Factors Influencing Team Behaviors in Surgery: A Qualitative Study to Inform Teamwork Interventions

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Background. Surgical excellence demands teamwork. Poor team behaviors negatively affect team performance and are associated with adverse events and worse outcomes. Interventions to improve surgical teamwork focusing on frontline team members' nontechnical skills have proliferated but shown mixed results. Literature on teamwork in organizations suggests that team behaviors are also contingent on psychosocial, cultural, and organizational factors. This study examined factors influencing surgical team behaviors to inform more contextually sensitive and effective approaches to optimizing surgical teamwork.

Methods. This qualitative study of cardiac surgical teams in a large United States teaching hospital included 34 semistructured interviews. Thematic network analysis was used to examine perceptions of ideal teamwork and factors influencing team behaviors in the operating room.

Results. Perceptions of ideal teamwork were largely shared, but team members held discrepant views of which team and leadership behaviors enhanced or undermined teamwork. Other factors affecting team behaviors were related to the local organizational culture, including management of staff behavior, variable case demands, and team members' technical competence, and fitness of organizational structures and processes to support teamwork. These factors affected perceptions of what constituted optimal interpersonal and team behaviors in the operating room.

Conclusions. Team behaviors are contextually contingent and organizationally determined, and beliefs about optimal behaviors are not necessarily shared. Interventions to optimize surgical teamwork require establishing consensus regarding best practice, ability to adapt as circumstances require, and organizational commitment to addressing contextual factors that affect teams.

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Promoting effective team behaviors is a principle of safe care. Evidence suggests that preventable errors in surgery today more often relate to nontechnical than to technical failures [1]. Nontechnical skills, "cognitive and social skills, not directly related to surgeons' clinical knowledge, dexterity and use of equipment, which underpin technical performance," include interpersonal team behaviors such as clear and open communication, task management, and information sharing [2]. Poor team behaviors are associated with adverse events (eg, wrong-site procedures) and worse outcomes for patients [3].

Interventions to improve surgical teamwork, including nontechnical skills/team training, checklists, simulation, and structured communication protocols, have proliferated. Such interventions have shown mixed success, however, suggesting different or complementary approaches

are needed [2, 4]. Existing surgical teamwork interventions directly target frontline team members' nontechnical skills. Yet literature on teamwork suggests that team behaviors also depend on psychosocial, cultural, and organizational factors [5, 6], which have received scant attention in designing interventions. Understanding such contextual influences may enhance the effect of training on team performance [7].

Teamwork is contingent on members sharing common "mental models" of ideal teamwork and the behaviors required to achieve it [8]. Mental models represent an individual's understanding of team objectives, tasks, and member roles and relationships, and are shaped by the knowledge, norms, and beliefs acquired as individuals

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train and work in particular professional and institutional contexts. They guide team members' own behaviors and their interpretations of others' behaviors. Mismatches in mental models thus risk misunderstandings and coordination breakdown [9]. Yet given the influence of organizational and professional contexts on their development, diverse conceptualizations of appropriate team leadership [10], teamwork, and teamwork quality are unsurprising [11].

Teamwork is also contingent on how conducive the context is to enacting different models of teamwork. In addition to the technical demands of a case, local culture may constrain or enable different behaviors. For instance, engrained hierarchical dynamics can stifle the ability of nonsurgeon team members to speak out and lead [12]. Organizational policies and processes (eg, handover practices) can also affect staff behaviors and their capacity to provide safe care [5].

Thus, although team training to improve nontechnical skills is valuable, psychosocial, cultural, and organizational factors shape mental models of teamwork and influence the opportunities, likelihood, and ease with which team members are able to put this training into practice. Better understanding of the factors that promote or undermine developing a shared mental model and that make the context more or less conducive to putting "ideal" behaviors into practice may offer complementary targets for intervention.

The aims of this study were to (1) investigate the mental models of ideal teamwork of the surgical team members and (2) identify contextual factors shaping those mental models and ability to put teamwork ideals into practice. We focused on cardiac surgery, a high-risk and high consequence environment where preventable adverse event rates have been estimated to be high [13] and where the technological complexity and degree of technical specialization likely amplifies the importance of nontechnical teamwork behaviors for ensuring optimal coordination and integration. Through in-depth, qualitative study of cardiac surgical teams in a large United States teaching hospital, we sought to identify factors underpinning teamwork with the aim of informing the design of more effective, contextually sensitive interventions to enhance team performance.

