Evaluation of a Preoperative Checklist and Team Briefing Among Surgeons, Nurses, and Anesthesiologists to Reduce Failures in Communication

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Objective: To assess whether structured team briefings improve operating room communication.

Design, Setting, and Participants: This 13-month prospective study used a preintervention/postintervention design. All staff and trainees in the division of general surgery at a Canadian academic tertiary care hospital were invited to participate. Participants included 11 general surgeons, 24 surgical trainees, 41 operating room nurses, 28 anesthesiologists, and 24 anesthesia trainees.

Intervention: Surgeons, nurses, and anesthesiologists gathered before 302 patient procedures for a short team briefing structured by a checklist.

Main Outcome Measure: The primary outcome measure was the number of communication failures (late, inaccurate, unresolved, or exclusive communication) per procedure. Communication failures and their consequences were documented by 1 of 4 trained observers using a validated observational scale. Secondary outcomes were the number of checklist briefings that demonstrated "utility" (an effect on the knowledge or actions of the team) and participants' perceptions of the briefing experience.

Results: One hundred seventy-two procedures were observed (86 preintervention, 86 postintervention). The mean (SD) number of communication failures per procedure declined from 3.95 (3.20) before the intervention to 1.31 (1.53) after the intervention ($P < .001$). Thirty-four percent of briefings demonstrated utility, including identification of problems, resolution of critical knowledge gaps, decision-making, and follow-up actions.

Conclusions: Interprofessional checklist briefings reduced the number of communication failures and promoted proactive and collaborative team communication.

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POOR COMMUNICATION IS THE single most frequent cause of adverse events across all facets of health care, resulting in problems that range from delays in treatment to medication errors to wrong-site surgery.[1-4] Although the imperative to avoid such errors is widely acknowledged,[5] progress has been slow.[6-8] Therefore, various initiatives to improve the quality of care across medical specialties have sought to improve communication within clinical teams.[9-13] Many studies of such initiatives have documented a perception of improvement by members of the care team regarding collaboration,[9] understanding of clinical goals,[10] teamwork,[11] and communication.[13] However, these studies have not objectively assessed whether and how communication actually improved. Such objective assessment of communication is needed to gain insight into the mechanisms of improvement and to determine the most efficient and effective approach to a target problem.[14]

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The objectives of this study were (1) to implement a preoperative checklist designed to support a team briefing in the operating room (OR), (2) to objectively assess whether the checklist briefings reduced communication failures, and (3) to characterize the precise nature of improvement in communication associated with this intervention.

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METHODS

SETTING AND PARTICIPANTS

The study was approved by the research ethics board of the University Health Network, Toronto, Ontario, Canada. The study institution was a Canadian academic tertiary care hospital. Consent was obtained from all participating members of the care team: 11 general surgeons, 24 surgical trainees, 41 OR nurses, 28 anesthesiologists, and 24 anesthesia trainees. All general surgery patients whose elective surgery was scheduled during the study period were eligible for inclusion in the study and were approached for participation via information sheet and/or in-person meeting. Patients were given an information sheet about the study in the preadmission clinic at least 2 days before their surgical procedures. Whenever possible, a research assistant (S.W., S.E.) also met with the patient during the preadmission appointment to request written informed consent to participate. Of the 229 patients approached, 223 consented to participate.

DESIGN

For this 13-month prospective study, we used a preintervention/postintervention design. During the first 5 months, preintervention data were collected. The intervention was implemented over a 3-month period, which was followed by 5 months of postintervention data collection.

INTERVENTION

A year-long process of stakeholder meetings and rapport building preceded the implementation of the intervention. This process included the principal investigator and other research team members negotiating with OR leaders and managers regarding best strategies for integrating a new communication routine in the hospital's OR culture; engaging OR team members in checklist prototype development, refinement, and piloting; and conducting formal presentations at all levels to introduce the evidence relating team communication to safety outcomes. Each of these steps encouraged leaders and team members to think about their team communication practices and to participate in discussions of how these practices could be improved to promote safer teamwork. Training on the conduct of team briefings involved the use of a video dramatization of best briefing practice that was shown to team members individually and in groups prior to the intervention. As well, researchers were present at team briefings to provide feedback and engage in spontaneous discussions about the process with team members in the 3-month intervention phase of the study, prior to the commencement of postintervention data collection. Champions were central to our implementation strategy. Surgeons agreed to take responsibility for initiating checklist briefings, and we both encouraged surgeons to maintain this leadership role and welcomed leadership in other team members.

