing safety.

Safety culture is a sub-component of organizational culture. Both can vary over time but are relatively stable and difficult to change (Chassin & Loeb, 2011, 2013; Reason, 1997). On the frontlines, *safety climate* is more transient and easier to change. Safety climate is *a* snapshot at a given time and place, such as in a surgery unit or team, of how workers perceive actual safety, and the attention and overriding priority that safety actually receives in practice (Dekker,

2019; Mearns & Flin, 1999). Safety climates can vary with different leaders, between different teams, and with the same leader or team at different times. In a Stanford qualitative interview study, 60% of nonsurgeon team members believed that the senior attending surgeon's tone and mood "could drastically alter OR communication" (Grade et al., 2018, p. 109); while only 36% of attending surgeons believed that *they* set the operating room climate.

Important elements of safety culture and safety climates include often underaddressed, and therefore less understood and less well-managed, nontechnical human factors such as leadership. Human factors were introduced at the beginning of this chapter, and are described in more detail below.

Human Factors

Patient harms from medical errors occur in hospitals most often in the perioperative areas before, during, and after surgery (Institute of Medicine, 2000, 2001, 2004). The leading root causes are breakdowns in leadership, human factors, and communications; which are all human factors (The Joint Commission, 2015). In many or most industries, including healthcare, human factors are underaddressed in academic education and workforce training.

In addition to leadership and communications, nontechnical human factors include perceived psychological safety—whether it will be personally and professionally safe or risky to voice concerns, opinions, or questions; and perceived self-efficacy and collective efficacy—whether speaking up will be effective on the parts of both the sender and receiver (Edmondson, 1999, 2019; Morrison, 2011, 2014; Okuyama et al., 2014). Transformational leadership, psychological safety, self-efficacy, collective efficacy, and collaborative voice and response skills and behaviors are human factors described in the following sections.

Transformational Leadership

Surgeons face unique challenges as team leaders. They are responsible for ensuring that all surgery tasks are performed safely and with quality of care, while optimally modeling collaborative teamwork and supporting individual team members (Hoyt & Ko, 2017). They do

this *while* focusing on the patient's condition and intricate procedures they are performing themselves; and *while* coping with various sources of pressure, stress, and fatigue—some of which are unexpected and all of which can make people more fallible, regardless of expertise.

An opinion article in the *Surgery Journal of the American Medical Association* (Vu et al., 2019) asserted that for surgical residents (in training after medical school), leadership training has been unstructured and informal. Residents thus experience and may adopt varied leadership practices, some of which may be inappropriate and detrimental.

> Without intentional training or knowledge of leadership concepts, residents may feel uncomfortable speaking out against inappropriate leadership behaviors or may adopt these bad practices themselves. Practice makes habit, and habits can be hard to break, reinforcing ineffective leadership over time. (p. 575)

The authors called for formal leadership development programs and leadership skills practice, with feedback and accountability for effective surgeon leadership in the operating room.

Keeping Patients Safe: Transforming the Work Environment of Nurses (Institute of Medicine, 2004) called for more team-oriented *transformational* leadership; describing it as potent, crucial, and "the "essential precursor" (p. 109) to safety. Transformational leadership is one of five criteria for nursing's coveted Magnet designation, which recognizes hospitals that attract and retain top nurses (American Nurses Credentialing Center, n.d.).

Transformational and transactional leadership have been viewed as contrasting or conflicting styles, with leaders predisposed toward one style or the other. However, they are not mutually exclusive; they can be chosen and used situationally as complementary styles (Hu et al., 2016). How they are used or misused, and the resulting impacts, can be significant.

To assess how transformational and transactional practices influence team members' discretionary behaviors of voice, cooperation, and knowledge sharing, Hu et al. (2016) correlated leadership styles from the Multifactor Leadership Questionnaire with surgeon behaviors from the Surgical Leadership Inventory; and then observed leadership behaviors of five surgeons, and the impacts on team dynamics. Transactional behaviors emphasized clear

performance targets and attention to mistakes and failures. Transformational behaviors also emphasized the collective mission and goals, while showing optimism and enthusiasm, seeking other perspectives, and considering the needs and contributions of team members. The researchers observed, recorded, and analyzed 28 hours from five general or oncology (cancer) surgeries, in procedures that normally had high complication rates of over 20 percent. For each of the five lead surgeons, observers rated transformational and transactional leadership behaviors on a scale of 0 (low) to 4 (high). Transactional ratings varied little, ranging from 2.38 to 2.69; while transformational leadership ratings varied considerably, ranging from 1.98 to 3.60.

The surgeon with the highest transformational leadership score (3.60) started early, during patient preparation in the preoperative area, to purposely engage each team member, including a nursing student and a medical student, without regard to their lower status in the hierarchy. Throughout the operation, this surgeon showed consideration toward individual team members as people, and as contributors and learners; while emphasizing the collective mission, seeking others' perspectives, supporting and complimenting others, and showing gratitude and enthusiasm. Communications included:

> To one of the students: *"Happy to be part of your first [operation]!"*
> To the anesthesiologist (a physician): *"Or what do you want to do?"*
> To the surgery resident: *"Should we take all that [cancer]… on top of that [organ] out?"*
> To all: *"We are so happy! You know what we're looking at? We are looking at the vessels, just sitting underneath us… Oh my goodness. This is when surgery is fun. Look at this beautiful anatomy. You've got to come over here and see this."* (pp. 45-46)

The surgeon with lowest transformational score (1.98) suboptimally used a self-focused, power-driven approach from the start, setting "an accusatory and antagonizing tone" (Hu et al., 2016, p. 46). He entered the operating room and immediately confronted the anesthesiologist who had, in accordance with hospital protocol, correctly ordered what the surgeon called a ridiculous and wasteful amount of blood. The surgeon refused to answer questions that had been asked for clarification; told a resident surgeon, "I don't care about any patients but mine" (p. 46); and did not ask a medical student's name until almost six hours into the operation.

Notably, *each one-point increase in transformational scores increased team voice behaviors by 542% and increased knowledge sharing by 300%* (Hu et al., 2016). And yet, task-focused, transactional leadership scores varied little among the five surgeons; indicating that some surgeons may have been more aware of and perhaps more inclined to use either style situationally. The study concluded that "transformational leadership is additive, rather than inversely correlated, to transactional leadership" (p. 48).

In summary, surgery units and teams are complex adaptive systems of individual agents who are simultaneously independent and interdependent, and whose actions and interactions influence each other and their work environments in often unpredictable ways. Unpredictable and sometimes suboptimal safety climates influence teamwork, performance, and outcomes (Institute of Medicine, 2001, 2004). Transformational leadership sets a positive tone and safety climate for more predictable, reliable, and functional interactions and relationships (Dillon, 2015; Edmondson, 2019; Grade et al., 2018; Hoyt & Ko, 2017; Nembhard & Edmondson, 2006; Edmondson & Lei, 2014). Closely related to the tones set by leaders, safety climates are also influenced by how team members perceive the presence or absence of psychological safety.

Psychological Safety

Edmondson (1999) defined psychological safety as "a shared belief held by members of a team that the team is safe for interpersonal risk" (p. 350). Psychological safety requires mutual trust and mutual respect, between any two individuals and within the team as a whole (Edmonson, 2019). Psychological safety climates vary qualitatively across surgery teams, influenced by team leaders' different leadership styles and their different understandings of the impacts they have on the team safety climate (Bognár et al., 2008; Grade et al., 2018).

Optimal Resources for Surgical Quality and Safety, the first manual of its kind by the American College of Surgeons (Hoyt & Ko, 2017), prescribed standards to reduce variations in safety and quality. It called for surgeons to lead coordinated, team-based, and collaborative processes throughout the preoperative, intraoperative, and postoperative phases. One standard

for surgeons is to lead preoperative team briefings—to confirm the patient identity and surgical site; discuss surgery procedures, plans, and patient conditions; discuss questions and concerns; and establish expectations by “telling other team members… to speak up” (p.31).

By explicitly encouraging voice and then demonstrating appreciation for it, surgeons help team members feel it is both psychologically safe and efficacious to voice safety concerns, contribute knowledge and opinions, and ask learning questions (Nembhard & Edmondson, 2006). Feeling safe from interpersonal risk empowers team members, including surgeons, to voice safety concerns, offer and ask for opinions and suggestions, ask learning questions, admit errors, and acknowledge their own human vulnerability,—without fears of being wrong, criticized, demeaned, or punished. “Without a recognizable invitation, impressions derived from the historic lack of invitation will prevail. And without appreciation (i.e., a positive, constructive response), the initial positive impact of being invited to provide input will be insufficient” (p. 948).

Nembhard and Edmondson (2006) found “significant differences across groups in the strength of the association between status and psychological safety” (p. 958). Physicians, nurses, and respiratory therapists in some teams reported similar levels of psychological safety; while the disciplines in other teams reported large disparities of psychological safety. Nembhard and Edmondson concluded that leader behaviors—such as inviting and appreciating safety voice, opinions, and questions—could improve interprofessional psychological safety, discretionary engagement in quality improvement projects, and the overall safety culture.

An annual review by Edmondson and Lei (2014) of psychological safety literature focused on individual, group, and organizational levels of analysis. Key insights were that psychological safety supports individual growth, satisfaction, and discretionary effort, plus individual, team, and organizational learning and performance; and that “psychological safety in organizational life can best be considered a phenomenon that lives at the group level” (p. 37). A more recent annual review by Edmondson and Bransby (2023) found that “the most glaring gap in the literature pertains to how to create psychological safety” (p. 71). There are needs for

more race and gender research on psychological safety, and for research on fluid teams as opposed to intact teams. The authors concluded that “creating a climate of psychological safety should be near the top of the leadership agenda... ensuring that people can speak up, ask for help, offer ideas, provide dissenting views, or collaborate effectively across boundaries” (p. 72).

“Silenced by Fear: The Nature, Sources, and Consequences of Fear at Work,” a literature review by Kish-Gephart et al. (2009), including Edmondson, identified complex fears that impede psychological safety. Feelings of safety or fear are influenced by varying combinations of human factors, including individual personalities (assertive/nonassertive; risk tolerant/risk averse), socialization during childhood, prior positive or negative work group experiences, organizational culture and socialization, and the current situation and colleagues. Fear intensity levels, in terms of perceived likelihood, immediacy, and severity of personal risk, often motivate silence. Especially when there is little time to choose between voice or silence, decisions to remain silent can result from learned, automatic, habituated, and even evolutionary conditioning, to be alert for and avoid threats. In some preoperative and postoperative situations, a team member may have a few moments or a few minutes to process voice or silence decisions. During surgery, a team member may face immediate “now or never” decisions whether to speak up with concerns, opinions, and questions, even about safety. In the heat of the moment, suboptimal responses to fear may incline people may toward silence.

In *The Fearless Organization: Creating Psychological Safety in the Workplace for Learning, Innovation, and Growth*, Edmonson (2019) described psychological safety as “a climate in which people are comfortable expressing and being themselves” (p. xvi)—a climate of psychosocial well-being and agency that helps people achieve personal goals, contribute to team goals, and thrive. Kish-Gephart et al. (2009) concluded that self-efficacy, addressed along with collective efficacy in the next section, appears to be “one avenue by which individuals can develop the cognitive skills necessary to overcome fear’s silencing effects” (pp. 182-183).

Self-Efficacy and Collective Efficacy

Psychologist Albert Bandura (1995, 2000, 2001, 2006, 2012) was at the forefront of research and theory on individual self-efficacy and group collective efficacy. Bandura's social cognitive theory takes an *agentic* perspective of human development, adaptation, and performance; in which people are *agents*—not just products, but also producers—of their experiences, events, and environments. Self-efficacy and collective efficacy are underlying mechanisms for agency. "To be an agent is to influence intentionally one's functioning and life circumstances… people are self-organizing, proactive, self-regulating, and self-reflecting… not simply onlookers… they are contributors to their life circumstances, not just products of them" (Bandura, 2006, p. 164).

Bandura (2000) described self-efficacy as individuals' core beliefs that they "can produce desired effects and forestall undesired ones by their actions" (p. 75). Collective efficacy is thus "people's shared beliefs in their collective power to produce desired results… the product not only of shared knowledge and skills… but also of the interactive, coordinative, and synergistic dynamics" (p. 75). With the increasing interdependence within surgery teams, collaborative voice and response requires both individual and collective efficacy. Senders and receivers need to have shared beliefs in the team's capacity to synergistically share knowledge, skills, and situational awareness of the presence or absence of both patient safety and team member well-being (Edmondson, 2019; Gittell, 2009, 2016; Morrison, 2014).

Agency, and the self-efficacy and collective efficacy mechanisms that underlie agency, are determined by affective, cognitive, behavioral, and contextual factors that influence how individuals and groups feel, think, act, and interact; including if, and how well, they adapt and persevere in the face of difficult social problems (Bandura, 2000). It is widely argued that individual and group well-being increase when team members and leaders share values, mental models, and mastery of congruent group norms (Atkins et al., 2019; Csikszentmihalyi, 1993; National Academy of Medicine, 2019; Wilson, 2019).

Dislodging entrenched, detrimental social norms such as hierarchical barriers to safety voice and clinician well-being requires a “great deal of united effort… to forge divergent self-interests into a shared agenda, to enlist supporters and resources for collective action… to execute them successfully, and to withstand forcible opposition and discouraging setbacks” (Bandura, 1995, p. 33). “The stronger the perceived collective efficacy, the higher the group’s aspirations and motivational investments… morale and resilience… staying power in the face of impediments and setbacks… and the greater their performance accomplishments” (Bandura, 2001, p. 14).

This section described self-efficacy and collective efficacy, the third of four human factors (after transformational leadership and psychological safety) in which breakdowns are common root causes of preventable surgical errors and patient harms (The Joint Commission, 2015). The fourth human factor, communications, is described below.

Collaborative Voice and Response

“As increasing focus is placed on quality, safety, and high reliability, surgeons will be expected to participate and lead efforts to facilitate a team approach in this new era of patient care” (Wakeman & Langham, 2018, p. 107). Conceptually and operationally, collaborative voice and response can be enhanced when team members share a mental model of the cognitive knowledge and beliefs, affective attitudes and dispositions, and behavioral skills and habits that are conducive to it. “Central to creating a shared mental model is effective communication” (p. 110).

In a study of 300 general surgeries at four sites, Mazzocco et al. (2009) conducted structured observations to determine the relationship between teamwork behaviors and subsequent 30-day outcomes indicated in patient records. Registered nurse researchers were trained to observe behavioral markers: “observable, nontechnical behaviors that have been shown empirically to contribute to performance in work environments, including the airline industry and health care” (p. 679).

Preoperative behavioral markers included routine team briefings, with surgeons stating plans, asking questions, and asking team members for input and relevant information. Intraoperative markers included situational monitoring, showing mutual respect, identifying risks and warning signs, and speaking up at critical times. Findings were “quantitative evidence of a direct link between teamwork during the surgical case and subsequent patient outcome… when teamwork behaviors were relatively infrequent during surgical procedures, patients were more likely to experience death or a major complication” (p. 682).

