



Teamwork & Communication

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*“I have always had an intense sense of personal responsibility and pride for my patients. I considered any errors or bad outcomes to be personal failings. There was a team around me to give me support but I did not always welcome their input and I am sure on several occasions, unintentionally, I created an environment in which others found it difficult to challenge me. I resisted standardized approaches, thinking that my work was as much art as science. **Altogether, I am sure this compromised patient care on a number of occasions.**”*

-Mitchel S. Berger, MD, FAANS, FACS, at the 2013 AANS Presidential Address¹

INTRODUCTION

As the scope of neurosurgical practice continues to expand, neurosurgeons increasingly function within complex, multidisciplinary

teams.² Effective teamwork is fundamental for delivering efficient high-quality care in a safe manner.

For decades, teamwork and communication skills have been formally recognized as important contributors to patient safety, but unlike other high-consequence professions (eg, aviation³), the medical field has been slow to implement techniques that train, standardize, and evaluate these skills.⁴ As a consequence, teamwork and communication breakdowns remain a major source of medical error,⁵⁻⁸ **contributing to nearly 70% of sentinel events reported to the Joint Commission between the years of 1995 and 2005.**⁹

In the neurosurgical operating room (OR), poor team performance can have devastating consequences, including wrong-site surgery, postoperative morbidity, and death.^{10,11} The purpose of this chapter is to examine the surgical safety literature involving teamwork and communication while identifying factors that improve team performance in neurosurgery.

This chapter is organized around the following 4 domains of surgical team functioning (**the 4 C's**):

1. **Composition**: how surgical teams are structured and organized
2. **Culture**: how teams prioritize and implement safety practices
3. **Communication**: how team members interact and share information
4. **Coordination**: how teams develop shared mental models for situation awareness (SA)

TEAMWORK AND COMMUNICATION IN SURGERY

Formal Recognition of Teamwork and Communication in Surgery

Modern surgery is the ultimate team endeavor, and each year, an unacceptable number of patients suffer complications attributable to

ineffective teamwork and communication.¹² In 2007, the World Health Organization (WHO) introduced the “Safe Surgery Saves Lives” campaign as a public health initiative to decrease rates of surgical complications, which they identified as a “major cause of death and disability worldwide.”¹³ Through publication of the *WHO Guidelines for Safe Surgery*,¹³ the working group identified ‘Safe Surgical Teams’ as 1 of 4 areas of care that could be improved, and listed effective team communication as 1 of 10 essential objectives for safe surgery:

“**Objective #9:** The team will effectively communicate and exchange critical information for the safe conduct of the operation.”¹³

Improving inter-professional communication in the perioperative setting has been cited as a priority by the Joint Commission¹⁴ and the Institute of Medicine.¹⁵ Teamwork and communication skills were also recognized as 1 of 4 domains in the Non-Technical Skills for Surgeons (NOTSS) taxonomy,^{16,17} and the following elements were specifically delineated (mapped onto the 4 C’s):

1. **Exchanging information** (“communication”)
2. **Establishing a shared understanding** (“coordination”)
3. **Coordinating team activities** (“coordination”)

In neurosurgery, many official organizations have identified teamwork and communication as fundamental skills for safe surgical practice, including the Council of State Neurosurgical Societies [Ad Hoc Committee for Patient Safety](#), the Accreditation Council for Graduate Medical Education and the American Board of Neurological Surgery (which jointly published the Neurological Surgery Milestones Project¹⁸), and the American Association of Neurological Surgeons.¹

Scope of the Problem: Ineffective Teamwork and Communication

Despite near-universal acknowledgement of teamwork and

communication as key contributors to surgical safety, **significant gaps in practice standards, safety culture norms, and quality assessments across surgical teams and institutions remain.**¹⁹ Breakdowns of teamwork and communication are still the leading contributors to wrong-site operations and other surgical complications,¹² and evidence suggests that many of these errors are preventable.^{20,21}

In a study of 444 surgical malpractice claims, Greenberg et al.⁸ identified 81 communication breakdowns in 258 cases that involved an error that led to patient harm; most (92%) of these breakdowns occurred during verbal exchanges between providers. The results of other studies suggest that communication breakdowns occur in almost every surgical case²² and that nearly 1 of 3 communication exchanges in the OR are “failures” because of poor timing, information loss, lack of resolution, or exclusion of key individuals.²³ Comparisons of surgical teams with low versus high morbidity and mortality rates have revealed that teams that communicate more effectively have better surgical outcomes.²⁴ These studies and others²⁵ have drawn a clear link between effective teamwork and patient safety.