As previously reported, the checklist briefing was piloted to confirm its feasibility.[12] During each briefing, surgeons, nurses, and anesthesiologists gathered for a review of the upcoming procedure. The briefing was intended to allow team members to share their knowledge of the case and to resolve knowledge gaps and discrepant assumptions of how the case would proceed. The briefing was structured by a 1-page checklist of prompts.[12] The checklist was designed to be comprehensive yet practical, pertinent for a range of general surgery procedures, and representative of all 3 professions. It contained prompts for patient information (eg, relevant medical history, allergies) and procedural issues (eg, operative plan, antibiotic requirements). A research assistant in the OR (S.W., S.E.) helped gather the team and initiate the briefing. Teams were encouraged to complete the checklist briefing as early as possible before each surgical case. Postprocedure briefing was not part of the intervention.

DATA COLLECTION AND ANALYSIS

The primary outcome measure was the total number of communication failures per surgical procedure. Failures constituted instances in which communication happened too late, had inaccurate content, failed to achieve its purpose, or excluded relevant team members.[15] Communication failures and their visible consequences were documented by 1 of 4 trained observers using a validated observational scale.[15] The scale was designed for use by a third-party observer in the OR theater to provide a detailed record of each communication failure observed during the procedure. For each failure observed, the observer identified, using a checklist of options, the types of communication failure and any visible, immediate consequences that arose. In addition, the observer recorded the time of the event, documented contextually relevant observation notes as required, and identified continuity between related events that were separated in time by cross-referencing previous forms. Visible consequences were also represented in a checklist of options based on previous research, including inefficiency, team tension, resource waste, workaround, delay, patient inconvenience, and procedural error.[15] These consequences had to be visible to the observer (therefore excluding consequences that may arise postoperatively or in other ORs) and clearly related to the communication failure.

Each of the 4 observers had at least 1 year of experience as an observer in our research program, and 1 had clinical expertise as an OR nurse educator. Training on the instrument included individual and group practice application of operational definitions of failure categories. Practice application involved discussion about different levels of interpretive effort in identifying an event as an error and decisions about "how much" interpretation was reasonable and reproducible among the raters. Observers cited objective evidence for their interpretations. When the evidence was ambiguous or missing, events were not included as failures. A "quick reference" of definitions was provided for use in the field. Observer blinding was not possible because team members often referenced the checklist discussion in their subsequent discourse.

Major surgical cases were selected for observation during the preintervention and postintervention phases of the study. Cases during the 3-month intervention phase, when teams were adopting the briefing practice, were ineligible for inclusion in the observational data. The 2 data sets were similar in terms of surgeon, duration of observation, and type of procedure. As is presented in the "Results" section, there was a large difference in standard deviations for communication failure rates between the 2 data sets and the distributions of data were strongly skewed (especially the postintervention data); the number of communication failures per procedure, measured before and after introduction of the briefing checklist, was therefore compared using a nonparametric Mann-Whitney *U* test. A secondary analysis was performed to determine whether the intervention systematically reduced communication failures that resulted in a visible negative consequence or those that had no visible consequence. To this end, the proportional reduction in failures with a visible consequence relative to those without was compared using a χ^2 analysis.

The secondary outcome was the number of checklist briefings that exhibited "utility." Here, *utility* is defined as an observable effect of the team checklist briefing on the knowledge or actions of the team. This outcome was based on a qualita-