Material and Methods

We conducted semistructured interviews in a mixed-methods study of leadership and team dynamics in cardiac surgery operating rooms (ORs) [14]. The setting was a cardiac surgery division in an academic medical center performing more than 1,000 operations with cardiopulmonary bypass annually in which mortality and morbidity rates consistently meet or exceed national benchmarks (http://www.sts.org/national-database), but prior survey data suggested room for improvement in team dynamics such as psychological safety and burnout [14].

Through purposive and snowball sampling, we conducted 34 interviews with representatives of all disciplines (surgeons, surgical trainees, scrub, circulating and anesthesia nurses, anesthesiologists, perfusionists, and physician assistants; Table 1). This included all attending surgeons but one, who spanned the full range of academic rank and years of clinical experience. Most had trained in the index institution. Interviews lasting 15 to 60 minutes covered views on ideal team dynamics, teamwork experiences, and factors that affected team behaviors and were recorded and transcribed. For the larger study, we observed 58 operations. Because the interviews were conducted by the same researchers (E.A., J.S., and S.S.), observation data informed probing questions.

Interview data were analyzed using thematic network analysis [15], supported by NVivo software (QSR International, Burlington, MA). Thematic networks converged around (1) mental models of teamwork and (2) factors influencing team behaviors. For each main theme, we iteratively derived and refined subthemes and applied this coding framework across transcripts. Theme identification combined deductive and inductive coding, informed by sensitizing concepts [16] derived from existing literature and insights from observations of teamwork in practice. Supplemental Material, Part 1, provides further methodological details.

Results

Mental Models of Ideal Teamwork

Participants held largely shared perceptions of ideal teamwork characterized by flow, competence, and appropriate leadership, but views on which interpersonal behaviors best supported these characteristics were conflicting (Supplemental Material, Part 2).

FLOW. Across roles, descriptions of ideal teamwork included images, such as a "well-oiled machine" and being "on the same page," such that the work "just flows." Descriptions of bad teamwork emphasized disruption and fracture. Participants expected team members to stay focused and engaged, even when not directly involved in the action. Team members exemplified engagement by anticipating others' needs, suggesting implicit coordination was particularly valued.

COMPETENCE. All roles valued technical and relational competence reliant on generic skills and local knowledge. Technical competence included adequate case preparation (ie, familiarity with technical and clinical details of the procedure and patient), task-related knowledge

Table 1. Interviews by Role

Role	Number
Surgeons	11
Anesthesiologists	3
Nurses	7
Perfusionists	4
Surgical trainees	4
Anesthesia nurses	1
Physician assistants	4
Total	34

enabling team members to perform clinical tasks associated with their role, and architectural knowledge about how different team roles and tasks fit together [6]. Such tacit, situated knowledge—central to the implicit coordination of ideal teamwork—required working with particular team members in particular ORs and familiarizing oneself with idiosyncratic jargon, organizational processes, and surgeon preferences. Relational competence included interpersonal behaviors such 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.

SURGEON-DIRECTED LEADERSHIP. Although participants argued that all team members should be valued, many pointed to the need for a "director" to "take charge" when needed to coordinate group activity. Participants felt surgeons should usually serve this role, although others (eg, anesthesiologists) may also do so.

CONFLICTING VIEWS OF APPROPRIATE BEHAVIORS. Although participants broadly agreed on how ideal teamwork looked and felt, views differed regarding which interpersonal behaviors supported flow, relational competence, and appropriate surgeon-directed leadership.

Surgeons and nonsurgeons disagreed whether needing a "director" meant the surgeon should always have more decision-making authority than others. This disagreement reflected perceived differences in responsibility felt for the patient's life. Some surgeons felt they carried greater responsibility than other team members and that this was not sufficiently recognized by other disciplines. Our data indicate, by contrast, that nonsurgeons did recognize the "heavy load" (participant 13, nurse) surgeons carried and that this did not diminish nonsurgeons' own sense of responsibility.