THE 4 C’S OF TEAMWORK AND COMMUNICATION

Improving teamwork and communication requires a systematic understanding of team structure and function. We examine here the 4 domains of team functioning that contribute to patient safety (**the 4 C’s**).

Composition

Composition refers to the structure and organization of a surgical team. The WHO defines *team structure* as the “**composition, hierarchy, and the distribution and coordination of work among individuals and professional groups.**”¹³ Team structure involves at least the following 3 general components:

- **Personnel:** Most surgical teams are composed of the attending surgeon(s), a surgical trainee(s) (eg, resident), an anesthesiologist(s), a

scrub nurse, and circulating nurses. Variations in team personnel can arise on the basis of the task demands of the case, hospital resources, staffing, and many other factors. Personnel are rarely static during an operation, with shift changes ushering in new team members who might have different levels of experience and familiarity with the case at hand.

- **Roles:** Tasks and responsibilities in the OR are rarely standardized, and role allocation can be ambiguous.¹⁹ A common example in neurosurgery is preparation of the operating microscope. In some ORs, this task might be allocated to a member of the nursing team experienced with handling the microscope. For other teams, the surgical resident might be tasked with this responsibility. **Role ambiguity can lead to confusion, and team performance is subject to variation when it depends on the level of familiarity among personnel.**¹⁹ This arrangement is in stark contrast with that in the field of aviation, in which team roles are defined meticulously to ensure that team members who are completely unfamiliar with each other can function without a decline in performance.²⁶ Indeed, since the 1990s, airlines have used a training protocol known as “Crew Resource Management” to provide standardized training in leadership, interpersonal communication, crew roles, and time-critical decision making, all of which lead to a clear allocation of responsibilities.³
- **Organization:** Surgical teams are traditionally organized as vertical hierarchies with the attending surgeon functioning as the *de facto* team leader. Prescribed and hierarchical team structure can be effective for certain tasks, particularly those that are more procedural in nature (eg, checking instruments, preparing the OR). However, intraoperative tasks often demand a less hierarchical, more fluid team organization.¹⁹ For example, when diagnosing the cause of hypotension, the interaction between the anesthesiologist and surgeon becomes critical. When resolving an issue with the surgical count, members from the nursing team assume the leadership role. **Studies have found that providers might hold**

discrepant views about their team's organization. For instance, a study by Undre et al.²⁷ discovered that nurses perceived the OR team structure as unitary, whereas surgeons and anesthesiologists perceived it as comprising multiple subunits. These discrepant views might lead surgeons to overestimate how cohesively their team is functioning.²⁷

Culture

Safety culture can be defined as **“an integrated pattern of individual and organizational behavior, based upon shared beliefs and values, that continuously seeks to minimize patient harm.”**²⁸ In 1998, Dr Lucian Leape, a pediatric surgeon and pioneer in the field of patient safety, offered his somber view of the prevailing safety culture in medicine as one that is “characterized by anger, blame, guilt, fear, frustration, and distrust regarding healthcare errors....”²⁹ Surgical teams uniformly endorse the primacy of safety and accountability,⁴ but studies have found that the majority of OR providers describe their own team safety practices as inadequate.³⁰ In addition, team members often hold discrepant views of their team's safety culture and practices.

In a survey study, Makary et al.³¹ found that 85% of surgeons rated their team's collaboration as “high” or “very high,” whereas <50% of nurses and anesthesiologists offered such a positive rating. This finding has been reproduced in both the surgical and intensive care settings,^{4,32,33} which suggests that surgeons (or other team leaders) tend to perceive a stronger culture of safety and collaboration than do other team members.

Authority gradients (ie, power imbalances) likely contribute to discrepant views of team cohesiveness and safety culture. As humbly noted in the frank Presidential Address by Dr Mitchel S. Berger, chairman of neurological surgery at University of California San Francisco, surgeons can unintentionally create a hostile environment that discourages team members from speaking up,¹ a phenomenon documented throughout the surgical literature.³⁴

Sexton et al.⁴ conducted a study in which pilots and surgeons were asked whether junior team members should question the decisions made by senior team members when an issue is perceived. In contrast to pilots, who almost uniformly encouraged such input, approximately half of the surgeons surveyed objected to it, which indicates that surgeons often hold attitudes that negatively affect the team's safety culture.

Communication

Interpersonal communication between team members occurs at every stage of surgical care.¹² Miscommunications both inside and outside the OR have been linked to errors that harm patients.⁶⁻⁸ Communication failures tend to be multifactorial, and the potential causes of miscommunication are manifold (Table 1).