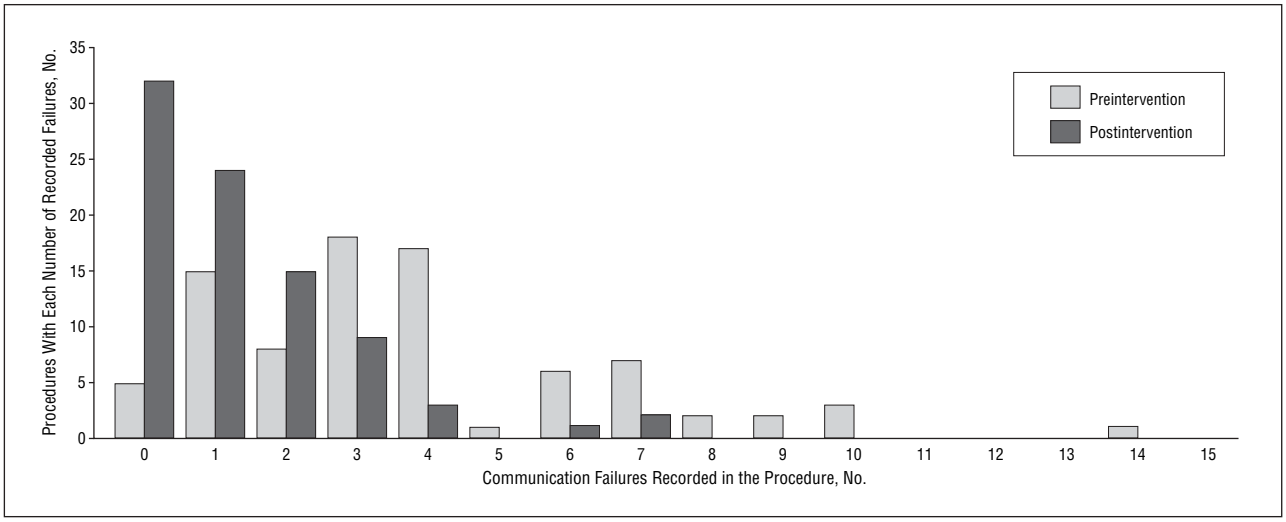

Figure. Frequency histogram with the x-axis representing the number of communication failures recorded in the procedure and the y-axis representing the number of procedures with each number of recorded failures.

tive analysis of observational data collected during the briefings. Each briefing was assigned a number in the data. For the analysis, 3 researchers (L.L., S.W., S.E.) used a constant comparative approach to review the observers' field notes[16] of briefing content and develop thematic categories that accounted for strong trends in the data.[17] NVivo software (QSR International, Doncaster, Australia) was used to code (ie, sort) instances into thematic categories and to facilitate analysis of relationships among categories.[18] Coded data were analyzed to determine the features of effective team communication in this context.

Finally, the perceptions of the care team regarding the checklist and briefing experience were documented with an 18-item exit survey probing its effect on safety, efficiency, education, and collaboration. The survey was distributed by the research staff either electronically or in person to all participants available to follow-up who had taken part in more than 1 checklist briefing. Responses were summarized using descriptive statistics.

RESULTS

During the intervention and postintervention phases of the study, 302 checklist briefings were completed. Of the 302 briefings, 295 were observed by the research assistant and 7 were conducted when the researcher was not present. The briefings involved at least 3 participants (1 representative each from surgery, nursing, and anesthesia) and were typically led by a surgeon. Both staff and trainees participated in the briefings. Most briefings (92%) lasted 1 to 4 minutes. A few occurred before patient arrival to the OR (23; 8%); most took place either after patient arrival but before induction of general anesthesia (100; 34%) or after induction of general anesthesia (139; 47%). The timing of 33 briefings (11%) was indeterminable due to incomplete documentation.

COMMUNICATION FAILURES

One hundred seventy-two procedures were observed (86 preintervention and 86 postintervention), and the number of communication failures was recorded for each (**Figure**). **Table 1** contains representative examples of a variety of communication failures with and without visible consequences. The mean (SD) number of communication failures per procedure declined from 3.95 (3.20) before the intervention to 1.31 (1.53) after the intervention ($U=1450.5$, $P<.001$). The number of failures that were of no visible consequence was 133 before and 38 after, a 71% reduction (**Table 2**). More importantly, the number of communication failures that was associated with at least 1 visible negative consequence declined by 64%, from 207 before the intervention to 75 after the intervention (Table 2). The reductions in consequential and inconsequential failures were similar ($\chi^2_1=1.09$; $P=.297$).

BRIEFING UTILITY

Analysis of the field notes revealed instances of "functional utility" in more than a third of briefings (100/295; 34%). Functional utility was identified as communication that identified a problem, ambiguity, or critical knowledge gap; provoked a change in plan; or prompted a follow-up action. Almost half of these communication events (44/100; 44%) had a direct impact on patient care by changing the decisions or actions team members took in the course of the surgical procedure. For example, in 1 briefing, the anesthesiologist noted that cefazolin had been ordered for a patient who had previously experienced a relatively severe reaction to penicillin. Consequently, the surgeon and anesthesiologist decided to administer an alternative antibiotic.