In conclusion, many challenges influence collaborative voice and response, including latent system and cultural flaws that can generate error-prone conditions, complexities of modern surgery with multiple possibilities for error in every operation, clinical ambiguities that in different situations can make a given safety concern either significant or not, surgeon leadership attitudes and behaviors that may raise or lower hierarchical barriers, psychological safety or its absence, self-efficacy and collective efficacy or their absence, clinician burnout which can be contagious in teams, and moral injury that can result when witnessing or personally acting in ways that conflict with personal, professional, organizational, and societal values and expectations. The next section presents relevant human factors from the science of teamwork.

Teamwork and Shared Mental Models

Teamwork research has moved from understanding separate teamwork components to understanding teams and teamwork as context-dependent, complex adaptive systems, with multiple agents (team members and leaders), human factors, and emerging states that interact and influence each other in multidirectional, often unpredictable, and sometimes unwanted ways (Keebler et al., 2022; McKeon et al.; Salas et al., 2005; Salas et al., 2009; Schmutz et al.).

Schmutz et al. (2019) conducted a systematic review and meta-analysis to investigate the relationship between teamwork and performance in healthcare. Titles and abstracts of 1,988 studies were screened, with full text examinations resulting in 31 included studies. Teamwork was defined as “a process that describes interactions among team members who combine

collective resources to resolve task demands" (p. 2). Articles on team performance were selected using the widely adopted I-P-O framework of inputs, processes, and outputs. Inputs included the quality of care provided, as well as errors. Processes included teamwork elements of communication, coordination, and decision making. Outcomes focused on were those of patients, but outcomes focused on were not those related to clinician well-being.

Significant for the current study's focus on cognitive, affective, and behavioral human factors, one contextual factor was that "diverse educational paths in interprofessional teams may shape respective *values, beliefs, attitudes, and behaviors*" [emphasis added] (Schmutz et al., 2019, p. 2). The overarching conclusion was that "teams who engage in teamwork processes are 2.8 times more likely to achieve high performance" (p. 12).

An *Annual Review of Organizational Psychology and Organizational Behavior* article by Salas et al. (2020) conceptualized teamwork as "the linchpin driving safety" (p. 283); and proposed that five emergent states, along with two foundational conditions, enable teamwork and safety. Emergent states are psychological states that result from team members' "shared attitudes and perceptions… [that] form and constantly evolve with each interaction and exert influence over the way teams carry out their work" (Marks et al., 2001, as cited in Salas et al., 2020, p. 290). The five identified emergent states that enable and drive teamwork and safety were psychological safety, team trust, collective efficacy, shared mental models, and situation awareness. The two foundational conditions that support teamwork and safety were organizational safety cultures and team safety climates. This paper has addressed each of these seven components of teamwork and safety, and especially shared mental models, an aim of this study. Salas et al. (2020) concluded that "foundational variables spark the potential for safety to exist, but teamwork is the catalyst inciting its emergence" (p. 305).

Gittell's (2009) model of *relational coordination* helps teams manage "task interdependencies, uncertainties, and time constraints" (p. 15), and "significantly improves surgical performance" (p. 30). Relational coordination establishes team relationships of mutual

respect, shared goals, and shared knowledge; with communications that are timely, accurate, frequent enough, and focused on problem-solving (not finger-pointing or blaming).

A 2021 systematic review of studies published since Gittell introduced relational coordination in 1991 found the evidence-based theory and practices were extensively validated, and improved performance outcomes and job satisfaction in a wide range of complex industries and organizations, including aviation and healthcare (Bolton et al., 2021). For example, a survey study with 382 direct care nurses from surgical, emergency, intensive care, post-anesthesia, medical-surgical, and obstetric units found that "relational coordination was significantly related to increased job satisfaction, increased work engagement, and reduced burnout… [and] contributes to the well-being of direct care nurses, addressing the Quadruple Aim by improving the experience of providing care" (Havens et al., 2018, p. 132).

Aveling et al. (2018) argued that "promoting effective team behaviors is a principle of safe care… teamwork is contingent on members sharing common 'mental models' of ideal teamwork and the behaviors required to achieve it" (p. 115). The qualitative case study used semi-structured interviews, with 34 multidisciplinary participants from cardiac surgery teams at a major academic medical center, to "investigate the mental models of ideal teamwork… and identify the contextual factors shaping those mental models and the ability to put teamwork ideals into practice" (p. 116).

Across roles, competence was valued in both technical and relational knowledge and skills. Relational competence was described as "sharing appropriate information with the right people, at the right time, audibly and clearly; appropriate communication style and tone; inviting and responding constructively to others' contributions; and acknowledging mistakes to enable learning" (p. 117). Appropriate surgeon leadership was described as valuing all team members.

Some surgeons felt that sharing information invited nonsurgeons to contribute, thereby enhancing team performance. Nonsurgeons believed information sharing "fostered inclusion, engagement, and open communication; whereas withholding information promoted division,

exclusion, or unhelpful hierarchy" (p. 117). One participating surgeon noted that "some [other surgeons] saw information sharing as giving up their 'mystique' " (p. 117)—arguably, a misguided and suboptimal priority.

The authors concluded that the "discrepant views of optimal interpersonal and leadership behaviors could generate frustration and misunderstanding, undermining teamwork" (p. 117); and that "optimizing teamwork to reduce nontechnical errors… requires multifaceted interventions that promote team consensus" (p. 120). One such facet to optimize teamwork is to improve how "approachable" physicians are as clinical team leaders, and are perceived to be.

Physician Approachability

The teamwork and communication studies cited above suggest a distinct and important, but less recognized human factor that can promote or discourage collaborative voice and response—*physician approachability,* a fairly new concept in healthcare literature, and likely underaddressed in practice. An academic hospital study with obstetric teams by Pack et al. (2022) observed interprofessional dynamics and communications during scripted simulation scenarios and debriefings, with follow-up interviews, to identify and describe elements of physician approachability. Participants were faculty obstetricians (OBs), OB residents in training, nurses, registered midwives, and family physicians. Scripted scenarios included five errors—unprofessionalism, clinical assessment, procedural checklist steps, medication, and lack of situational awareness—that, unknown to other team members, were intentionally committed by embedded OB faculty participants, as the simulation team leaders. Among the 13 simulation scenarios with five scripted errors each, there were a total of 65 scripted errors.

The scripted errors by faculty members were considered to be "challenge moments" in which other team members should speak up about errors, unprofessionalism, or lack of situational awareness. The embedded faculty OBs expected to be challenged. "However, interprofessional teams often went along with the unsafe and unprofessional behaviors set in motion by the faculty member" (p. 4).

In debriefs of the simulations and subsequent interviews, faculty OBs commented that their scenario experiences were eye-opening and uncomfortable; and they "grappled with the fact that their out-of-character behavior was seemingly accepted by the team: 'nobody from the team questioned the ridiculousness that I was doing' " (p. 4). One faculty OB commented, "Maybe I'm not that approachable. Maybe they're scared to disagree with me… but I don't know. Maybe I should reflect on it myself" (p. 4). Another wondered if team members would speak up about a safety error in "an off-moment or an off-day... I would hope that someone would call me out on it and bring that to my attention and not just internalize it and rationalize it" (p. 5)

Before the study, most faculty participants thought of themselves as approachable (a person to whom people can speak up) simply because they avoided overtly disrespectful or disruptive patterns of behavior. Instead, the study found that approachability is an active "state of constant becoming, produced through one's actions and behavior… presence, debriefing, and thinking aloud" (pp. 7-8).

> Approachability necessitates that team leaders actively create the conditions in which team members perceive that speaking up is welcomed, rather than an act of bravery. In practice this conceptualization of approachability involves the tangible actions of signaling availability through presence, uncertainty through thinking aloud, and vulnerability through debriefing. Furthermore… approachability is a dynamic state that is constantly reconstructed through action and more fragile than our faculty had originally assumed. (p. 8)

In conclusion, part one of this chapter, the literature review, highlighted multiple interrelated human factors surrounding surgery patient safety and surgery team member well-being, and collaborative voice and response in particular. Surgery teams face significant adaptive challenges in understanding and managing the human factors that impact the quality of their work and work lives. A broad consensus in the literature from leading academic and medical scholars, and empirical studies at leading hospitals and major academic centers, is that in addition to high quality clinical or technical taskwork, shared mental models of effective *nontechnical* human factors are required to help teams keep patients safe from errors and harm, and to nurture the well-being of all team members, including surgeons.

Part II – Conceptual Framework

According to Ravitch and Riggan (2017) a conceptual framework is an argument for the study's relevance, significance, and use of appropriate and rigorous theoretical and methodological tools. The conceptual framework for this study starts with its intentional design as *engaged scholarship:* "a participative form of research for obtaining the different perspectives of key stakeholders… [that] can produce knowledge that is more penetrating and insightful than when scholars or practitioners work on the problems alone" (Van de Ven, 2007, p. 9).

For relevance and significance, the study answered calls to action—by the Institute of Medicine (2000, 20001, 2004) and the renamed (in 2015) National Academy of Medicine (2019)—for research toward highly reliable patient safety (first do no harm) and clinician well-being (care of the caregivers), which are mutually influencing. The study responded to the Institute of Medicine (2000) recommendation to create research, protocols, and safety systems "inside healthcare organizations through the implementation of safe practices at the delivery level… the ultimate target of all recommendations" (p.6).

The study responded to the Institute of Medicine (2001) recommendation for designing, understanding, and operating 21st century healthcare organizations, and their microsystems such as surgery teams, as complex adaptive systems. "The unpredictability of behavior in complex adaptive systems can be seen as contributing to huge variation… some of these actions need to be specified to the extent possible so they are predictable with a high level of reliability" (p. 64). The study responded to Institute of Medicine (2001, 2004) recommendations for action to reduce hierarchical barriers and promote cooperation among clinicians; and for researchers to develop collaborative care models for teams (developed in this study not *for* teams, but *with* teams). The study responded to National Academy of Medicine (2019) recommendations for research to "transform health care work systems by creating positive work environments that prevent and reduce burnout, foster professional well-being, and support

quality care" (p. 9); to facilitate "interprofessional teamwork, collaboration, communication, and professionalism" (p. 10); and to "create positive learning environments" (p. 11).

Theoretical and methodological tools were rigorous and appropriate in merging the constructivist inquiry paradigm and methodology (Lincoln & Guba, 2013) with adaptive work theory and methods (Heifetz, 1994). Theoretically, the constructivist paradigm posits that individuals and groups construct, co-construct, and may reconstruct their social realities. Adaptive work theory holds that individuals and teams who face adaptive challenges in their work and work lives can best explore, discover, generate, design, implement, sustain, and evolve adaptative solutions. Methodologically, constructivist inquiry seeks to discover the full range of perspectives in the group, and assimilate them into a consensus or near-consensus co-construction—in this study, a shared mental model for collaborative voice and response. Adaptive work methods surface and identify values, beliefs, attitudes, and behaviors held by individuals and groups; distinguish those that are essential from those that are expendable; and select or adapt those that help individuals and teams succeed and thrive.

Chapter Summary

Analysis and synthesis: For analysis, the literature review addressed what is known about the unresolved human factors challenges that hinder collaborative voice and response; and the significant impacts on patient safety and clinician well-being. For synthesis toward resolving those challenges, the review took a systems perspective, as recommended in landmark, consensus study reports by the Institute of Medicine (2000, 2001, 2004), and the National Academy of Medicine (2019). Systems perspectives of the four reports have been integrated to address organization, unit and team, and individual level challenges.

Patient safety: "Never events" that should never happen but do happen in surgery include unintentionally retained foreign objects, wrong surgeries, surgical site infections, and burns that cause patient harms. Hazardous technology, high-risk surgical procedures are most often life-saving and life-enhancing; but have multiple complex possibilities for system flaws,

error-producing conditions, potential failure points, and frontline errors. Systems and frontline clinicians—the last lines of defense—are at risk from breakdowns in nontechnical human factors, which are often underaddressed and less understood than clinical or technical factors.

Clinician well-being is at risk when well-meaning clinicians unintentionally cause patients harm. Patient families and clinicians, in different and profound ways, become second victims. Clinicians suffer from burnout (emotional exhaustion, cynicism and detachment, and perceived losses of self-efficacy) when job demands, including production pressures and dealing with hierarchical abuses of power, overwhelm job resources. Moral distress and moral injury occur when clinicians witness, take part in, or fail to prevent actions that conflict with personal, professional, organizational, and societal values and expectations. More predictable and more highly reliable collaborative voice and response could keep patients safer and help clinicians thrive.

Systems approaches include that 21st century hospital systems, and microsystems such as surgery teams, should be designed, understood, conceptualized, and operationalized as *complex adaptive systems,* made up of multiple agents who are simultaneously independent and interdependent, and whose individual actions and team interactions influence each other's work, work environments, and work lives in ways that are sometimes unpredictable and unreliable (Institute of Medicine, 2001). Unwanted variations require systemic solutions such as shared mental models for teamwork and communications at the unit and team levels. Individual actions and reactions, and team interactions must be predictable to the extent possible to achieve and sustain high reliability.

High reliability – While there are pockets of high reliability in healthcare and many hospital systems, the industry seeks to achieve significantly fewer errors and harms overall—regardless of potential failure points in systems, and potential individual and team human errors. Robust informed safety cultures and team safety climates, along with leadership, process

improvements, and heedful attention to human factors, help teams in high-consequence industries—where people's health, safety, and lives are at stake—achieve high reliability.

Nontechnical human factors include values, beliefs, attitudes, and behaviors, which influence each other through individual actions and reactions, and team interactions. Values are principles and beliefs that prioritize and motivate action toward goals. Beliefs include what we know (such as evidence-based medicine); and what we think (such as how we interpret our experiences). Attitudes are emotions and feelings that manifest as dispositions (prevailing tendencies), and habits (patterns of behavior). Behaviors are what individuals and teams do (actions, reactions, and interactions). "One *behaves* or acts in relation to what one *knows* and *feels* and *can do*" (Hauenstein, 1998, p. 125).

CHAPTER 3: RESEARCH DESIGN, METHODOLOGY, AND METHODS

This qualitative case study with surgery team participants explored collaborative voice and response*,* in terms of what makes it easier or more difficult for surgeons, as clinical team leaders, to first encourage team members to voice safety concerns, clinical opinions, and learning questions; then for team members to actually speak up; and then for surgeons to respond effectively and collaboratively to voice. This chapter presents the research design, methodology, and methods used.

The primary methods guidebook used was *Qualitative Methods for Health Research* (Green & Thorogood, 2018). Other guidebooks used included *Qualitative Research: Bridging the Conceptual, Theoretical, and Methodological* (Ravitch & Carl, 2021); *Completing Your Qualitative Dissertation: A Road Map from Beginning to End* (Bloomberg & Volpe, 2016); and *The Coding Manual for Qualitative Researchers* (Saldaña, 2021).

As qualitative studies progress, research designs often evolve as newly retrieved literature and ongoing data collection and analysis may lead to new insights, perspectives, questions, inquiry paths, and applications of methods (Bloomberg & Volpe, 2016; Glesne, 2016; Merriam & Tisdell, 2015; Ravitch & Carl, 2021). A central tenet of constructivist inquiry is *emergent design,* with the researcher continually interacting with participants, to interpret and adapt to their meaning-making (Lincoln & Guba, 1985). “At times only simple refinements in procedure or a simple adjustment in questions to be asked may be called for… other times an investigator may strike out on a wholly new tack as a result of a single insight” (pp. 102-103).