Perspectives differed regarding the extent to which this "heavy load" afforded surgeons license to adopt an authoritarian leadership style. Although some surgeons argued it did (and espoused a more hierarchical view of team relationships), nonsurgeons favored more distributed leadership, emphasizing shared responsibility and support for voicing concerns and opinions. Moreover, many nonsurgeons argued that authoritarian leadership could be interpreted as negative or aggressive, induce fear and anxiety, shift attention from "doing the best for the patient" to avoiding negative interactions, or threaten patient safety by making team members unwilling to raise concerns.

Particularly for surgeons, there appeared to be a tension between creating a safe environment for speaking up and learning from mistakes and ensuring everyone could perform under pressure. Some argued that anxiety inhibited speaking up and curtailed learning, others that stress was necessary for learning to perform under pressure: "being tough" on someone could be "doing them a service" (participant 5, surgeon).

Surgeons also differed in their attitudes toward information sharing. One surgeon suggested that some saw sharing information as giving up their "mystique." These surgeons often shared case details on a need-to-know basis. Others viewed information sharing as a way to enhance overall team performance by drawing out others' contributions and shared information more freely. In addition to getting team members "on the same page," nonsurgeons suggested that information sharing fostered inclusion, engagement, and open communication, whereas withholding information promoted division, exclusion, or unhelpful hierarchy. Thus, even when the desired goal (ideal teamwork) was shared, discrepant views of optimal interpersonal and leadership behaviors could generate frustration and misunderstanding, undermining teamwork.

Factors Influencing Aspirations for and Experiences of Teamwork

We identified three sets of factors influencing mental models of teamwork and the potential to practice ideal teamwork (Supplemental Material, Part 3).

LOCAL ORGANIZATIONAL CULTURE. Participants felt a local history of hierarchy among disciplines had bred an antagonistic culture and negative reputation. Although many felt these interprofessional dynamics were changing and that teamwork was often extremely good, others felt that authority gradients still dominated, affecting the way team members engaged (eg, making them afraid to speak up or raise concerns). Although participants' teamwork ideals contrasted with such a culture, there was evidence that "bad physician behavior" (participant 89, nurse) had become normalized [17]. Shouting and bullying were often seen less as deviant behaviors warranting censure than as a "normal" part of the stressful business of cardiac surgery.

In addition to local history, surgeons suggested that surgical training did not focus sufficiently on developing relational competence but rather promoted competition and autonomy. Once a physician, autonomous practice and production pressure left little opportunity for surgeons to observe and learn from peers.

Formal mechanisms for addressing disrespectful behaviors also seemed limited. Our data suggest such behaviors often went undisciplined and persisted over time. Participants' frustration lay not only with the effect of not holding individuals accountable but also with what this indicated about how little the organization valued relational competence. Conversely, some felt the division's recent introduction of initiatives aimed at improving teamwork had a positive effect, signaling that relational competence and its improvement mattered.

VARIABLE TECHNICAL CASE DEMANDS AND TECHNICAL COMPETENCE. Case-related factors, such as complexity, patient acuity, cognitive demand, and degree of urgency, could raise or lower intensity, tension, and stress team members endured. One common effect of case-related stress was to decrease timely information sharing, which could undermine team coordination and "flow." Surgeons' ability to remain calm under stress and maintain constructive communication was particularly influential.

Technical demands also varied within cases, with different phases being more or less demanding for different professionals at different times [18]. Failure to understand this could disrupt teamwork (eg, when team members lacked the architectural knowledge to adapt their own behavior to others' needs).

As situational leadership theory would predict [19], technical demands of the case also affected which interpersonal behaviors were most appropriate. For example, during complex cases or when unanticipated complications arose, more authoritative direction by the surgeon was considered appropriate. The technical competence of team members, which varied by case and training, also affected which behaviors were most appropriate (eg, whether using local jargon was problematic, how much direction and information sharing was appropriate). Demonstrating relational competence thus meant adapting interpersonal behaviors to suit the technical competence of teammates and technical demands of the case and phase.

As observed generally [20], trust in team members' technical competence played a central role in determining appropriate interpersonal behaviors. Confidence in others' technical competence appeared fundamental to respectful, constructive ways of interrelating and establishing a psychologically safe environment. Lack of confidence in nonsurgeons' technical competence appeared associated with a tendency of some surgeons to adopt more authoritarian interpersonal behaviors. The inevitable subjectivity of judgements about colleagues' technical competence introduced potential for mismatched perceptions of appropriate interpersonal behaviors. Such mismatches could have negative effects on team dynamics, such as when well-intentioned direction by one team member was perceived as condescending and "micromanaging" by another.