Table 1: Potential Barriers to Effective Communication (Nonexhaustive)

Physical Factors	System Factors	Interpersonal Factors
<ul style="list-style-type: none"> • Ambient noise • Physical distractions • Physical distance between interlocutors 	<ul style="list-style-type: none"> • Insufficient dedicated time • Lack of standardization • Lack of implementation (eg, no dedicated handoff) • Technological barriers (eg, telephone reception) • Resource inaccessibility (eg, medical record downtime) 	<ul style="list-style-type: none"> • Authority gradients • Language/cultural barriers • Interruptions • Inattention • Premature evaluation (ie, receiver draws conclusion before sender has conveyed the message)

Standardization of interprofessional communication, particularly during critical tasks (eg, handoffs), can decrease the rate of communication failures.³⁵ The SBAR (situation, background, assessment, recommendation) tool is a communication framework used for such standardization. Developed by the US Navy and adapted for the healthcare setting by clinicians at Kaiser Permanente of Colorado, the SBAR tool has been endorsed by key medical organizations (eg, the Joint Commission, Agency for Healthcare Research and Quality, Institute for Health Care Improvement, and WHO) and shown to improve the accuracy of information exchange during patient handoffs.^{36,37} It has also been reported to increase confidence in communications across authority gradients (eg, between nurses or junior residents and an attending physician).^{38,39} An example telephone call from a neurosurgical resident to an attending using the SBAR approach is shown in Table 2.

Table 2: Example Telephone Call Demonstrating the SBAR Technique*

	Step	Example
S	Situation <ul style="list-style-type: none"> ● Identify yourself and the site/unit from which you are calling ● Identify the patient by name and the purpose of your communication ● Describe your concern 	<p>“Hi Dr R (attending neurosurgeon), this is Jason (postgraduate-year-3 resident). I am calling about Ms M, our 83-year-old female patient in the postoperative recovery ward. I am calling because I am concerned that she has developed headaches and progressive confusion over the past 2 h.”</p>
B	Background	<p>“The patient was admitted yesterday with altered</p>

	<ul style="list-style-type: none"> • Give the patient's brief admission history (date of admission, admitting diagnosis) • Highlight significant medical history • Describe pertinent procedures, current medications, allergies, and diagnostic results 	<p>mental status after experiencing a fall earlier in the week. We diagnosed and evacuated a large subdural hematoma yesterday evening. She had an uneventful night in the recovery room without any headaches, and her family felt she had returned to her neurocognitive baseline. However, her condition has changed this morning. On my assessment 10 minutes ago, she appeared lethargic and struggled to orient to the hospital setting. She also endorsed a constant holoccephalic headache with an 8/10 severity. Her most recent blood pressure was high at 165/105 mm Hg. She is not taking any anticoagulants, and her coagulation study results were within normal limits."</p>
A	<p>Assessment</p> <ul style="list-style-type: none"> • Clinical impressions and concerns 	<p>"I think the problem might be recurrence of her subdural hematoma, which could explain her headache and altered mental status."</p>
R	<p>Recommendation</p> <ul style="list-style-type: none"> • Communicate your plan • Ask for input or suggestions 	<p>"My plan is to order a rush head computed tomography study to evaluate for hematoma recurrence. Do you agree with my assessment and plan?"</p>

*Adapted from reference 40.

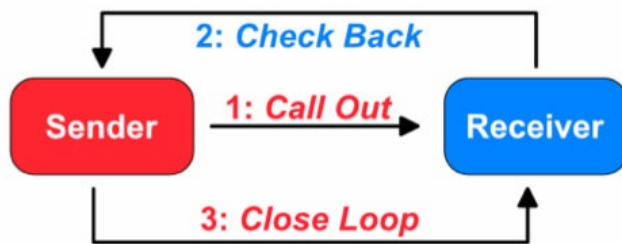
Another communication strategy that has proven efficacious in the surgical setting is to use closed-loop dialogue.⁴¹ Closed-loop exchanges should involve the following 3 steps to ensure that no critical information is lost or misinterpreted (Fig. 1):

1. **Call Out:** the sender initiates an exchange by issuing a request or

question

2. **Check Back:** the receiver acknowledges receipt of the message and communicates understanding back to the sender
3. **Close Loop:** the sender closes the exchange and initiates action (if applicable)

Closed-Loop Communication



Example Dialogue

- 1 **Call Out:** "I am preparing to remove the head clamp. Is the patient secured?"
- 2 **Check Back:** "The patient's head is secured. I am ready for you to remove the clamp."
- 3 **Close Loop:** "Proceeding with removal of the head clamp now."