This chapter restates the research questions and then describes the final research design, including the research site, participants, and stakeholders; the qualitative research approach and research strategy; the constructivist inquiry paradigm and methodology (Lincoln & Guba, 1985, 2013); adaptive work theory and methods (Heifetz, 1994; Heifetz & Linsky, 2017); the confluence of constructivist inquiry and adaptive work theory; supplemental concepts from

both appreciative inquiry (Cooperrider et al., 2008) and a constructivist framework of holistic cognitive, affective, and behavioral human factors (Hauenstein, 1998); data collection and thematic content analysis methods (Green & Thorogood, 2018); member checking strategies and methods; trustworthiness and quality criteria; and delimitations and limitations.

Research Questions

Research question 1: What are participants' most collaborative experiences with voice and response? (Interview questions: What stands out? What makes it easier or more challenging?)

Research question 2: What values and cognitive, affective, and behavioral human factors do participants perceive to be *essential* to preserve, modify, or create; and *expendable* to discard, and perhaps must be discarded, for collaborative voice and response?

Research question 3: What consensus or near consensus shared mental model could participants and the inquirer co-construct, that when used in practice may reduce unwanted variation and unpredictability, and increase reliability of collaborative voice and response.

Research Site and Institutional Review Boards

The research site was a leading academic hospital in the western United States. The researchers (doctoral candidate and faculty advisor) met several times with each of the separate hospital and university institutional review boards (IRBs). The researchers and both IRBs concurred that it was necessary to protect all participants, and nurses in particular, from professional or personal risk in voicing their experiences, opinions, and feelings during interviews and member checking sessions. Therefore, all parties in IRB meetings agreed that interviews would be private and confidential, all data sources (including descriptions of roles or professional disciplines) would be de-identified, and direct quotations would not be used in the written report(s). Instead, data would be reported in the aggregate, using words and phrases referring to general perspectives of *all, most, some,* and/or *one* participant(s) (Bloomberg & Volpe, 2016, p.211). This proved to be a key challenge in evidencing and reporting the findings.

The hospital IRB eventually yielded review oversight to the university IRB, because hospital clinicians and staff were not formally considered to be co-researchers. The approved university IRB protocol, and the informed consent letter given to each participant before interviews, stipulated the data identity protections described in the preceding paragraph.

Upon receipt of university IRB approval, hospital leaders formally granted access for the study, and provided considerable support to help the study succeed. Patient safety and clinician well-being efforts at the hospital were already significant and continuously evolving.

Participants and Stakeholders

Surgery team members (surgeons, anesthesiologists, perioperative nurses who provide care before, during, and after surgeries, and surgical technologists who provide technical support with operating room setup and turnover, equipment, and supplies) were asked to participate. Participating and non-participating surgery team members were considered to be stakeholders; as were patients, their families, and hospital leaders, "for whom the research itself is important, or informs some part of their work or their lives" (Lincoln & Guba, 2013, p. 41).

Convenience, snowball, and maximum variation sampling methods were used to seek participants (Lincoln & Guba, 2013). Convenience sampling, beginning with a brief recruiting presentation to 36 members of the hospital's multidisciplinary perioperative safety and quality committee, was the primary method used, because of the busy schedules of surgery team members. A one-page recruiting letter plus the informed consent letter were provided at that meeting; and then sent as email attachments several times to various people and groups known to be interested in safety and quality. One participant actively recruited seven other participants who were interested in safety and quality. The snowball and maximum variation methods were used together once, by asking an early participant to recommend another participant from a then-underrepresented age and gender demographic, and from a surgery specialty not yet represented. Two possibilities were suggested, one of whom accepted; and whose identity was not divulged to the early participant. The recruiting methods and voluntary participation resulted

in self-selection by participants who already supported collaborative voice and response; and who actively sought and contributed to changes in organizational and cultural barriers, such as dysfunctional hierarchy in which status and power are abused.

Five surgeons, each from different specialties, and five anesthesiologists participated. The 10 participants represented a full range of ages and experience, equal gender distribution, and limited ethnic diversity. No perioperative nurses participated, regardless of 10 recruiting attempts (through online and in-person meetings, emails, and follow-ups); and no surgical technologists participated, regardless of two recruiting attempts. Nurses and technologists generally do not have protected work time for administrative duties or research interviews, although it may have been provided if requested.

The informed consent letter was delivered to each participant before their interview, with written and verbal invitations to ask questions and express any concerns. Letter information included the research topic, purpose, privacy and confidentiality of participation and their data, planned methods for co-constructing a proposed shared mental model, and anticipated benefits of participating. Data collection methods were explained as one-to-one, semi-structured interviews, and the option to participate in an additional member checking meeting to confirm or refine the thematic findings and the resulting proposed shared mental model. The informed consent letter confirmed that all participation was voluntary and could be withdrawn at any time.

Semi-structured interviews lasted 60 to 90 minutes, most of them 90, with two interviews (one surgeon, one anesthesiologist) extending beyond two hours. Eight interviews were in person and two were online, as chosen by each participant. With each participant's consent, in-person interviews were audio recorded, and online interviews were audiovisual recorded. All 10 participants agreed to and did engage in subsequent member checking meetings. All member checking meetings lasted 60 minutes, with eight in person and two online; and again all were recorded with each participant's consent. No participants withdrew from the study, and all participants were actively engaged throughout their two sessions; while often explicitly or

implicitly expressing appreciation and support for the study, and genuine interest in the findings and implications for practice.

Findings from interviews and member checking sessions are reported in chapter four and discussed in chapter five. The following sections provide and describe rationales for the qualitative research approach, the research strategy, methodologies, and methods.

Qualitative Research Approach

In "Studying Patient Safety in Health Care Organizations: Accentuate the Qualitative," Hoff and Sutcliffe (2006) argued that qualitative inquiries complement quantitative studies and can gain insight and understanding, particularly in strongly entrenched cultures "where less is known about what people think, how they act, and how they make sense of their behaviors within a culture" (p. 6). Qualitative inquiry explores complex cycles of "conditions in which problems and/or situations arise and to which persons respond through some form of action-interaction and emotion (process), and in doing so it brings about consequences that in turn might go back to impact upon conditions" (Corbin and Strauss, 2008, p. 88). Fitting with this study, qualitative research can increase understandings of organizational cultures, multiple social realities, subjective attitudes and beliefs, complex issues and processes, unidentified variables, little-known phenomena, power differentials, and why practices sometimes differ from goals (Marshall & Rossman, 2011).

Research Strategy

The research strategy integrated constructivist inquiry with adaptive work theory, supplemented with concepts from appreciative inquiry and a holistic human factors framework. The constructivist inquiry and methodology included discovery and assimilation stages articulated by Lincoln and Guba (2013). The discovery *stage* collected and analyzed data on existing perspectives and constructions. Resulting themes were used in the assimilation stage by the inquirer to co-create a consensus or near consensus reconstruction—the proposed shared mental model for collaborative voice and response—intended for catalytic action.

Adaptive work theory and methods, based on biological evolution, are for the purposes of individual and cultural evolution (Heifetz, 1994). Participants distinguished what values, beliefs, attitudes and behaviors are essential from those that are expendable, in order for them as individuals and teams to meet adaptive challenges, achieve shared goals, evolve, and thrive.

Appreciative inquiry and a holistic framework also informed the development of research questions and interview questions, plus data analysis, findings, and discussion. Appreciative inquiry is a generative theory building methodology, in which people envision and design ways to be at their best, by exploring and discovering what is possible, provocative (in a positive way), applicable, and collaborative (Cooperrider & Srivastva, 1987). (Note: Cooperrider's 2013 contemporary comments are embedded in a reprint of the original 1987 article, "Appreciative Inquiry in Organizational Life," by Cooperrider and Srivastva). Hauenstein's (1998) holistic framework is a constructivist perspective to explore the complexities of how cognitive, affective, and behavioral human factors interact in whole-person individuals and teams.

Constructivist Inquiry Paradigm and Methodology

The constructivist paradigm posits that individuals and groups construct, co-construct, and may reconstruct their social realities (Lincoln & Guba, 1985, 2013). Social realities, including individual actions and reactions, and team interactions and working relationships, may be more or less functional or dysfunctional, and can change in either direction, by intentional design or not. The constructivist inquiry methodology for case studies, as articulated by Lincoln and Guba (2013), is a two-stage process of discovery and assimilation: to *discover* the range of existing constructions in a group, and *assimilate* them into a co-constructed, consensus, or near consensus reconstruction, that may sharpen values and ameliorate or eliminate the problem.

The Constructivist Credo (Lincoln & Guba, 2013) elaborated the constructivist belief system, applicable in the human or social sciences, on the paradigm-defining philosophical questions of ontology, epistemology, methodology, and axiology. Each supposition is constrained by and builds on those that precede it, and the suppositions "can be accepted or

rejected only by virtue of their pragmatic utility" (Lincoln & Guba, 2013, p. 39). Table 3.1 describes constructivist suppositions and implications for this study.

Table 3.1

Constructivist Suppositions and Applications

Constructivist Suppositions	Applications for This Study
Ontology – relativism: The nature of individual and group social reality is relative to the individual and group meaning-making and sense-making, in their own contexts.	The study sought to understand the social realities, sense-making, and meaning-making of all participants in their individual and team roles and contexts.
Epistemology – transactional subjectivism: Realities to be known (constructed) are highly subjective and are influenced in transactions among personal and cultural values, knowledge, experiences, interpretations, social status and power, and other factors.	The study explored how psychosocial human factors—values, beliefs, attitudes and behaviors—influence the actions, reactions, interactions, and interpretations of them, that construct social realities that help or hinder collaborative voice and response.
Methodology – hermeneutic-dialecticism: a two-stage method of (1) *discovery* of existing constructions (affective meaning-making and cognitive sense-making) among participants; and (2) *assimilation* for consensus or near consensus reconstructions, done through a dialectic process that "seems most appropriate" (Lincoln & Guba, 2013, p. 40).	*Discovery* of each participant's existing constructions was through semi-structured interviews. *Assimilation* was through thematic analysis of interview data, which the "researcher as instrument" used to co-construct a proposed shared mental model for collaborative voice and response, refined and confirmed through member checking.
Axiology – "In this shared and co-created reality, the values of the inquirer… research participants… which inhere in the context all must be uncovered and made transparent…" [and, the values of stakeholders] "for whom the research itself is important, or informs some part of their work or their lives" (p. 41).	This study sought knowledge "which is the most valuable… the most truthful… the most beautiful… the most life-enhancing" (p. 37) Constructivist inquiry aims and this study's goals were "clarifying the focus at issue, moving to eliminate or ameliorate the problem, [and] sharpening values" (p. 70).

For discovery, semi-structured, one-to-one interviews explored the existing constructions participants held about collaborative voice and response, and surfaced unresolved issues and underexplored perspectives. For assimilation, the qualitative "researcher as instrument" co-constructed a proposed shared mental model from thematic analysis of the interview data. Member-checking with participants slightly refined the proposed mental model (a one-word change) and confirmed it was comprehensive, accurate, and likely to be useful in practice.

Keeping Patients Safe: Transforming the Work Environment of Nurses (Institute of Medicine, 2004), recommended research to develop and evaluate collaborative care models for

teams. This study's proposed shared mental model for collaborative voice and response was developed not *for*, but *with* frontline surgery team members, by combining constructivist inquiry with adaptive work theory and methods.

Adaptive Work Theory and Methods

Adaptive leadership theory is based on leading individuals and groups to do their own adaptive work to advance their individual growth and cultural evolution (Heifetz, 1994). Adaptive work is based on Darwin's theory of biological evolution and its three components: *variety, consequences,* and *selection*. Just as biological species must adapt to environmental changes to survive and even to thrive; so too, must individuals and groups adapt—to challenges in their professional, organizational, and societal environments—to succeed, grow, and thrive.

Healthcare's changing environments are marked by the explosive growth of increasingly complex medical science, technologies, and treatments; the resulting demands on clinicians to keep their knowledge and skills current; plus increasing expectations and scrutiny—from patients and families, healthcare organizations, regulators, insurance payers, and patient safety organizations—to achieve multiple performance outcomes (Avgar & Vogus, 2016; Leape, 2021).

Hospital leaders and frontline caregivers are being called to improve both patient safety and clinician well-being, which are mutually influencing (Institute of Medicine, 2000; National Academy of Medicine, 2019). The Institute for Healthcare Improvement (IHI) Triple Aim of better care, lower costs, and improved community population health (Berwick et al., 2008) has gradually given way to calls for a "quadruple aim" to also improve clinicians' own well-being (Bodenheimer & Sinsky, 2014; Dzau et al., 2018; Privitera, 2018, 2022; Sikka et al., 2015). More recently, led by Kedar Mate, MD, IHI president and chief executive officer as of 2020, the IHI proposed that the 2008 Triple Aim model should evolve to a "quintuple aim," with a fourth aim of clinician well-being, and a fifth aim of healthcare equity (Nundy et al., 2022).

Adaptive work, in the face of such environmental changes, requires that people make two important distinctions. The first is to distinguish between technical problems and adaptive

challenges (Heifetz, 1994). Most issues in organizations are combinations of technical problems and adaptive challenges; but parts of issues, and sometimes the major issues, are primarily one or the other. Technical problems may be solved, often but not always more easily and quickly, through changes in policies and procedures, and/or through current or readily obtainable expertise, resources, and authority, including each of those capacities of the frontlines. Adaptive challenges can only be solved by often more difficult shifts in hearts and minds; that is, individual and cultural values, beliefs, attitudes, and behaviors. Fears of losing accustomed identities, long-held dispositions (prevailing tendencies), and habits (patterns of behavior) can generate active or passive, conscious or unconscious resistance. For individuals and groups who are either more inclined or more resistant to change, confronting adaptive challenges requires honest reflection and often difficult adaptive work to change, grow, evolve, and thrive.

Distinguishing between technical problems and adaptive challenges is necessary to effectively apply technical solutions to technical problems, and adaptive solutions to adaptive challenges. “Indeed, the single most common source of leadership failure… is that people, especially those in positions of authority, treat adaptive challenges like technical problems” (Heifetz & Linsky, 2017, p. 14). Imposing top-down technical solutions, such as new policies and procedures, while not addressing adaptive challenges, is one reason change efforts often fail.

The second and related distinction necessary in doing adaptive work is for individuals and groups, especially in complex adaptive systems like surgery teams, to determine what is *essential* and what is *expendable* for them to indeed *adapt and thrive.* In doing adaptive work both individually and collectively, people distinguish what personal and cultural values, beliefs, attitudes and behaviors are essential to preserve, modify, or create to succeed in their goals; and what values, beliefs, attitudes and behaviors are expendable to discard, and perhaps must be discarded, for them to adapt, succeed in their goals, and thrive (Heifetz, 1994).

Distinguishing between essential, healthy, and functional uses of hierarchy as opposed to expendable, unhealthy, and dysfunctional abuses of hierarchical power is one example of

adaptive work, that is addressed in chapters four and five. The next section describes how the constructivist inquiry paradigm and methodology fit with adaptive work theory and methods.