ORGANIZATIONAL FITNESS. Organizational structures and processes influenced team behaviors directly and indirectly, in transient and enduring ways. The extent to which the same individuals consistently worked together was limited by trainee turnover, call schedules, and considerations of efficiency, equity, and training needs. Instability was exacerbated by nonspecialty-specific nightshift nurses who were less familiar with rooms and teams. Some staff felt this instability undermined teamwork by reducing team members' opportunities to develop situated architectural and relational competence (eg, knowledge of a particular surgeon's preferences). It also limited opportunities to leverage positive interpersonal relationships that can develop within stable groups.

OPERATIONAL FAILURES. Delays or problems with equipment could generate tension, frustration, or interpersonal conflict. Nurses often felt unfairly blamed by surgeons because problems were caused by systems defects beyond their control. Systems issues repeatedly reported yet unresolved exacerbated strain on relationships.

FORMAL INFORMATION-SHARING STRUCTURES AND PROCESSES. Case preparation was an important element of ideal teamwork but was affected by individuals' ability to access information. Scheduling practices resulted in some staff receiving little notice about case assignments, limiting opportunity to review case-related information.

By contrast, almost all staff viewed the introduction of precase briefings as beneficial in that they provided structured time to share information and facilitate preparations. Directly, this enhanced shared understanding and coordination of activities. Indirectly, staff perceived formalized briefings as providing a space that legitimized asking questions and voicing concerns. Other aspects of organizational fitness could undermine benefits of briefings (eg, if surgeons' other duties prevented them from being physically present). Their value also depended on constructive participation; disrespectful or dismissive responses to "speaking up" undermined the value of the briefing.

Another supportive structure was overhead cameras worn by surgeons, which helped everyone be "on the same page" even when not directly involved in the action.

Comment

The results of this study indicate that perceptions of ideal team behaviors depend on the specifics of a given situation and team members' (sometimes conflicting) mental models of teamwork. Mental models of teamwork characterized by effortless "flow," technically competent team members, and appropriate interpersonal and leadership behaviors align with surgical safety and teamwork literature emphasizing implicit coordination, technical competence, nontechnical skills, and effective leadership [2, 10–12]. However, discrepancies regarding authoritarian behavior by surgeons as leaders, which behaviors kept people focused and performing under pressure but not too afraid to speak up, and how much and when to share information, could engender misunderstandings, frustration, and breakdowns in flow and coordination.

Accordingly, improving teamwork requires explicit attention to achieving consensus around ideal teamwork and the specific interpersonal and leadership behaviors needed to support that model. Our results suggest that these behaviors include in-person preoperative briefing and active sharing of information during the case. Institutional mechanisms sensitive to local history and culture should be established to adapt leadership behaviors to specific team composition, technical demands, and phases of a case. When misperceptions or misunderstandings arise out of inconsistent mental models, opportunities to debrief and clarify intent and effect of behaviors should be created.

Our findings also highlight the role of organizational practices, policies, and systems in shaping team behaviors and the opportunities to put teamwork skills into practice. Hence, interventions that solely target development of frontline team members' nontechnical skills, although necessary, may not be sufficient for high functioning teams. Optimizing teamwork interventions for surgical safety requires organizational commitment to addressing contextual factors that can undermine OR

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team behaviors in practice. These include minimizing operational failures and institutional appreciation for the importance of specialty-specific familiarity and information and, accordingly, efforts to establish specialty-specific teams. In addition, efforts should be made to share case assignments to OR staff in sufficient time for them to prepare themselves as team members. In turn, when organizational constraints make these interventions impractical, all team members must recognize that accommodation must be made for the loss of implicit knowledge with greater degrees of explicit information sharing.