PARTICIPANT PERCEPTIONS

The exit survey was distributed to the 83 participants who had taken part in at least 2 team checklist briefings, of whom 77 (93%) responded. **Table 3** lists responses, by profession, to a number of survey items. Seventy-one of the respondents (92%) agreed that the briefing allowed the team to identify and resolve problems, and 68 (88%)

Table 1. Examples of Communication Failures Data Records

Example	Failure Type	Consequences	Explanation
The circulating nurse returned from [seeing the patient in] the holding area at 7:45 and gave a report to the other 2 nurses in the room. She mentioned that the anesthesiologist was still with the patient. The surgical resident arrives at 7:50 with a paper copy of ECG, which he sets down on OR desk near where I [the observer] am sitting. He proceeds to work on the computer. At 7:58, the circulating nurse takes a call. Hanging up, she tells the scrub nurse that the anesthesiologist is just waiting for a copy of the ECG (ie, this is why the patient is not in the room yet). Surgical resident isn't included in the exchange. I tell them that, "I think the ECG is here in front of me." Surgical resident later explains that he brought the ECG down because "they forgot it upstairs." (Case 05, Event 01)	Content (relevant information not communicated)	Delay	Relevant information about the ECG is not communicated among the team members, preventing resolution of the issue.
The patient is asleep and surgical resident has prepped his arm for a reconstruction of arteriovenous fistula. The staff surgeon arrives and asks where the chart is, saying "I need to see what I'm doing." After reviewing the chart, staff surgeon has to assess and then re-prep the arm. Staff surgeon says to the circulating nurse, "Call me before prepping. I need to assess first what I'm doing." Circulating nurse replies sheepishly: "Okay." (Case 30, Event 01)	Occasion (too late to be maximally useful)	Inefficiency, tension	The late timing of this exchange necessitates repetition of work; surgeon's implication that circulating nurse is responsible for this extra work appears to create some tension.
Circulating nurse enters the room after checking in the patient. She reports to scrub nurse that the patient is "positive for sickle cell." Scrub nurse asks, "Sickle cell, or sickle cell trait?" Circulating nurse: "Sickle cell trait." Anesthesiologist, overhearing: "We don't know that for sure. She's never had hemophoresis." It later becomes clear that this is a significant concern for the anesthesiologist. He discusses this concern with staff surgeon after the patient's arrival to the operating theater. (Case 37, Event 02)	Audience (gap in group composition) and content (relevant information missing)	None visible	Missing information about the patient causes concern for anesthesiologist. The surgeon is absent from this exchange, which delays resolution of the problem but does not visibly delay procedural issues.
When staff surgeon arrives, the patient is asleep, positioned in stirrups, and draped. Surgical resident asks circulating nurse: "How difficult is it to put this patient in candy cane stirrups?" Circulating nurse: "Difficult but not impossible." Staff surgeon: "Okay, forget about it." Staff surgeon changes his mind later in the case and there is an attempt to change the stirrups, which causes significant delay and tension. (Case 46, Event 04)	Occasion (too late)	Delay, tension	The late timing of this exchange prevents resolution of the problem, which creates suboptimal operating conditions, tension, and delay.

Abbreviations: ECG, electrocardiogram; OR, operating room.

agreed that it helped guard against mistakes. Sixty-two (81%) of the respondents agreed that the briefings were worthwhile overall. There was no significant difference in responses among surgeons, nurses, and anesthesiologists.

COMMENT

Consistent with other studies in the OR, intensive care unit, and emergency department settings, we found that a routine team checklist briefing was feasible and had positive perceived effects on team communication and teamwork.[9-11,13] What distinguishes our study is the objective assessment of the briefing's effect on team communication. The intervention reduced observed communication failures among OR team members 3-fold, from a mean of 3.95 to a mean of 1.31 failures per surgical procedure. Furthermore, the reduction in observed communication failures was not limited to "inconsequential" failures but included an equal reduction in communication failures that were accompanied by a visible negative consequence. Thus, our objective measure-

ment of an improvement in communication moves beyond self-reporting surveys and represents an advance in the field of patient safety.

An analysis of briefing content revealed that a substantial number of the briefings benefitted clinical work by revealing knowledge gaps or provoking a change in the care plan. Such instances of utility demonstrate a preventive function for the checklist briefing. Events such as the identification of medication allergies and changes of medication plan are known in safety terms as *near misses*. Furthermore, our documentation of the consequences associated with communication failures identified several of the intermediate processes along the causal pathway between communication and error. For example, a tardy equipment request can lead to intraoperative delay and extended anesthesia time. Such intermediate processes exemplify how apparently trivial problems can cascade toward negative consequences, exposing one path by which poor communication decreases resilience in a team's ability to capture errors.[19,20]

The checklist briefing also represented a situated learning intervention that is a more cost-effective approach than traditional team training approaches such as crew resource management (CRM). Traditional approaches involve removing teams from the clinical setting for training and then implementing posttraining interventions to change communication routines.[21] As studies by Awad et al[13] and Morey et al[11] have shown, this is a powerful training model whose comprehensiveness and attention to attitudinal learning has produced some promising results. However, it may not be financially feasible for many health care organizations. Our research suggests that a team briefing based on a structured checklist can promote learning and create commitment to improved communication while incurring minimal resource expenditure and no loss of OR time. This echoes the experience by Pronovost et al[10] with a daily goals form in the ICU, where they found that a simple communication tool founded on CRM theories could demonstrate positive effects in the absence of traditional formal CRM training. As they suggest, the value of a structured communication tool is evidenced by its uptake: OR management at our study institution has now begun to implement the checklist briefing as a surgical quality and workflow initiative.