Constructivist Inquiry and Adaptive Work Theory

This study used a confluence of constructivist inquiry and adaptive work to help surgery team participants surface, identify, distinguish, and address human factors and organizational culture obstacles to collaborative voice and response, and to their own well-being. Constructivist inquiry seeks knowledge that "*accumulates in the form of ever more informed and sophisticated reconstructions"* (Lincoln & Guba, 2013, p. 56). More informed reconstructions are "inclusive of more and perhaps different meanings" (p. 62). More sophisticated reconstructions are "more complex, higher level and/or larger scale" (p. 62).

In constructivist inquiry, "personal and social progress… requires that there be differences to explore, challenges to meet, conflicts to resolve, and ambiguities to clarify" (Lincoln & Guba, 2013, pp. 73-74). Likewise, "adaptive work is required when our deeply held beliefs are challenged, when the values that made us successful become less relevant, and when legitimate yet competing perspectives emerge" (Heifetz & Laurie, 2001, pp. 57-58).

Even smart people in smart organizations like hospitals use defensive routines to avoid ambiguities, conflicts, learning and growth challenges, and changes in the status quo (Argyris, 2008; Tucker & Edmondson, 2003). In professional (and personal) relationships, sensitive issues of hearts and minds can be "the elephants in the room," those big obstacles people see, but often avoid addressing. Silently tolerating, dodging, and working around elephants prolongs emotional frustrations and system dysfunctions (Smith, 2011). The challenge is "making the undiscussable and its undiscussability discussable" (Argyris, 1980, p. 205).

The constructivist inquiry paradigm and methodology for reconstructing social realities of individuals and teams (Lincoln & Guba, 2013) fits with adaptive work theory and methods for individual and cultural evolution (Heifetz, 1994); thereby informing the research and interview questions. Methods used to answer the research questions are described below.

Methods

Data Collection: Semi-Structured Interviews

Using the two-stage constructivist methodology of discovery and assimilation (Lincoln & Guba, 2013), this study first discovered participants' existing constructions in semi-structured, one-to-one interviews (see the Appendix). The interviewing approach was one of *humble inquiry* (Schein, 2013): asking questions and listening with care, without assuming preconceived answers or making judgments about answers.

Interviews sought to build genuine, collaborative research relationships with each participant, based on sincere interest in their expertise, experiences, and perspectives (Ravitch & Carl, 2020). The aim was to vicariously experience what was in the participants' hearts and minds, and to deeply understand their personal and professional experiences, challenges, and aspirations. I did feel a very genuine and rewarding rapport, and collaborative relationship, with each participant; all of whom explicitly stated they felt the same, or seemed to imply that they did through their authentic engagement and enthusiastic conversations.

Questions in the interview instrument or interview guide (see the Appendix) were pilot-tested and refined with the active engagement of two registered nurses and one surgeon, who were not study participants nor at the research site. Interview questions were aligned with and designed to answer the research questions, and were grouped accordingly in the interview guide. When the study began, the interview questions were emailed to participants in advance of interviews. In addition, paper copies were provided to the participants whose interviews were in person. All participants seemed to be familiar with the study purposes, and most seemed to have thought in advance about the interview questions, their answers, and narrative examples.

Opening interview questions asked participants to describe their most collaborative experiences of perioperative voice and response, what stood out to them, and what made collaborative voice and response easier or more challenging. Follow-up dialogues probed the narratives of participants for additional insights and reflections.

Mid-interview questions asked what human factors—in terms of values, beliefs, attitudes and behaviors—participants felt are essential versus expendable for collaborative voice and response. Closing interview questions asked participants to contribute their insights and ideas that had not been discussed; and whether they would be willing to participate in a subsequent member checking meeting to refine and confirm the identified themes, and the proposed shared mental model that I, the "researcher as instrument," would co-construct from the participants' interview themes. The next section describes how thematic analysis of the qualitative interview data identified themes from which the proposed shared mental model was co-constructed.

Thematic Content Analysis

Fitting with this study, thematic analysis is useful for answering research questions related to participants' experiences, perspectives on factors underlying social processes, practices in particular contexts, and their social constructions (Clarke et al., 2015, as cited in Saldaña, 2021). A theme "captures something important about the data in relation to the research question, and represents some level of *patterned* response or meaning within the data set" (Braun & Clarke, 2022, p. 82).

Major themes often represent or lead to the findings in qualitative studies (Ravitch & Carl, 2021; Saldaña, 2021). The aim of thematic analysis was to identify major themes as sound findings: the grounds for a proposed shared mental model for collaborative voice and response. This process followed the constructivist aim of the participants and the inquirer co-constructing a consensus, or near consensus, reconstructed social reality (Lincoln & Guba, 2013).

According to *Qualitative Methods for Health Research* (Green & Thorogood, 2018), the primary methods source used for thematic analysis of the interview data:

> Thematic analysis is perhaps the most common approach used in qualitative research reported in health journals, and aims to present the key elements of participants' accounts. It is the basis of much qualitative description, and also of many other approaches to qualitative analysis, as well as being a method in itself...Thematic analysis as a stand-alone method is a useful approach for answering questions about the salient issues for particular groups of respondents or identifying typical responses...

> The basis of many types of qualitative analysis, particularly of interview data, is a reduction of the complexity of participants' accounts by looking for patterns or 'themes' in the data. Themes are recurrent concepts which can be used to summarize and organize the range of topics, views, experiences, or beliefs voiced by participants. A 'theme' is therefore an abstract label for groups of data segments which you as the researcher can credibly argue belong together as a set because they are 'about' the same thing at an abstract level. (p. 258)
>
> Most approaches to thematic analysis involve a number of common steps, including: familiarizing yourself with the data, identifying themes, coding the data set, and organizing codes and themes (p. 259)... Thematic content analysis is, then, enough for many health research projects, particularly if they are exploratory or the aim is qualitative description, and can, when done well, produce sound findings that are useful for policy and practice. (p. 268)

The purpose of this research was to explore and understand participants' perspectives, and produce sound findings in the form of themes used as the basis for the proposed shared mental model for collaborative voice and response. The mental model's potential use in practice and policy will be determined at the hospital, and is further explored in chapters four and five.

Thematic content analysis in this study followed the four steps, elaborated by Green and Thorogood (2018, pp. 258-268), as the stand-alone method to both deductively and inductively identify and analyze themes. After repeated immersion in and considerable familiarization with the interview data, themes were identified as patterns in the data, then confirmed by member checking, and further substantiated by coding and organizing the themes: condensing the data to elaborate and substantiate findings, and discuss their meanings in the written report (Miles et al., 2014). The four thematic content analysis steps as used in the study are detailed below.

Step 1: Familiarization With the Data

Immersion in and familiarization with the interview data began in the extensive, conversational style interviews, which made deep and lasting impressions on me, both during and after the interviews. Even as a non-clinician—but with my extensive studies of the healthcare literature, my air traffic control experience, and my relevant human factors expertise—it seemed that participants felt I had credible foundational knowledge of their

adaptive challenges. It also seemed participants knew I could relate to their responsibilities for having people's health, safety, and lives in their hands, and what that means to them.

These deep impressions became expanded, more instructive, and more meaningful to me as I personally transcribed each interview. In transcribing, I played each recording on the computer speakers, with a new Microsoft Word document open and the "Dictate" feature activated, as I listened to the audio and watched the dictated transcription. There were numerous errors and redundancies in each transcription, which I then corrected line by line and word by word, further immersing myself in and familiarizing myself with the data.

Step 2: Identifying Themes

I next re-read all of the corrected transcripts repeatedly and in depth, identifying, highlighting, underlining, and notating thematic patterns in the margins that were relevant to the research questions and interview questions. Four of the six provisional theme titles (or codes) were identified deductively from the literature-based research and interview questions. Two provisional themes: "let's be best-in-class" and "respect and be kind to all," were identified inductively as *in vivo* codes, in the words of participants (see next section).

Step 3: Coding the Data

> Once a provisional list of themes has been identified, the next task for a content analysis is to refine these into a set of 'codes'... labels for the themes that have been identified so far... the initial coding scheme can include notes on what the code covers, and what it excludes. There are no right or wrong ways to organize codes. (Green & Thorogood, 2018, pp. 262-264)

The six themes were identified, defined, and described in a one-page document that was then presented to participants during member checking sessions, to be refined and confirmed. With one word changed, participants confirmed the six themes were accurate, comprehensive, and captured their perspectives. Two subthemes, dysfunctional hierarchy and production pressures (or time pressures), which are well-documented in organizational and safety culture literatures, were also identified as significant obstacles to collaborative voice and response.

The provisional theme “respect and be *kind* to all” was originally written as “respect and be *nice* to all.” Changing “nice” to “kind” was the only theme or shared mental model refinement suggested by any participant, who was in the second of 10 member checking meetings. Having learned one distinction that being nice refers to how one wants to be perceived, while being kind refers to how one thoughtfully treats others, which was a better fit—I promptly agreed and made that change before other member checking sessions.

Further transcript reviews revealed that one participant had actually used the exact phrase, “respect and be kind;” but I had missed that, in large part from being influenced by a second “golden rule” I had recently learned from an article on Jeff Shiffrin, an anesthesiologist, who was World Cup ski champion Mikaela Shiffrin’s father. He said, “Be nice. Think first.” Thinking first, as often as possible, helps being kind become more second nature. Combined with reflecting afterward, the two practices seem to develop stronger emotional intelligence.

Step 4: Organizing Codes and Themes

Organizing codes and themes helps the researcher “look across the data ‘horizontally’: that is, at themes across all cases [or interviews, in this study]... done by various methods of ‘cut and paste’ by which data extracts relating to the same codes are gathered together” (Green & Thorogood, 2018, p. 264). Using the copy and paste (not cut and paste) function on Microsoft Word, relevant data units from each interview transcript were placed in the rows and columns of tables for each theme; to organize and help further analyze the data for the findings chapter; and eventually, to help interpret meanings made by participants, for the discussion chapter.

Data were thus sorted on separate tables and documents, and labeled according to research questions, themes, and codes. While manually using Word tables was a small technical step beyond using the older method of index cards and chart paper to organize, sort, and analyze qualitative data; the semi-manual method provided a deeper learning experience and a good foundation in principles, strategies, and processes of analyzing qualitative data, as recommended by Saldaña (2021), before future use of qualitative data analysis software.

Data extracted from interview transcripts were entered into tables designed to analyze and answer the first two research questions; first, about participants' most collaborative voice and response experiences, and second, how they distinguished essential versus expendable values, beliefs, attitudes, and behaviors for collaborative voice and response. Many data extracts were relatively lengthy narratives, much of which I intentionally retained in the tables, to better interpret the "meaning in context" (Mishler, 1979, p. 1) of participants. Data to answer the third research question, about what proposed shared mental could be co-constructed for more predictable and highly reliable collaborative voice and response, were also entered into tables for thematic content analysis. Resulting themes were used to co-construct a proposed shared mental model, and presented to participants in member checking meetings.

Co-Construction and Member Checking

Following the constructivist methodology discovery stage interviews that explored participants' existing constructions, identifying themes was the first step in the assimilation stage (Lincoln & Guba, 2013). Assimilation of the themes and other relevant participant perspectives were used to co-construct a proposed, consensus or near-consensus shared mental model for collaborative voice and response, and to sharpen values and surface significant obstacles.

Using the qualitative concept of "researcher as instrument," I used the identified themes to co-construct a proposed shared mental model primarily based on participant data, which may be supplemented by the literature and "the inquirer's own knowledge and experience" (Lincoln & Guba, 2013, p. 67). Relevant concepts from the literature (including hierarchical barriers, production pressures, physician approachability, and shared values and goals of patient safety and clinician well-being) were often initially brought up by participants and then explored in the interviews. My knowledge and experience were useful in developing the interview question guide, which in the Appendix of this paper.

An essential step in the co-construction process, member checking with participants, confirmed that the themes, and the resulting proposed shared mental model, accurately

represented their views, and that the proposed mental model is comprehensive, relevant, and likely to be pragmatically useful. As reported, the single theme refinement suggested was to change “respect and be nice to all” to “respect and be kind to all.” One participant commented on some overlap in the wording among elements in the proposed shared mental model, which was true but intentional, and the participant agreed with the consensus on the model.

Member checking is a “person-centered approach to challenging interpretations by creating conditions for participants to speak into and about a study… Lincoln and Guba (1985) consider them [member checks] the most important validity measure used to establish credibility” (Ravitch & Carl, 2021, p. 176), one of the quality criteria described below.

Trustworthiness and Quality Criteria

This study of collaborative voice and response was itself collaborative, with participants, stakeholders, and academic colleagues. “Collaboration means that everyone involved must be willing to be changed in meaningful ways” (Ravitch & Carl, 2021, p. 195). To conduct a rigorous qualitative study, ethical research relationships with participants and ethical representations of their perspectives are essential for trustworthiness. For example, trustworthiness is essential during participant recruiting, interviews, data analysis, member checking, and reporting the findings (Bloomberg & Volpe, 2016, Lincoln & Guba, 1985; Ravitch & Carl, 2021).

Quantitative quality and rigor are commonly assessed with criteria of *validity, reliability, objectivity,* and *generalizability* (Bloomberg & Volpe, 2016; Lincoln & Guba, 1985; Ravitch & Carl, 2021). For qualitative research, Lincoln and Guba (1985), and more recently Bloomberg and Volpe (2016) plus Ravitch and Carl (2021), argued for parallel standards of *credibility, dependability, confirmability,* and *transferability*—described below as applied to this study.

Credibility is “the researcher’s ability to take into account all of the complexities that present themselves in the study and to deal with patterns that are not easily explained” (Guba, 1981, as cited in Ravitch & Carl, 2021, p. 168). Credibility is enhanced by a research design that

“not only seeks complexity but also attends to the real-life complexities that exist in any group setting” (Ravitch & Carl, 2021), as this study has done.

“A key element that makes for good scholarship is integration… making connections between ideas, theories, and experience… thereby providing a new way of looking at that phenomenon” (Hart, 1998, p.8). The connections made are indeed new ways of looking at collaborative voice and response. This study made such connections between constructivist inquiry and adaptive work theory, complex adaptive systems thinking and high reliability theory, plus unpredictable human factors (values, beliefs, attitudes and behaviors) and the need for a more predictable and reliable shared mental model for collaborative voice and response. During interviews, participants frequently commented that the study was addressing underexplored and unresolved issues.

Dependability “refers to the stability of your data... [in] answering your research question(s)... this entails appropriate methods... to answer the core constructs and concepts of your study” (Ravitch & Carl, 2021, p. 171). Appropriate methods have been described in this chapter. Answers to the research questions, plus hierarchical abuses of power and production pressures surfaced by the study, are presented in the findings and discussion chapters.

Confirmability: Qualitative researchers “seek to have confirmable data and ‘relative neutrality and reasonable freedom from unacknowledged researcher biases’—at the minimum, explicitness about the inevitable biases that exist’ “ (Miles et al., 2014, p. 311). During member checking sessions, participants confirmed that their constructions and the proposed shared mental model were represented accurately and comprehensively. Member checking is “the most crucial technique for establishing credibility” (Lincoln & Guba, 1985, p. 314).

Transferability depends on applicability and similarities with other people, groups, contexts, and cultures; and can be determined only by readers for their own situations (Lincoln & Guba, 2013; Ravitch & Carl, 2021). Still, the identified issues, participant perspectives, thematic content analysis, subtheme findings (the impacts of misguided hierarchical abuses of

power and underaddressed production pressures), and the proposed adaptive solutions are consistent with the literature—while addressing commonly known but underexplored and unresolved patient safety and clinician well-being issues throughout healthcare.