Recommendations

Interventions to improve teamwork should build and reinforce consensus on optimal interpersonal and leadership behaviors. Beyond developing skills and knowledge, this means addressing adaptive (sociocultural, psychological, and political) challenges to mobilize a "collective local faith" in the efficacy of specific behaviors [21]. Disagreements between surgeons and nonsurgeons over authoritarian vs distributed models of leadership [10] no doubt reflect the practical challenge of ascertaining when to assume control and when to "trust others to do their job." They may, however, also reflect well-described tensions that arise when professionals feel their authority and autonomy threatened [22]. Therefore, optimizing teamwork requires use of coercive "hard edges" as well as "soft" tactics (eg, persuasion and discussion), both of which rely on supportive organizational policies and practices [23].

Hard tactics include instituting formal mechanisms for holding individuals accountable for technical and nontechnical performance, such as through performance appraisals, mechanisms for collecting and acting on team member feedback, teamwork, and culture assessments, and rewarding greater relational competence. As this study showed, through such management practices, leaders shape local culture and expectations of "normal," acceptable, or valued team behaviors [24].

Soft tactics include training and ongoing professional development opportunities that create forums for explicitly articulating assumptions about ideal teamwork to reach consensus about appropriate behaviors [25]. Well-intentioned interpersonal behaviors may have unintended consequences because team members hold different views regarding the meaning of those behaviors. Thus, well-facilitated multidisciplinary forums that enable nonsurgeon team members to share their interpretation of team leader behaviors and their consequences are needed to enable unit-wide consensus building. Postcase debriefings could also incorporate more emphasis on nontechnical failures.

Our findings also suggest the need for consensus-building and horizontal norming among attending surgeons (eg, through peer-to-peer observation, or use of leadership behavior profiling tools) [14] to raise awareness of differences in leadership behaviors among attendings. Further research to better establish associations between interpersonal team and leadership behaviors

and objective outcomes would also inform and motivate interventions.

The ability to adapt team behaviors to situational demands of the case and team also influenced teamwork. Video recordings of cases offer a powerful tool for ensuring situational contingencies are accounted for in building consensus on ideal behaviors and also providing lessons on adaptability of style and approach. By preserving situational specifics, video excerpts provide fertile prompts for discussion about beliefs and assumptions and examples of best practice that are more persuasive than generic prescriptions.

Organizational fitness [26] must also be optimized to enable team members to enact ideal behaviors adaptively. For example, although the ability to prepare, maintain coordination, and stay engaged and in sync may appear to reflect individual competence, we observed that enacting such team behaviors was organizationally determined. Scheduling practices and formal information-sharing structures (precase briefings, use of overhead cameras) must work well to ensure individuals' capacity to adequately access information, prepare for a case, and be attentive and coordinated during the operation. Similarly, the functioning of organizational processes, including those seemingly unrelated to teamwork (eg, systems underlying equipment failures), is also important to address. Ways in which policies driven by other imperatives (eg, efficiency concerns) may undermine those intended to promote quality, safety, and effective teamwork require careful consideration [6].

Finally, interdependence of factors suggests interventions focused on any one aspect are likely to bring limited gains. For example, the value of structured communication protocols [27], such as checklists or briefings, depends on other (more or less supportive) contextual factors, such as a culture that promotes constructive engagement, organizational processes that enable surgeons to participate (not be diverted to other duties), and organizational will and mechanisms to ensure "active resistors" are held accountable [28]. Multifaceted interventions that recognize the bidirectional interaction of interpersonal behaviors and technical performance and the need to address technical barriers and adaptive, context-dependent challenges [5, 21] have the greatest chance of success.

Limitations

Our study is a single-site, in-depth case study, and inclusion of more sites may have identified further factors influencing team behaviors. Dynamics and processes identified may manifest in particular ways in this institution (eg, specific structures that facilitate or impede information sharing). However, the factors theorized to affect team behaviors, including local organizational culture or organizational fitness, are likely to apply elsewhere. Literature suggests that challenges such as an unsupportive organizational culture, inadequate organizational fitness, disruptive team instability, or

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within-team discrepancies in mental models of teamwork are present in other settings [5, 6, 11, 26].

Conclusion

This study makes clear the central role of organizations in cultivating and reinforcing consensus on ideal team behaviors and the nontechnical (as well as technical) abilities of surgical team members. Optimizing teamwork to reduce nontechnical errors is not simply a matter of one-off training for frontline staff, but rather requires multifaceted interventions that promote team consensus and target the organizational determinants of team behaviors, including organizational culture, institutional prioritization given to team behaviors, and the fitness of the organizational processes that support the work of surgical teams.

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