Figure 1: Closed-loop dialogue. The schematic diagram on the left was adapted from reference 41.

Coordination

Coordination is a “**process that involves the use of strategies and patterns of behavior aimed to integrate actions, knowledge and goals of interdependent members, in order to achieve common goals.**”⁴² In our context, coordination is the net result of having a clear team structure, a well-subscribed safety culture, and effective team communication, which brings together the 4 C’s. Simply put, team coordination is the state of understanding what is happening, how people are acting, and how their actions relate to the team goal.

Well-coordinated surgical teams develop a shared understanding of the procedural goals, the component steps, and the potential pitfalls. This shared understanding is referenced variably in the surgical literature by terms such as *shared mental models*,⁴³ *distributed cognition*,^{2,44} *team sensemaking*,⁴⁵ and *situation awareness (SA)*.⁴⁶ For a thorough discussion of coordination and SA, including strategies that promote SA in neurosurgery (eg, perioperative briefings), please refer to the [Situation Awareness](#) chapter.

IMPROVING TEAMWORK AND COMMUNICATION IN NEUROSURGERY

Surgery has lagged behind other high-consequence fields in developing systematic approaches to improving teamwork and communication.¹³ Many factors contribute to the slow pace of progress, including the lack of consensus opinion about the scope of the problem, institutional inertia, and the difficulty of measuring nontechnical skill performance objectively.

Several strategies for improving interpersonal skills among OR teams have been explored, including performing team-based simulations,^{47,48} implementing nontechnical skills coaching,⁴⁹ and instituting a formal safety training curriculum (Department of Neurological Surgery at University of California San Francisco) that features a [video](#) that outlines skills for effective multidisciplinary teamwork.⁵⁰

Safety Checklists

Perhaps the most significant advance in OR safety and teamwork is the popularization of safety checklists. Since publication of the *WHO's Surgical Safety Checklist* in 2008⁵¹ and Dr Atul Gawande's popular book *The Checklist Manifesto* in 2009,⁵² checklists have officially entered the surgical mainstream. Such checklists aim to standardize performance of and compliance to a variety of essential perioperative tasks. Checklists can be implemented for procedural tasks (eg, ensuring that all stages of OR preparation are complete), team tasks (eg, surgical time-out and debrief), quality improvement (eg, recording errors and near-misses), and potentially endless others.^{53,54}

Ample literature shows that surgical checklists favorably affect rates of preventable errors, morbidity, and death.⁵⁵⁻⁵⁷ The results of a large systematic review also have provided evidence indicating that safety checklists improve the quality of OR teamwork and communication while decreasing errors attributable to team breakdowns.⁵⁸

Dozens of neurosurgeons have called for the implementation of safety checklists in routine practice,^{1,59-61} and several studies have examined the feasibility and utility of checklists in neurosurgery.⁶²⁻⁶⁵ In particular, a literature has emerged demonstrating the effectiveness of surgical checklists for decreasing rates of wrong-site neurosurgical operations.⁶⁶⁻⁶⁸ Such checklists can be especially useful for spine surgery; 50% of neurosurgeons polled in a 2006 survey acknowledged having performed at least 1 wrong-level spine surgery in their career.⁶⁹

Of the many benefits offered by checklists, improvements in communication and coordination between OR team members seem to be central to their efficacy.⁵⁸ Thus, safety checklists represent a promising opportunity for improving teamwork and communication in neurosurgery.

SUMMARY AND CONCLUSION

Teamwork and communication are fundamental nontechnical skills for surgeons of all specialties. Breakdowns of teamwork are a source of preventable surgical complications and can occur at any level of team functioning (Table 3). Strategies for improving teamwork and communication include standardizing dialogue (eg, SBAR, closed-loop dialogue), implementing team-based training, performing simulations, and using safety checklists.

As team leaders, neurosurgeons are responsible for creating a positive safety culture that empowers team members, overcomes authority gradients, and values patient safety above all else.

Table 3: Causes of Ineffective Teamwork and Communication, Mapped Onto the 4 C's (Nonexhaustive)

Composition	<ul style="list-style-type: none"> ● Ambiguous team roles ● Limited team familiarity ● Discrepant perceptions of team organization and cohesion
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Culture	<ul style="list-style-type: none"> • Limited consensus about safety culture and values • Hostile authority gradients that silence team members
Communication	<ul style="list-style-type: none"> • Use of inefficient or error-prone dialogue structure • Overreliance on nonverbal communication or assumed understanding
Coordination	<ul style="list-style-type: none"> • Poor implementation of preoperative and postoperative briefings • Limited awareness of how individual tasks relate to team goals

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