Lincoln and Guba (2013) added *authenticity criteria*, two of which can be used to aid any modifications, potential implementation, and evaluation of the proposed shared mental model of collaborative voice and response. Those criteria are *catalytic authenticity,* "clarifying the focus at issue, moving to eliminate or ameliorate the problem, sharpening values" (p. 70); and *tactical authenticity*, "an assessment of the extent to which individuals are empowered to take the action that the inquiry implies or proposes" (p. 70). Both will be essential for nurses and technologists.

McComb and Simpson's (2014) criteria of teamwork content, similarity, accuracy, and dynamics also can be used to adapt, implement, and evaluate the proposed shared mental model or alternative. Methodology and methods are summarized in Table 3.2.

Table 3.2

Methodology and Methods Summary

Process	Method(s)	Description
Discovery		
Data collection	Semi-structured interviews	Pilot-tested interview instrument (guide) designed to answer the research questions. Interview questions were open-ended, with follow-up discussions on participants' experiences, perspectives, concerns, and ideas surrounding collaborative voice and response.
Data Analysis	Thematic content analysis, data coding, categorizing, condensing	Familiarizing myself with the data, identifying themes, coding the data set, and organizing codes and themes (Green & Thorogood, 2018). Highlighted potential themes as patterns in interview data. Unitized chunks of relevant meaning-making qualitative data from interviews. Data were coded or themed, organized, and managed in tables for further analysis and interpretation.
Interpretation	Meaning	Interpreted meaning in terms of participants' sense of worklife purpose, significance, and coherence (Steger et al., 2006). Also interpreted discrepancies between global (aspirational) meaning and current situational (actual) meaning-making (Park, 2010).

Assimilation		
Researcher as instrument	Co-constructing a proposed shared mental model	As the researcher, I used themes that captured patterns and meanings from the data to co-construct a proposed shared mental model for collaborative voice and response.
Participant confirmation (member checking)	General criteria	Member checking and refining of themes and the resulting proposed shared mental model with participants confirmed the model is accurate and likely to be pragmatically useful.
	Shared mental model criteria	Teamwork content, similarity, accuracy, and dynamics (McComb & Simpson, 2014).
Quality		
Throughout all processes	Researcher as instrument	Researcher authenticity, presence, transparency; and dialogic engagement with participants, stakeholders, committee chair and members, and peer classmates
	Qualitative criteria	Credibility, dependability, confirmability, and potential transferability (Bloomberg & Volpe, 2016; Lincoln & Guba, 1985; Ravitch & Carl, 2021)

Delimitations and Limitations

Delimitations are set by the researcher to limit the scope of the study. Time constraints to complete the dissertation delimited the scope of the study in two ways. First, this was a single case study with surgery teams in one academic hospital. Multiple cases in the same hospital with other units, such as the emergency department and intensive care units, or in different hospitals with other surgery teams, would provide larger, more diverse samples, along with opportunities for cross-case comparisons.

Second, time constraints meant that implementing and evaluating the study's proposed shared mental model will need to be done in future research. A possible and hopefully near future use would be due consideration of the mental model—along with the themes upon which it was based, plus the subthemes of hierarchical abuses of power and how to understand and manage production pressures—by a multidisciplinary perioperative work group, to further address issues identified in the study and the recent perioperative safety culture survey.

Still, the findings provide opportunities for contributing knowledge to the field—with a new, holistic approach that combined the constructivist inquiry paradigm and methodology to reconstruct social realities, with adaptive work theory and methods to holistically explore and

better understand nontechnical human factors—in terms of essential versus expendable values, beliefs, attitudes, and behaviors—that can help individuals and teams thrive. The findings may be catalytic for participants, transferrable to other contexts as determined by readers, and contribute to patient safety and clinician well-being.

Limitations are "external conditions that restrict or constrain the study's scope or may affect its outcome" (Bloomberg & Volpe, 2016, p. 12). By far the most significant limitation was that perioperative nurses and technologists chose to not engage in the study; and their voices and contributions were deeply missed. During the COVID-19 (Coronavirus Disease 2019) pandemic, healthcare leaders and frontline clinicians met unprecedented stressful challenges with heroic dedication, great ingenuity, and countless individual and collective acts of courage and sacrifice. They have undergone tremendous upheavals that surfaced and magnified difficult and longstanding issues throughout the healthcare industry and its organizations. Some of the known nursing issues and concerns are identified and discussed in chapter four and five.

Chapter Summary

Research design decisions and rationales were presented for using the qualitative approach; collaborating with research participants and stakeholders in engaged scholarship; the constructivist inquiry paradigm and methodology; the data collection method to discover participant perspectives through semi-structured interviews; adaptive work theory and methods in which participants distinguished nontechnical human factors (values, beliefs, attitudes and behaviors) that are essential from those that are expendable; the assimilation methods of thematic content analysis to identify themes, then using the themes to co-construct a proposed shared mental model for collaborative voice and response and member checking to refine and confirm the themes and proposed shared mental model are accurate, comprehensive, and likely to be pragmatically useful; thematic data analysis for further coding and analyzing the data to more accurately interpret participants' meaning; trustworthiness and quality criteria; plus delimitations and limitations. The research design and methods were chosen to conduct a

significant, rigorous, collaborative, and potentially catalytic study of the nontechnical human factors that influence patient safety and the well-being of all surgery team members. Study results and discussion of interpretations and implications are in the following two chapters.

CHAPTER 4: RESULTS

The purpose of this study was to co-construct, with surgery team participants, a proposed shared mental model for collaborative voice and response. The shared mental model or any adaptations of it, used in practice, may help reduce unwanted variation and unpredictability, and increase reliability, of collaborative voice and response; which in turn may contribute to the complementary goals of patient safety and the well-being of all team members. Findings are presented that answered the research questions and identified challenges to collaborative voice and response. Themes and the resulting proposed shared mental are presented first, followed by each research question and its findings.

Findings

By collecting and analyzing interview data from participants to answer the research questions, the findings were six themes and two subthemes that were used to co-construct a proposed shared mental model for more predictable and reliable collaborative voice and response. The themes were *respect and be kind to all, value patient safety and well-being of all team members, let's be best-in-class, am I really that approachable(?), explicitly encourage and appreciate voice,* and *do speak up for safety, opinions, and learning questions.* Two subthemes, "differences to explore, challenges to meet, conflicts to resolve, and ambiguities to clarify" (Lincoln & Guba, 2013, pp. 73-74), were *dysfunctional hierarchy* and *production pressures.*

The resulting proposed shared mental model, for more predictable and reliable collaborative voice and response, is the easily-remembered mnemonic REVAT, representing the first letters of the first words in each step of the model. While each step can be elaborated briefly or at length; the first words in the REVAT components: respect-encourage-voice-appreciate-thrive, can stand alone to be conceptualized and operationalized.

Some practices in the shared model correspond directly to the themes, such as respect and be kind to all, encourage voice, do speak up, and appreciate voice. However, a one-to-one

correlation between each theme and REVAT practice is not the case for two themes, “let’s be best-in-class” and “am I really that approachable?” nor the REVAT practice of “thrive – all of us.” Participants confirmed in member checking sessions that the goals in all the themes: including to value both patient safety and well-being of team members (including surgeons), let’s be best-in-class, and being approachable; would likely be achieved if the shared mental model is used in practice. Themes and the proposed model are displayed in table 4.1.

Table 4.1

Themes and Proposed Shared Mental Model

Themes	Shared Mental Model
Respect and be kind to all.	**REVAT**
Value patient safety and well-being of all team members.	**R**espect and be kind to all
Let’s be best-in-class.	**E**ncourage voice
Am I really that approachable?	**V**oice – do speak up
Explicitly encourage and appreciate voice.	**A**ppreciate voice
Do speak up for safety, opinions, and learning questions.	**T**hrive – all of us

Readers are reminded that the institutional review board protocol, and the corresponding participant informed consent letter, were designed and written to assure participants that all interview data would be de-identified as to names and disciplines, reported in the aggregate, and that no direct quotations would be used. This presented challenges in writing and evidencing the findings, because direct quotations are commonly used in qualitative studies to provide *thick description* of participants’ experiences and perspectives (Ryle, 1949, and Geertz, 1973, as cited in Ponterotto, 2006). Chapter five, the discussion, will instead present thick descriptions of a different kind, by interpreting participants’ meanings—in terms of the purpose, significance, and coherence—of their experiences, perspectives, and aspirations.

Unrelated to the research questions, a significant finding was that perioperative nurses and surgical technologists chose to not participate in the study, which will also be discussed in chapter five. Findings to answer the three research questions are further elaborated in the table and narratives below. First, the findings of research question one are displayed in Table 4.2.

Table 4.2

Collaborative Voice and Response Experiences

FINDINGS – RESEARCH QUESTION 1
RESEARCH QUESTION 1: What are participants' most collaborative experiences with voice and response?
INTERVIEW QUESTIONS Interview questions asked each participant to describe their *most collaborative* experience(s) in surgery teams with speaking up and responding effectively, including: What most stands out to you? What was most meaningful to you? What makes collaborative voice and response more challenging?
FINDINGS Prominent findings among the 10 participants (five surgeons, five anesthesiologists) were that surgeons need to initially and explicitly "set the tone" and climate that is psychologically safe for all team members to collaborate by voicing concerns, opinions, and learning questions (in ways that are not unnecessarily distracting); and for surgeons to maintain that tone and climate throughout the perioperative stages, rather than let psychological safety degrade or let separate disciplines revert to working silently in their own silos.
PARTICIPANT PERSPECTIVES Collaborative voice and response is most effective when surgeons intentionally and actively set a collaborative tone from the beginning; show genuine interest in each team member as a valued and included human being who inherently deserves respect and courtesy in the workplace; explicitly invite people to speak up with concerns, opinions, and questions; thank people for speaking up and making other important, even routine contributions; consistently support psychologically safety and collaboration by their prevailing tendencies and behavior habits; and apologize for incivilities, which within reason can be understood.. Surgeons should genuinely lead and actively engage in timeouts (preoperative briefings), rather than go through the motions; then keep an ongoing discourse throughout the surgery. Surgeons can demonstrate and encourage collaboration by supporting other team members in their roles and responsibilities, such as helping nurses completing instruments and sponge counts to ensure that no unintentionally retained foreign objects are left in the patient. It helps other team members be ready to plan and do their parts when surgeons *think out loud* about upcoming steps. Team leaders and members can think out loud to share situational awareness and task information, especially during urgent, often chaotic cases with severely injured trauma patients, when multiple tasks, sometimes separate and sometimes jointly, are being accomplished simultaneously by different people and parallel processing is necessary; for example, "I'm getting IVs." "I put an 18-gauge in." "I have access here." "We have the secured airway." "This is what I have for a tube." "We have blood in the room." "I drew the labs." Team leaders and members can also "think out loud" while working with unfamiliar teams and team members. Collaboration is enhanced by introducing and welcoming new people, and learning and using first names within the team. Collaborative voice and response come more easily when working in established teams, with team members who are professionally and personally well-known and comfortable with each other. Because different people often have different techniques, understandings, insights, and philosophies, it matters to routinely discuss these factors before, during, and after surgeries.

Themes: Essential and Expendable Values, Beliefs, Attitudes, Behaviors

This section describes the finding for research question two: What cognitive, affective, and behavioral human factors, in terms of values, beliefs, attitudes, and behaviors, do participants believe are *essential* to preserve, modify, or create; or *expendable* to discard, and perhaps must be discarded, for collaborative voice and response? This question was designed from adaptive work theory and methods, in which individuals and groups distinguish what is essential from what is expendable for them to succeed and thrive (Heifetz, 1994).

Definitions and descriptions of the terms values, beliefs, attitudes, and behaviors were derived from the literature and provided to participants so they would have common frames of reference in answering the interview questions. *Physician approachability* and *shared mental models* were also defined and described, for interview questions about what was essential or expendable. The definitions and descriptions provided to participants are below.

Values are principles and beliefs chosen by individuals and groups to prioritize, motivate, and direct action toward goals (Schwartz, 2012). Values and goals, such as patient safety and clinician well-being, can be compatible and even complementary, or conflicting; and they can be prioritized equally, nearly equally, or more unequally.

Beliefs, in the cognitive domain of human factors, are what people know and think (Bloom et al., 1956, Hauenstein, 1998; Salas et al., 2009). People know empirical data such as evidence-based medicine, and research findings on human factors that influence individuals and teams. What people think is commonly based on their lived experiences and their interpretations of those experiences.

Attitudes, along with emotions and feelings from which attitudes are often derived, are in the affective domain of human factors (Hauenstein, 1998; Salas et al., 2009). Attitudes are often reflected in people's *dispositions,* which are prevailing tendencies. Prevailing tendences are often displayed as *habits*, which are patterns of behavior.

Behaviors and patterns of behavior (habits) are individual actions and reactions, and team interactions (Hauenstein, 1998; Salas et al., 2009). In complex adaptive systems that lack shared mental models, team members influence each other in ways that can be unpredictable and less reliable, unless and until teams do in fact adapt (Institute of Medicine, 2001).

Physician approachability refers to whether, how well, and how consistently physicians' prevailing tendencies and behavior patterns demonstrate and earn trust from team members, that speaking up is encouraged, is psychologically safe, and that response will be collaborative (Deyo-Svendsen et al., 2017; Pack et al., 2022). Each physician's actions, reactions, and interactions influence how approachable team members perceive and in fact trust them to be. Approachability or its absence can also be a factor within and between other disciplines.

Shared mental models are guiding frameworks for both taskwork and teamwork, that have enough similarity with the frameworks of colleagues so that interdependent team members can function collaboratively (McComb & Simpson, 2014). Shared mental models depend on how accurately they represent reality. As applied to this study, the accurate representation of reality means shared awareness of the presence or absence of patient safety and team member well-being. Shared mental models should be dynamic; that is, flexible and adaptable as needed.

Because the study design integrated values, beliefs, attitudes, behaviors, physician approachability, and shared mental models, as interwoven and mutually influencing human factors—findings on essential versus expendable human factors were relevant to all three research questions. As a result, there are some overlaps in the findings that are centered on six themes and two subthemes identified in thematic content analysis of the interview data.

Paraphrased narratives and perspectives are reported in the aggregate as being expressed by all participants, most participants (more than half), some participants (less than half), or by one participant. Absence of such descriptors indicates that most or all participants expressed similar perspectives. The themes, subthemes, and related findings are below.

RESPECT AND BE KIND TO ALL – Participants reported it is essential that values, beliefs, attitudes, and behaviors show mutual respect for all team members—that they are all equals as people, and as knowledgeable, skilled, and dedicated professionals who contribute to the team's work and outcomes. "Think first" could be added to this theme. Participants directly or indirectly expressed that emotional intelligence—thinking first to show respect and be kind in words and actions, reading reactions, and reflecting afterward on what was said and done, and how—helps improve values, beliefs, attitudes, behaviors, and the culture and work climate.