Although this early effort proved successful, we encountered cultural barriers that have relevance for others considering similar communication interventions. Three issues arose recurrently: all 3 OR professions (surgery, nursing, anesthesia) are accustomed to thinking and working independently; they embrace the notion of individual excellence; and they are overwhelmed by chronic staff shortages, educational duties, and economic pressures.[22] Each of these barriers threatens the consistent uptake of a new communication routine like the briefing. For instance, team members may be reluctant to alter their habitual workflow to gather for the briefing, they may resist the briefing because "if everyone knew what they were doing we wouldn't have to do this," and they may necessarily prioritize other duties in their multitasking list. Such attitudes and behaviors influenced the timing of the briefing such that only 42% occurred at the most useful time—before induction. Amalberti et al[8] assert that such issues, which they summarize as "historical and cultural precedents and beliefs that are linked to performance and autonomy,"[8(p756)] pose the greatest threat to improved safety. Factors contributing to our success in the face of these barriers include the in-depth stakeholder work we conducted the year prior to the inter-

Table 2. Number of Communication Failures With and Without at Least 1 Visible Consequence in the Preintervention and Postintervention Phases

	Preintervention	Postintervention	Total
Failures with no visible consequence	133	38	**171**
Failures with at least 1 visible consequence	207	75	**282**
Total	**340**	**113**	**453**

Table 3. Number of Survey Respondents by Profession and Status Who Agreed With Selected Survey Items Relating to Safety, Education, Collaboration, and Overall Value of the Team Checklist Briefings

	"Agree" Responses, No. (%)[a]					
Survey Item	Surgery Staff (n = 9)	Surgery Trainees (n = 13)	Anesthesia Staff (n = 20)	Anesthesia Trainees (n = 12)	Nurses (n = 23)	Total (n = 77)
The checklist gives me information about the patient and/or procedure that would otherwise not have been available to me.	4 (44)	7 (54)	15 (75)	11 (92)	16 (70)	53 (69)
The checklist provides an opportunity for the team to identify and resolve problems and ambiguities.	9 (100)	12 (92)	18 (90)	10 (83)	22 (96)	71 (92)
The checklist provides an educational opportunity for students and residents.	7 (78)	11 (85)	16 (80)	6 (50)	20 (87)	60 (78)
The checklist has the potential to guard against mistakes in the operating room.	7 (78)	11 (85)	20 (100)	10 (83)	20 (87)	68 (88)
The checklist strengthens the operating room team.	6 (67)	10 (77)	14 (70)	9 (75)	17 (74)	56 (73)
Considering all of the positive and negative aspects of the checklist, are routine checklist discussions worthwhile?	7 (78)	11 (85)	16 (80)	9 (75)	19 (83)	62 (81)

[a]The remainder of respondents indicated "disagree" or "no opinion" or did not provide a response.

vention, the presence of researchers to prompt team gathering and prioritizing of the briefing, and the surgeon-champion model.

Our study has several limitations. Although the briefing reduced communication failures and yielded observable improvements in team communication, this study did not isolate its active component. Improvements could have been driven by the checklist prompts, the physical gathering of team members, or both. A comparative study isolating these variables is required to probe this question. Future research is also required to establish the generalizability of our findings beyond the academic hospital setting, where trainee rotation schedules may influence team coherence and a strong research culture may support uptake of new team practices. Further, we cannot know how our study institution compares with others with regard to the extent of the communication failure problem and, therefore, the potential impact of the intervention. Finally, although the tenets of systems and error theory[23] suggest that the negative consequences we have documented, such as inefficiency, delay, and team tension, may reflect decreased resilience in the ability of the team to prevent errors, further research is required to determine the clinical significance of these consequences.

CONCLUSIONS

Interprofessional checklist briefings reduced the number of communication failures in the OR and promoted team communication that was proactive and collaborative and that prevented errors. The objective measurement of communication outcomes and careful analysis of communicative content in this study advance our understanding of the causal association between communication and safety.

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