Participants said *incivility* (from Latin, "not of a citizen") and *rude and disrespectful behaviors* (a term in the healthcare literature) hurt colleagues emotionally and must be discarded; and that it is essential to apologize for overt uncivil behaviors and less intentional human lapses in professional relationships. Some participants said that while strong but healthy personalities are essential to take on the responsibilities of surgery; aggressive and passive-aggressive language, body language, and facial expressions such as eye rolls and glares, are expendable and should be discarded. Attitudes and behaviors that abuse hierarchical power and status to intimidate people who would otherwise speak up, or even did speak up about safety (for example, violations of sterile policies) are expendable and should be discarded.

It is essential for surgeons to set collaborative tones and working climates from the start, and maintain them throughout all perioperative stages. All participants expressed perspectives and narratives to the effect that simply among people, there should be no hierarchy in mutual respect and dignity. Some participants said that they and a significant cohort of surgery colleagues are passionately invested and actively engaged in moving this culture forward.

VALUE PATIENT SAFETY AND WELL-BEING OF ALL TEAM MEMBERS – All participants said patient safety is the top priority and is essential. Most participants said the well-being of all team members, including surgeons, is essential in its own right; and contributes to patient safety, surgical performance, and outcomes. Some participants felt, because clinician well-being and patient safety influence each other, that well-being of all team members could be

equally valued and prioritized as complementary goals. Others felt that clinician well-being can be almost equal to patient safety as a value and goal. One participant observed that because clinician well-being is in the early stages of being understood and addressed, it is still undervalued and underprioritized. Another participant said there has been a common belief that you have to sacrifice yourself to succeed; but that belief is expendable, should be discarded, and often is being discarded by the younger generation.

Participants reported that values, beliefs, attitudes, and behaviors that clearly establish and intentionally maintain psychological safety are essential for well-being. Some participants said well-being was sometimes supported, but sometimes not supported, especially when production pressures to achieve efficiency goals were driving decisions and behaviors.

LET'S BE BEST-IN-CLASS – also stated as "let's *do* best-in-class" are *in vivo* codes, words used by a participant, which reflected participants' pride in their hospital, colleagues, and work; even while they aspire for their units and teams to more predictably and consistently be at their best. Participants felt it is essential to be leaders among hospitals, and units within this hospital. In addition to top performance and outcomes, they endorsed best practices in values, beliefs, attitudes, and behaviors to achieve a best-in-class culture. Supporting and building colleagues up is essential; stifling and putting colleagues down is expendable and must be discarded. Emotional intelligence is essential—being self-aware of how they interact with colleagues, reading how colleagues react, and reflecting afterward on ways to improve. This requires individuals, teams, and units to discard or resolve human factors and system obstacles to being and doing all that is best-in-class: a key theme that will be discussed in chapter five.

AM I REALLY THAT APPROACHABLE? – Some participants were convinced that many physicians overestimate their own approachability, compared to how other team members perceive them. One participant suggested a study to compare that data. Necessary, healthy, and functional uses of hierarchy are essential for structure; while unnecessary, unhealthy, and dysfunctional abuses of hierarchical power are expendable and should be discarded.

Unhealthy egos and hubris—thinking you are immune from making mistakes, or that it will not matter when you circumvent safety protocols—are expendable and must be discarded. Acknowledging your own vulnerability to mistakes and admitting your errors encourages team members to provide a safety net to catch and correct mistakes and errors before patients are harmed, or to minimize harm. Using first names when among only team members is one sign of approachability; while treating people as nameless objects or discipline roles is expendable. Participants felt it is essential to explicitly value and show appreciation for the knowledge, skills, and contributions of every team member, including nurses and surgical technologists. Meeting and introducing new people, and helping them feel welcome and comfortable, is essential.

EXPLICITLY INVITE AND APPRECIATE VOICE – It is essential for surgeons to set the tone from the start for a collaborative voice and response safety climate, and to maintain that collaborative climate throughout all perioperative stages. It is essential to explicitly invite team members to speak up, and express appreciation when they do; especially when voiced safety concerns are accurate and significant. Still, surgeons as leaders should show appreciation even when voiced concerns or opinions are not pertinent to the current situation, because the next time they could be. Surgeons should provide learning explanations when time permits.

DO SPEAK UP FOR SAFETY, OPINIONS, & LEARNING QUESTIONS – With psychological safety established, it is essential for team members to speak up with timely safety concerns, clinical opinions, and learning questions. One participant noted there are times of intense concentration on clinical tasks when a surgeon should not be asked non-safety critical questions that can wait; suggesting that situational awareness of safety- and time-criticality (what to voice and when) are professional judgements to which everyone should be attuned.

Subthemes: Production Pressures and Dysfunctional Hierarchy

Two important, mutually influencing organizational subthemes were identified: *production pressures*, a key system factor, and *dysfunctional hierarchy,* a key cultural factor. Unless they are well-understood, differentiated as to what is positive and what is negative, and

well-managed, either factor or both together can impede collaborative voice and response and contribute to errors and harms.

PRODUCTION PRESSURES are common in high-consequence industries, and have repeatedly contributed to preventable organizational errors and tragic disasters (see page five). Production pressures, also known as time pressures, result from policies, goals, and efficiency measures which are commonly well-intended. Two examples given by participants are first case (of the day) on-time starts, and turnaround times between successive cases in the same operating room. No participant said efficiency is unnecessary or expendable. Still, unmanaged production pressures can contribute to errors and harm, and reduce clinician well-being.

Time pressures can lead to taking little or no time for debriefing and decompressing from critical incidents, including when patients have just died, regardless of how good the care was. Teams should also take time after surgeries for routine debriefs of what was done well, and what could be done better in the future, including team interactions. Time pressures before, during, and after surgeries can lead to perfunctory preoperative briefings and timeouts (before incision); hinder speaking up during surgeries, including at critical pause points, and when errors are detected but not conveyed and corrected; plus cause conflict among surgery team disciplines and members. Examples given of team conflict were seeking blame for small delays in operating room turnaround times; and not following through with collaborative discussions about differences or misunderstandings of clinical opinions that may take time to rectify. It was noted that time pressures can bring out incivility toward others, and that not speaking up about negative effects of time pressure is itself a form of not speaking up for patient safety.

Production and efficiency are necessary, but production pressures must be recognized, understood, and well-managed, keeping “safety first” as a precondition for production. Helping frontline clinicians manage the risks of production pressure is discussed in chapter five.

DYSFUNCTIONAL HIERARCHY – Participants noted that hierarchies necessarily exist in most organizations, and that healthy and functional forms of hierarchy are needed for

leadership and structure of surgery units and teams. All participants agreed that while unhealthy and dysfunctional hierarchical abuses of power have been changing for the better, the culture is not yet what it should be; and that remaining hierarchical abuses of power by even by a small number of clinicians are disruptive and must be discarded. Some participants thought there are generational and/or gender influences toward positive change; and most participants spoke directly or indirectly of leading and being part of changing the culture.

One participant reported it is no longer acceptable to “yell at” nurses but that some attending surgeons still yell at resident surgeons in training. It was noted that residents who were yelled at during training, when they become more senior, may be more likely to yell at others. In place of raised voices, more subtle signs of disrespect continue, such as quieter abusive comments, and facial expressions such as eye rolls and glares. Participants agreed that healthy and functional purposes of hierarchy give no one the right to either overtly or subtly abuse power, demean and belittle people, and generate fears of retribution for speaking up.

One participant noted that surgeons can model collaboration by showing that no task is beneath anyone; such as by arriving early to help team members set up the operating room, and by helping nurses rectify instrument and sponge counts to help ensure no unintentionally retained foreign objects are left in the patient. Participants spoke of collaborating with other disciplines so everyone could work at the top of their scopes (education, training, experience, and skill) and contribute what is best for the patient. Mutual respect and genuine support for all team members is important throughout even routine matters of surgery, and especially during and after more difficult and stressful procedures and times.

Proposed Shared Mental Model for Collaborative Voice and Response

Research question three was: What consensus or near consensus shared mental model could participants and the inquirer co-construct, that when used in practice may reduce unwanted variation and unpredictability, and increase reliability of collaborative voice and

response? The proposed shared mental below was co-constructed by the inquirer using themes and subthemes identified from participants' interviews, elaborated in the sections above.

REVAT
Respect and be kind to all
Encourage voice
Voice – do speak up
Appreciate voice
Thrive – all of us

REVAT is proposed as an easily-remembered mnemonic that surgery teams may use to be mindful of essential values, beliefs, attitudes, and behaviors that can used in practice for more predictable and more highly reliable collaborative voice and response. The short phrases represented by each letter in REVAT briefly extend the model, and were elaborated further on a one-page document used in member checking. In member checking meetings, participants confirmed that the themes and subthemes were accurate and comprehensive, that the proposed shared mental model captured the themes and subthemes, and that the model, used in practice, is likely to be effective.

Most member checking sessions included discussions about how the proposed shared mental model could be considered for use in practice. The decision to adopt or modify REVAT and implement it, with leadership approvals, or use it as a starting point for developing another shared mental model, could perhaps best be made by consensus or near consensus of interdisciplinary representatives, such as an existing perioperative committee or an ad hoc work group. Participants emphasized that engaging nurses and surgical technologists in that effort is essential. Further discussion of potential efforts is in the following chapter.

CHAPTER 5; DISCUSSION

The purpose of this qualitative, constructivist case study was to co-construct, with surgery team participants, a proposed shared mental model for more predictable and more highly reliable collaborative voice and response, that used in practice may help improve patient safety and clinician well-being, which are mutually influencing. Following guidance adapted from Bloomberg and Volpe (2016), this chapter presents interpretations of participants' meanings related to the study's findings, recommendations for future research, implications for practice, and conclusions.

Drawing from multiple definitions of meaning identified by Steger et al. (2006), their own composite definition, and elements in their Meaning in Life Questionnaire, this study interprets meaning in the findings as participants' sense that their worklives have *purpose*, *significance*, and *coherence*. People want to be part of something important (purpose), to make their own contributions (significance), and for their purpose and significance to be supported in healthy and functional ways (coherence). People also want joy and meaning in their worklives, so they can thrive, rather than feel stifled in unhealthy and dysfunctional ways (Leape et al., 2009).

Using similar constructs, Park (2010) argued that when people experience stressful situations (situational meaning) that are discrepant from their aspirational meaning (in the sense of one's self in the world, their *global* meaning), they either make successful adjustments or experience more distress in trying to resolve the discrepancies. People may find or restore meaning through various processes, such as reinterpreting their experiences and/or and making positive life changes in values, beliefs, attitudes, and behaviors—thereby evolving their identities to be aligned with their aspirations for personal growth. In that sense, at the individual and/or group levels, people generate adaptive solutions to adaptive challenges (Heifetz, 1994).

Accordingly, this chapter will discuss meanings in the theme and subtheme findings, in which participants described purpose, significance, and coherence, or discrepancies between

their aspirational and situational senses of meaning. Findings are situated as human factors and organizational system factors, as elaborated in chapter two, part one and depicted in Figure 5.1.

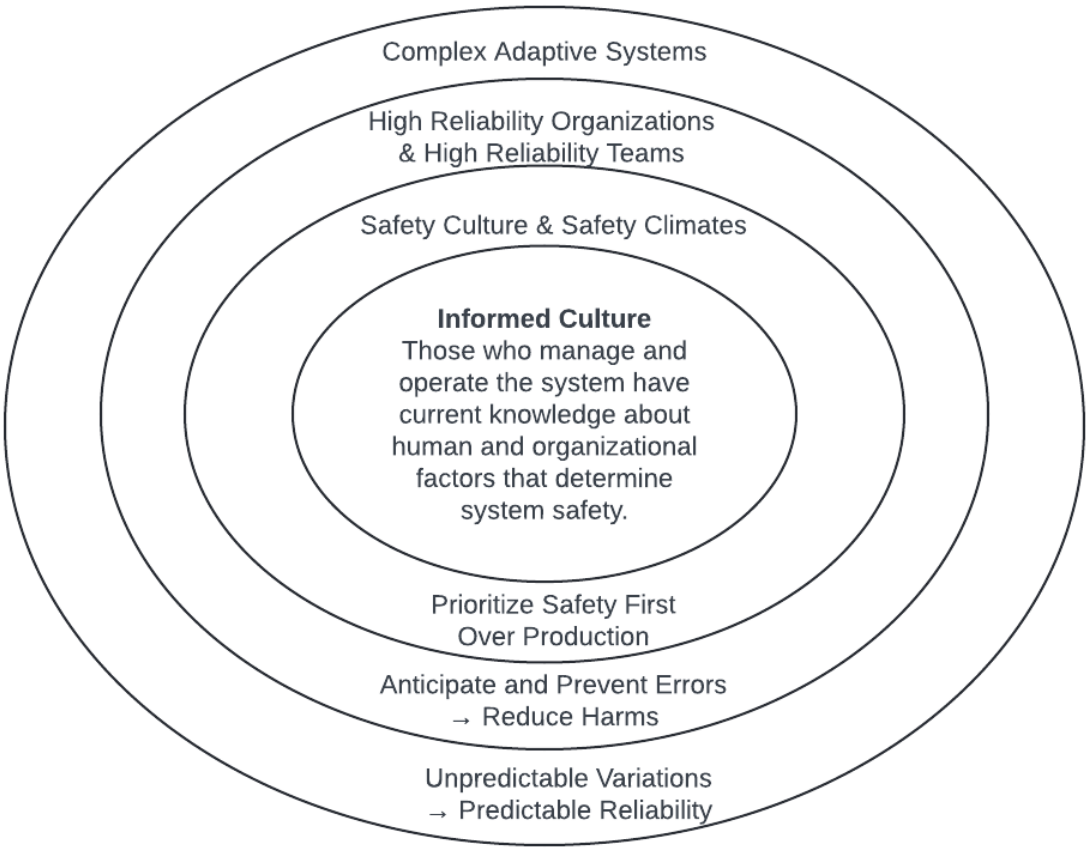

Figure 5.1

Human Factors and Organizational System Factors

Starting from the center of the figure, according to Reason (1997), a subset of safety culture is an *informed culture,* in which "Those who manage and operate the system have current knowledge about the human, technical, organizational, and environmental factors that determine the safety of the system as a whole. In most important respects, an informed culture *is* a safety culture" (p. 195). Strong organizational safety cultures and team safety climates prioritize safety first over production. Consistently mindful safety cultures, with leaders who target zero harm, plus robust process improvements, are required for high reliability (Chassin & Loeb, 2011, 2013). In high reliability (or highly reliable) organizations, leaders and frontline

teams anticipate and prevent as many errors as possible, and avoid or minimize harms from errors that remain (Weick & Sutcliffe, 2015). To achieve and sustain high reliability, healthcare organizations such as hospitals, and their microsystems including surgery teams, must be designed, understood, and operated as complex adaptive systems, so that systems and human factors influence each other as predictably and reliably as possible (Institute of Medicine, 2001)

Perioperative Nurses and Surgical Technologists

A finding not related to the research questions was that no perioperative nurses or surgical technologists chose to participate. There are no data from the study as to why nurses or technologists did not respond to recruiting attempts.

As context, healthcare in general, leaders, physicians, staff, and the nursing workforce in particular have faced tremendous challenges during and since the COVID-19 pandemic, which disrupted industries and societies globally. In 2020, COVID cases and patient deaths hit the U.S. and global populations historically hard, which in turn hit frontline clinicians and hospital leaders. Then, in 2022, the “great resignation” hit global industries, healthcare, and nursing.

The pandemic has exacerbated pre-COVID challenges, including cultural issues such as long-entrenched hierarchical power and status differentials between physicians and other healthcare workers, and between senior and junior colleagues in the same disciplines. Leaders with good interpersonal attitudes and behaviors support all team members. All surgeon and anesthesiologist participants in this study expressed high regard for the knowledge, skills, dedication, and contributions of perioperative nurses and surgical technologists; and that as people they are equal and inherently worthy of respect and dignity. Participants spoke of their own efforts to help nurses and surgical technologists feel welcome, included, and encouraged to contribute. Some participants told of efforts to reduce or ease difficult situations when nurses, technologists, residents, and medical students were mistreated.

Leape, formerly a pediatric surgeon and a pioneer in the modern day patient safety movement, was among a dozen patient safety leaders who co-authored “Transforming

Healthcare: A Safety Imperative" (Leape et al., 2009). The authors called for healthcare organizations to implement five transformations essential for becoming high reliability organizations. One transformation is *joy and meaning in work* for all physicians, nurses, and other healthcare workers. While this transformation is ongoing in the healthcare industry, the specific problems and solutions are local. Purpose and significance in work are virtually givens in healthcare, but incivility from even a small number of colleagues can stifle the coherence people should feel between their situational meaning and the meaning they aspire to have.

Meanings Interpreted in Themes and Subthemes

Findings for research question one, about participants' most collaborative experiences with voice and response, and what makes it easier or more difficult, are in Table 4.2. Meaningful purpose, significance, and coherence are supported when surgeons, from start to finish, set the tone and climate to communicate collaboratively themselves, and encourage all team members to do so; and when team members share current situational awareness of taskwork and teamwork, especially by "thinking out loud" during emergent situations with trauma patients, and when working with unfamiliar team members. Surgery teams who routinely work together tend to establish and evolve taskwork preferences and teamwork tendencies over time.

More collaborative individual actions and reactions and team interactions could minimize discrepancies between purpose, significance, and coherence; and better manage discrepancies when they inevitably appear. Interprofessional collaboration is increasingly taught in medical schools, nursing schools, and other health profession schools, reinforced in continuing education forums for healthcare professionals; and promoted in quality, safety, and professional education forums; however, much work remains to be done (Thibault, 2020).

Discussion of research question two, about what values, beliefs, attitudes, and behaviors participants perceive to be essential versus expendable for collaborative voice and response, focuses on the six themes and two subthemes. Interpretations of participants' meaning—purpose, significance, and coherence—for themes and subthemes are in the following sections.

Let's Be Best-in-Class

For a logical order of discussion to interpret aspirational meanings, situational meanings, and any discrepancies between them, this discussion starts with the aspirational purpose, significance, and coherence indicated by the theme "Let's be best-in-class" It is an in vivo code from the words of a participant, and a conversation that was already taking place among clinicians at the time of the interviews. This academic hospital is nationally-ranked overall and in 10 medical specialties, and is led by enlightened, progressive, and award-winning leaders. In a rare achievement, the hospital has met rigorous criteria four consecutive times to be designated as a Magnet hospital, attracting and retaining top nurses. Being and doing best-in-class are being achieved in many ways, and in other ways are within reach.

In terms of meaning, considerable pride was reflected by all participants in the purpose, significance, and overall coherence of their own work and of their colleagues from all disciplines. Purpose (being part of something important, and larger than themselves) and significance (making their own important contributions) seem to be at a peak; while coherence (being supported and not being stifled) is high, but some discrepancies or gaps remain between aspirational meaning (what one participant called an idealized state) and situational meaning (the current actual states). This study helps identify and address the discrepancies.

Toward the aspirational theme of "let's be best-in-class" (and "do" best in class), other themes will be discussed in the following order: respect and be kind to all; value patient safety and well-being of all team members; explicitly encourage and appreciate voice; do speak up for safety, opinions, and learning questions; and am I really that approachable(?). Two important subthemes, dysfunctional hierarchy and production pressures, will then be discussed.

Respect and Be Kind to All

Every member of the team deserves respect and dignity first as a person, in addition to deserving respect and appreciation for their education and knowledge, training and skills, and their experience, dedication, and contributions. Leading psychological safety researcher Amy

Edmondson's "required reading" (Kinni, 2016) was the 2000 book *Leadership and Self-Deception: Getting Out of the Box*, by the Arbinger Institute. The self-deception is not seeing you have a problem; and the problem is being in the box from which you treat people as objects, rather than treating each person with respect and inherent dignity. This is a good lesson in life for anyone. Making the effort to learn and use first names whenever possible, rather than routinely saying, for example, "Hey, nurse," is important. To be and do best-in-class, it is essential to be kind, to think first, and to show respect to all team members for having their own inherent rights to purpose, significance, and coherence in their work and work lives.

Value Patient Safety and Well-Being of All Team Members

Two words in the interview data on this theme stood out: *intentional* and *reflecting*. It is important to be intentional toward values, beliefs, attitudes, and behaviors, especially but not only in moments of stress when "true colors" tend to come out. It is important to reflect afterward on how words and actions were received, and what the impacts were on patient safety and the well-being of team members, including surgeons. Notably, intentionally being best-in-class was alluded to by a participant who greatly admired a leader who, professionally and personally, exemplified that the highest standards of perioperative performance, patient safety, and team member well-being can all be achieved together. Others can emulate leaders like this, who model a strong, yet humble and pleasant, best-in-class presence and competence that reflects the integrity of their own purpose, significance, and coherence.

The discrepancy that stood out is that best-in-class values, beliefs, attitudes, and behaviors are sometimes undermined by their opposites. One participant noted that attitudes and behaviors go together and influence each other. Some participants wondered aloud if negative prevailing tendencies and behavior patterns by some could be changed without strong leaders intervening on behalf of what is best-in-class. The well-being of all surgery team members does not have to be sacrificed, neither by oneself, by those (perhaps few) who abuse power through dysfunctional uses of hierarchy, nor by organizational production pressures.

Explicitly Encourage and Appreciate Voice

The frequency and effectiveness of preoperative timeouts, during which speaking up can first be explicitly encouraged, are perceived to be improving but still need to be more frequent and more effective. Intraoperative communications can include thinking out loud to share situational awareness, task planning, and opinions, or can regress to working silently in silos. Post-operative debriefs (before the patient leaves the operating room) are held less often than preoperative timeouts, in large part due to time pressures. When debriefs are held, team members should be asked what clinical steps and nontechnical team interactions went well and what could be done better in the future, to enhance collaboration and continuous improvement.

In terms of meaning, those positive attitudes and behaviors deepen purpose and significance for everyone, and bring a coherent sense to team leaders and all team members of providing mutual support and being supported in healthy and functional ways. Discrepancies, or incoherence between aspirational and situational (experienced) meaning, result when leaders intimidate others through unhealthy egos, hubris, or dysfunctional abuses of hierarchical power; with the result that people feel stifled, and that it is not safe to speak up.

Do Speak Up for Safety, Opinions, and Learning Questions

With psychological safety consistently and more predictably established, it then becomes incumbent upon team members to speak up with timely safety concerns, clinical opinions, and learning questions. One participant expressed that there are times of intense concentration on surgical tasks that require the utmost focus, precision, and dexterity, when surgeons should not be distracted by non-safety critical comments and questions that can wait. Situational awareness of both safety-criticality and time-criticality (what to voice and when) are professional judgements to which all team members should be attuned. In surgery teams and other healthcare teams—discernment, good judgment, collaboration, and effective team communications come with the territory of the professions, just as it does for airline flight crews and air traffic controllers, upon whom people's safety and lives also depend.

Am I Really That Approachable?

Participants said surgeons and other physicians tend to think of themselves as being more approachable than they really are; and that actions matter, not just thinking or saying you are approachable. Making consistent efforts to be someone with whom people feel it is safe to raise safety concerns provides a safety net against individual and team errors. Asking people their clinical opinions engages them, shows respect for their knowledge and contributions, and can result in better decisions. Encouraging and answering questions helps teams learn and improve together. Genuine apologies for unintended lapses and difficult moments that anyone might have helps restore approachability; and can restore people's sense of meaning in the purpose, significance, and coherence of their work and work lives.

Subtheme: Dysfunctional Hierarchy – Incivility and Abuse of Power

Participants in this study reported that incidents of hierarchical abuses of power and incivility have been diminishing in recent years; but that abuses and incivility by some colleagues remain, and they have outsized adverse effects on psychological safety, speaking up, and the well-being of unit and team colleagues. Abuses of power can be flagrant, such as rude, disrespectful, and overtly aggressive verbal statements; or subtle microaggressions, such as dismissive tones of voice and facial expressions such as eye rolls, that some may use rather than "yell at" colleagues. However, compared to verbal statements, facial expressions get more attention from senders and receivers as to their intent, are more accurately recognized and interpreted, and even have more negative impacts (Elfenbein et al., 2002).

"Healthcare is delivered in an emotionally charged environment" (Sattar et al., 2024, p. 2) that includes anxious patients, worried families, hazardous technologies with high risks and high consequences for failure, multidisciplinary teamwork in a time-pressured environment, limited resources, and constantly confronting human pain, suffering, and death. Relevant to this study, two of the most commonly reported emotional triggers are "patient safety events and their repercussions (including adverse events, medical errors, and surgical complications)... [and]

workplace toxicity (including workplace bullying and staff hostility)" (p. 4). Some participants said more and better emotional intelligence is needed in the workplace, and spoke of reflecting on and working to improve their own emotional intelligence. Commonly known as EQ, emotional intelligence has been defined as the "accurate appraisal and expression of emotions in oneself and others and the regulation of emotion in a way that enhances living" (Mayer, et al., 1990, p. 772, as cited in Elfenbein et al., 2002, p. 37). Even though gradual change for the better has occurred, abuses of power and incivilities by some colleagues continue, suggesting a need for emotional intelligence education in medical schools and nursing schools, ideally in combined discipline classes, plus continuing interprofessional education in organizations.

Whether flagrant or subtle, abuses of power harm people's dignity, joy in work, and their sense of purpose, significance, and coherence of what makes work meaningful. The healthcare dictum "first, do no harm" should be practiced with colleagues as well as with patients.

Subtheme: Production Pressure (Time Pressures)

In the literature on high-consequence industries where people's safety and lives are at stake, *production pressure* is a common term. Some participants raised this issue as production pressure, while others used the term *time pressures*. Leaders and frontline workers who make crucial decisions, often "in the heat of the moment," commonly feel pressured by well-intended organization goals and policies, driven by data that measure production and time. As organizational factors interact with complex human factors and situational factors, production pressures can and sometimes do contribute to preventable errors and resulting harms.

In high-consequence industries such as commercial aviation and space flight, preventable disasters can claim the lives of multiple people at once (see disasters in chapter one). In healthcare, preventable deaths or injuries generally occur one person at a time, although harms resulting from ongoing system and culture flaws can be cumulative.

Some well-intentioned leaders and scholars assume there is a need to "balance" safety and production. That assumption, the word balance, along with often unexpected human,

system, and/or situational factors in complex high-consequence industries, can and do tip the scales in the wrong direction, as people under production pressures inevitably make risky decisions. When tragic disasters result, one can only ask, “What was so productive about that?”

There is an adage in medicine, “Make the safe thing the easy thing.” It is not easy to balance two values and goals, implying that they are competing, that instead should be thought of, and practiced, as complementary. The safe thing is not to *balance* safety and production, inevitably tipping the scales toward disaster. The safe thing is to *prioritize* “safety first” as a precondition for production. That means to safely be as productive as possible under current conditions, slowing or even stopping production as necessary, then safely increasing production as conditions improve. Safety and production, in that order, are thus conceptualized and operationalized as complementary. There is a need for organizations to address why and how some well-intended, data-driven efficiency goals can actually be counterproductive, and then help people see, understand, and safely manage the risks that remain; with explicit, clear, and unambiguous organizational support to value and prioritize safety first (Griffith, 2023).

Proposed Shared Mental Model for Collaborative Voice and Response

The proposed shared mental model for more predictable and more reliable *collaborative voice and response*, used in practice, may contribute to clinical outcomes, patient safety, and clinician well-being, which are mutually influencing (Institute of Medicine, 2000; National Academy of Medicine, 2019). For clinicians and teams, these are complex adaptive challenges.

The proposed mental model represented by the mnemonic *REVAT* simply and easily represents explicit practices—*respect-encourage-voice-appreciate-thrive.* Paradoxically, in complex adaptive systems, *simple rules*, such as *first do no harm* and perhaps REVAT, can help people meet complex adaptive challenges (Institute of Medicine, 2001). Expanded, but still short, simple, and easy phrases for REVAT are: Respect and be kind to all, Encourage voice, Voice – do speak up, Appreciate voice, and Thrive – all of us. Combined with “think first,” REVAT may be a helpful model for increasing individual and collective emotional intelligence.

Recommendations for Future Research

As noted, the perspectives and voices of perioperative nurses and surgical technologists were profoundly missed in this study. The first of four recommendations for future research is to engage nurses, technologists, anesthesiologists, and surgeons to better explore and understand the adaptive challenges of nontechnical human factors—values, beliefs, attitudes, and behaviors—in their work and work lives, and to create adaptive solutions together.

Nurses have been America's most trusted professionals every year except one since 1999, when they were first included in the Gallup organization's annual surveys of how the public views the honesty and ethics of various professions (Gallup, 2024). In 2001, after the 9/11 terrorist attacks that year, firefighters ranked first, and nurses were second. Medical doctors have generally ranked in the top five or 10. It should not be the case that such honorable, trusted, and essential healthcare professionals have increasingly struggled in their work environments, and sometimes with each other.

In healthcare, positive workplace emotions include satisfaction, joy, and meaning. Negative workplace emotions (fear, anger, and guilt) are triggered by adverse events, critical incidents, medical errors, surgical complications, workplace toxicity, patient deterioration and deaths, work overloads, and team difficulties (Sattar et al., 2024). While many "care of the caregivers" efforts focus on organization and individual levels, more nontechnical human factors research is needed at the unit and team levels to help caregivers take better care of each other.

The second recommendation is for research to help improve physician approachability, a relatively new concept that needs to be recognized and addressed, at all levels, to advance culture and practice. In the interviews with participants, physician approachability was defined as whether, how well, and how consistently physicians' attitudes (prevailing tendencies) and behavior patterns (habits) demonstrate, and are perceived by team members, that speaking up is encouraged, is psychologically safe, and that response will be collaborative. Approachability also matters within and between other disciplines, including nursing and anesthesiology.

The third recommendation for future research is to help the frontlines and leaders distinguish between functional and dysfunctional uses of hierarchy, and address them in ways that are clear, explicit, and consistent. Functional hierarchy provides appropriate leadership and structure, while dysfunctional hierarchical abuses of power work against patient safety and clinician well-being, and against unit and team aspirations of being best-in-class.

The fourth recommendation for future research involves helping frontline clinicians and teams better understand and manage production pressures. In high-consequence industries including healthcare, efficient production is necessary but not sufficient. Unmanaged production pressures can impede collaborative voice and response, contribute to errors and harms, cause conflicts among team members, and preempt postoperative debriefings that enhance future safety, as well as critical incident stress debriefings for clinician well-being. It is vital for leaders, researchers, educators, and frontline colleagues to better understand and manage the risks of production pressures, and to reliably prioritize safety first, as a precondition for production.

Implications for Practice

One-hour member checking sessions with the 10 participants first focused on the identified themes and the proposed shared mental model. Most of the remaining time with each participant sought their perspectives on how to implement the REVAT model or any modifications of it. While the hospital has vast implementation experience, ideas from the literature and participants are offered here.

Implementation discussions were guided in part by a two-page summary, provided to each participant, of the seminal work by Rogers (2003) on diffusion of innovations. “Diffusion is the process in which an innovation is communicated through certain channels over time among the members of a social system” (p. 5). Over time, an innovation may be adopted or rejected, or both, in any order. On a normal bell curve, which often may not be the case, Rogers categorized potential adopters as innovators (2.5%), early adopters (13.5%), early majority (34%), late majority (34%), and laggards (16%). The “tipping point” toward widespread adoption is passing

the first 16% of innovators and early adopters, into the early majority who adopt the innovation. The late majority is inclined to “wait and see” sustained practice and results before adopting. Laggards (a descriptive and nonjudgmental term) may have legitimate concerns that should be addressed; but dysfunctional resistance or malicious compliance should not drive the culture.

Potential adopters consider five characteristics of an innovation that could be applied to the REVAT shared mental model: (1) *relative advantage* over previous practices (in this study, those unpredictable and unreliable practices that put patient safety and team member well-being at risk), (2) *compatibility* with values, past experiences, and needs (for patient safety and team member well-being); (3) *complexity* as to how easy or difficult the innovation is to understand and use (REVAT—respect, encourage, voice, appreciate, thrive—is a “simple rule”); (4) *trialability* as to pilot testing the innovation (ideally pilot-tested by unit and team change agents, formal and informal clinical leaders supported by hospital and perioperative leaders, and study participants who are innovators and early adopters); and (5) *observability* as to how visible the results of using the innovation are (results can reinforce use or address changes). REVAT can meet all of these considerations, as any modifications or alternatives should do.

Other useful considerations include strategies for attaining critical mass, and consideration of desirable, direct, and anticipated consequences versus undesirable, indirect, and unanticipated consequences (Rogers, 2003). Published reports on healthcare-specific approaches and road maps to diffusion and adoption, some of which cite Rogers, could be helpful (Balas & Chapman, 2018; Barnett et al., 2011; Berwick, 2003).

In member checking sessions, the surgeon and anesthesiologist participants suggested that principles such as those in REVAT should be taught in medical schools and in nursing schools. Nontechnical human factors should purposely be integrated and ingrained with clinical practices. Participants also supported interdisciplinary education in human factors as medical and nursing students, and then as hospital clinicians, learning together (Thibault, 2020).

Within the hospital, participants suggested that REVAT should be seamlessly built into the existing work and culture in ways that require little added time and cognitive workload. In the realm of cognitive human factors and ergonomics, cognitive workload should not be a burdensome job demand (Privatera, 2022). Instead, an innovation such as the REVAT shared mental model should be cognitively, emotionally, physically, and morally informed and restorative; promote a culture of respect, kindness, well-being, and thriving; and generate superior teamwork competencies; so the efforts for adoption and practice are worthwhile in the greater benefits they return—another case that can be made for REVAT.

Participants suggested that implementation pathways could include engaging the multi-disciplinary perioperative quality and safety committee, plus existing leadership groups for each discipline. Posters of the model could be displayed, with a standard procedure to verbalize REVAT in preoperative time-outs, and encourage using the practices during surgeries and in postoperative debriefs. Change agents, formal and informal leaders from all disciplines, study participants, and the cohort participants said is already seeking change could actively model and encourage the use of REVAT.

Follow-up is essential in change efforts. Leaders, leadership groups, and perioperative safety and quality committees could coordinate follow-up, which could include formal and informal feedback from the workforce, ongoing reinforcements, evaluations, and evolutions of the shared mental model and related practices. An anesthesiologist who was not a study participant offered to lead an interdisciplinary work group, including nurses and technologists, to map how REVAT could be adopted and/or revised, and implemented.

Those who work to adopt or modify and implement REVAT as a best-in-class practice would be well-advised to consult two recent articles on frontline voice being heard and implemented within the organization. Kerrissey et al. (2024) interviewed 24 registered nurses, nurse managers, and nurse practitioners, who identified two barriers that prevent being heard: walls (organizational barriers that reject ideas outright) and voids (organizational gaps where

ideas get lost in the system). Satterstrom et al. (2023) offered a multilevel model for how frontline voice can be better implemented within organizations. The multiple levels are voicers, teammates and coworkers, frontline and middle managers, and senior leaders. Topics and issues addressed include voice antecedents that encourage voice plus; benefits and barriers; what people at each level, including receivers of voice, can do; and practical implications.

Because the REVAT model has policy and practice implications, approvals would be needed from perioperative and hospital leaders as receivers of frontline voice, from participants of the study and groups who modify or seek adoption of the model. Leaders should consider that the REVAT model's five steps target the mutually influencing values and goals of patient safety and clinician well-being, and nontechnical human factors that are often underaddressed. "Respect and be kind to all" and "thrive – all of us" are bookend markers of clinician well-being. The middle three steps: "encourage voice," "voice – do speak up," and "appreciate voice" are markers for collaborative voice and response in general, and specifically for patient safety.

One tool to help evaluate results of pilot-testing and full-scale adoption of the REVAT model is the Coworker Concern Observation Reporting System (CORS), from the Center for Patient and Professional Advocacy at the Vanderbilt Medical Center. Categories of concerns reported are physician communications, professional responsibility, medical care, and professional integrity. From 2018 through 2022 inclusive (five years), in a cohort of 35,120 physicians at 193 participating hospitals, coworkers reported concerns about 3,179 (9.1%) of the cohort (Cooper et al., 2024).

Less than 1% of the cohort were subjects of multiple reports over the five years for which data were analyzed. CORS reports could help frontline clinicians see and evaluate empirical results, and help leaders more effectively support and reinforce REVAT practices for a collaborative care shared mental model. CORS could also help leaders directly help or address that relatively small percentage of clinicians who seem to generate an outsized portion of disrespect, incivility, cultural dysfunction, and system harm.

Conclusions

This study's findings highlight the need to understand and operate hospitals, and their microsystems such as surgery teams, as complex adaptive systems, as they strive for more predictable and more highly reliable patient safety and clinician well-being (Institute of Medicine, 2001). These are complex adaptive challenges, for which frontline clinicians need and deserve the best possible help from leaders, researchers, educators, and each other, to indeed adapt.

Weick (2001) considered "organizational culture as a source of high reliability" (p. 330) and suggested "there should be fewer accidents when there is a better match between system complexity and human complexity. A better match can occur basically in one of two ways: either the system becomes less complex or the human more complex" (p. 330). Rather than an either/or approach, this study addressed both the system and the human elements.

First, the proposed shared mental model, REVAT, could help the system, at the unit and team levels, be less complex—helping team communications be more collaborative, more predictable, and more reliable. REVAT, much like "first do no harm" in healthcare, is intended to be a "simple rule," used in complex adaptive systems to conceptualize, operationalize, and guide practice (Institute of Medicine, 2001). Second, the findings are intended to help frontline clinicians explore and discover more complex, deeper, and wider understandings of the essential versus expendable human factors—values, beliefs, attitudes, and behaviors—that influence patient safety, and the personal and interpersonal well-being of clinicians themselves.

According to Elisseou (2023), clinical instructor of medicine at Harvard Medical School and an advocate for trauma-informed care, including care of the caregivers, "While the relationship between trauma and burnout is not fully understood... it is likely that chronic, unmanaged stress at work can worsen the symptoms of trauma, and vice versa" (p. 170). Trauma, "one of the most underrecognized epidemics in the world... can be any perceived harm with lasting adverse effects on one's functioning or well-being" (Elisseou et al., 2024, p. 198). Healthcare workers are affected not only by increasing social and political strife, exacerbated in

recent years, that affect the general population, but also by the profound responsibilities of their work, including caring for patients through pain, suffering, and death.

"Addressing Health Worker Burnout: The U.S. Surgeon General's Advisory on Building a Thriving Health Workforce" (Office of the Surgeon General, 2022) reported that in general, the healthcare industry is at a breaking point, healthcare workers are at their limits, and the stakes are high. Even before the height of the pandemic, as thousands of healthcare workers lost their lives and thousands more sooner or later resigned, job-related burnout symptoms were reported by 35 to 54% of nurses and physicians and 45 to 60% of medical students and residents, with 69% of residents at one major academic center reporting burnout. Many healthcare workers feel "exhausted, helpless, and heartbroken... [from] the long-standing crisis of burnout, exhaustion, and moral distress" (p. 4). While frontline workers struggle to keep their hope and courage, they know significant changes are needed because the current state is unsustainable.

The call to action advised healthcare educational institutions to better prepare learners for the emotional demands of their professions and work environments; and for healthcare organizations and systems to transform their cultures, engaging frontline workers to improve not just workflows and processes, but also their cultures and team climates. The call to action recommended "research that is inclusive of the diversity of professions and health workers across the health care system... [including] the effects of integrated team-based models of care on health worker well-being, patient outcomes and other impacts" (p. 56).

REVAT is a simple, team-based, shared mental model of collaborative care. It is human-centered on integrated human factors: respecting and being kind to all, encouraging voice, then voicing (speaking up), appreciating voice, and thriving of all team members. The aim is to help frontline caregivers, who are all in this together, take better care of each other as they take care of patients. In practice, the model could help achieve desired outcomes for all stakeholders—patients and families, frontline clinicians, and transformational hospital leaders.

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APPENDIX

SEMI-STRUCTURED INTERVIEW QUESTION GUIDE

Study title: *Hearts and Minds in the Operating Room: Co-constructing a Shared Mental Model with Surgery Teams for More Predictable and More Highly Reliable Collaborative Voice and Response*

This study focuses on how improving collaborative voice and response can contribute to the values and goals of patient safety and clinician well-being (care of the caregivers).

The interview questions (IQs) below, about the human factors of individual actions and team interactions, are categorized by topics. Terms are defined and described from the research literature so participants will have shared understandings in answering. Your added perspectives and insights are always welcome during your interview and throughout the study.

Topic: Collaborative voice and response ***Collaborative*** – Unlike hierarchy-based teamwork that can stifle voice, collaborative teamwork requires mutual respect and trust, with all team members contributing to shared goals. ***Voice*** describes when team members "speak up" to team leaders – in a timely and effective way – with safety concerns, opinions, and learning questions. ***Response*** means that that team leaders first explicitly invite and encourage voice, and then respond effectively to voice, as appropriate to the situation.	
IQ 1	Please describe your *most collaborative* experience in surgery teams speaking up and responding effectively. - What most stands out to you? What was most meaningful to you? - In what ways do you experience variation or consistency in collaborative voice and response with different teams? - What makes collaborative voice and response more challenging? - How is voice and response different between preop, intraop, and postop stages?
Topic: Human factors that influence collaborative voice and response – *values, beliefs, attitudes,* and *behaviors* – are related, overlapping, and often mutually influencing. **Values** are individual and shared principles chosen to prioritize, motivate, and direct action toward goals. Importantly, values and goals can be compatible (complementary) or conflicting; and they can be prioritized equally, nearly equally, or more unequally. Surgery team values and goals outside the scope of this study include clinical task performance, surgical outcomes, and efficiency. Values and goals included in this study are patient safety and clinician well-being. **Well-being** refers to mental, physical, and emotional health in the growth and success of all team members. It includes the absence of dysfunctions such as burnout, depression, and moral distress when individual actions and team interactions conflict with values and goals. **Beliefs** are what people know and think. We *know* empirical data such as evidence-based medicine, and research findings of human factors that influence individual actions and team interactions. What we *think* is commonly based on our lived experiences and our interpretations of those experiences. Beliefs can evolve with new information, reflection, and new perspectives. **Attitudes** are emotions and feelings, often reflected as people's *dispositions,* or *prevailing tendencies*. Prevailing tendences are often displayed as *habits*, which are *patterns of behavior*. **Behaviors** and patterns of behavior are *individual actions* and *team interactions* which, without shared mental models, influence each other in often unpredictable or suboptimal ways.	

IQ 2	Please describe how you and your colleagues *value* and *prioritize* surgery team member well-being in relation to *valuing* patient safety as goals. - Do you value patient safety and team member well-being as *compatible* or *conflicting* goals, and why? Do you think your colleagues value patient safety and team member well-being as *compatible* or *conflicting* goals, and why? - Do you *prioritize* patient safety and team member well-being *equally*, *nearly equally*, or *more unequally*, and why? Do your colleagues *prioritize* patient safety and team member well-being *equally*, *nearly equally*, or *more unequally*, and why?
IQ 3	What *beliefs* are *essential* for surgery leaders and teams to more reliably invite speaking up, actually speak up, and respond effectively? Why?
IQ 4	What *beliefs* should be discarded, or perhaps *must* be discarded, for surgeons & teams to more reliably invite speaking up, actually speak up, & respond effectively? Why?
IQ 5	What *attitudes* are *essential* to preserve, modify, or create for surgeons & teams to more reliably invite speaking up, actually speak up, and respond effectively? Why?
IQ 6	What *attitudes* should be discarded, or perhaps must be discarded, for surgeons & teams to more reliably invite speaking up, actually speak up, and respond effectively? Why?
IQ 7	What *behaviors* are *essential* to preserve, modify, or create for leaders & teams to more reliably invite speaking up, actually speak up, and respond effectively? Why?
IQ 8	What *behaviors* should be discarded, or perhaps must be discarded, for leaders & teams to reliably invite speaking up, actually speak up, and respond effectively? Why?
Topic: Shared mental models, including physician approachability **Shared mental models** are guiding frameworks held by individuals that have enough similarity with those of colleagues to help interdependent team members function collaboratively in both clinical taskwork (which is beyond the scope of this study) and in the focus of this study – individual actions and teamwork interactions. Shared mental models also depend on how *accurately* they represent reality – for this study, the presence or absence of both patient safety and the well-being of all team members, including surgeons. **Physician approachability** refers to whether, how well, and how consistently physicians' prevailing tendencies and behavior patterns demonstrate to team members that speaking up is encouraged, is psychologically safe, and that response will be collaborative. Each physician's actions and interactions influence how approachable team members perceive them to be. Importantly, approachability may also be a factor within and between other disciplines.	
IQ 9	What stands out to you in your experiences with physician approachability?
IQ 10	What is most essential for positive physician approachability?
IQ 11	What is most expendable to discard, and perhaps must be discarded, for more positive physician approachability?
IQ 12	Among various people's approaches you know of for voice and response, what *similarities* are significant to include for a collaborative shared mental model?
IQ 13	Among various people's approaches you know of for voice and response, what *differences* are significant to resolve for a collaborative shared mental model?
Closing – Thank you for engaging in this study and contributing your valuable expertise to generate new knowledge for the field. Throughout the study, please share your further insights.	
IQ 14	What have we not covered that you'd add about a shared mental model for surgeons to invite speaking up, team members to speak up, and surgeons to respond effectively?
IQ 15	Would you be willing to participate in another private, confidential 60-90 minute meeting for *member checking*, to help refine a proposed mental model developed from the interview data, and confirm that the model is accurate, memorable, and useful?