Teamwork and Communication in Surgical Teams: Implications for Patient Safety

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BACKGROUND:	As part of a national program in the Department of Veterans Affairs to improve communication within the health-care environment, the Medical Team Training questionnaire was developed to assess organizational culture, communication, teamwork, and awareness of human factors engineering principles.
STUDY DESIGN:	The Medical Team Training questionnaire was pilot tested with 300 health-care clinicians. The final version of the Medical Team Training questionnaire was administered to an interdisciplinary group of 384 surgical staff members in 6 facilities as part of the Medical Team Training pilot project in the Department of Veterans Affairs.
RESULTS:	The results revealed a pattern of discrepancies among physicians and nurses in which surgeons perceive a stronger organizational culture of safety, better communication, and better teamwork than either nurses or anesthesiologists do.
CONCLUSIONS:	The Medical Team Training questionnaire was helpful in identifying hidden problems with communication before formal team training learning sessions, and it will be useful in focusing efforts to improve communication and teamwork in the operating room. (J Am Coll Surg 2008; 206:107–112. © 2008 by the American College of Surgeons)

Failures in coordination and communication among hospital clinicians have been associated with higher mortality rates in intensive care units,[1] longer lengths of stay and higher nurse turnover in intensive care units,[2] and greater postoperative pain with lower functioning levels for patients.[3] Nursing reports of collaboration between nurses and house staff were positively associated with improved patient outcomes in medical intensive care units, but reports from the house staff were not associated with better outcomes.[4] Surgical teams at Department of Veterans Affairs (VA) hospitals with low mortality rates communicated more effectively and more often than surgical teams associated with high mortality rates.[5]

Assessing the effectiveness of cooperation and communication among surgical teams and ICU teams is critical to timely problem solving in the management of surgical patients. The VA offers a program, developed by the National Center for Patient Safety (NCPS) in 2003, entitled "Medical Team Training" (MTT). This program is based on the principles of crew resource management[6] and is designed to improve communication within the health-care environment. The primary objectives of the program are to improve the outcomes of patient care and staff job satisfaction by introducing crew resource management communication principles for application in the clinical workplace. The questionnaire is administered before the MTT Learning Session to assess the safety climate and reveal differences in perceptions between professional groups working in the same clinical units. This article summarizes development of the questionnaire and reports our initial findings.

METHODS

The MTT questionnaire was developed from the Team Training questionnaire[7] that had been used to evaluate medical quality improvement teams in facilitated improvement projects within the VA.[7-14] The earlier questionnaire was modified to elicit more specific information related to communication and teamwork between clinicians. This instrument was pilot tested with 300 clinicians and administrators from the operating rooms (ORs) and ICUs in 6 VA medical centers (VAMCs) while the medical centers hosted MTT Learning Sessions between September and November 2003. After undergoing iterative changes, the

final version of the MTT questionnaire was administered before the start of the Learning Sessions to 384 operating room staff and administrators in 6 VAMCs before their Learning Sessions from May through December 2005. Respondents were asked to rate the degree to which they agreed with statements in the questionnaire on a five-point Likert scale. Response options ranged from "1" (strongly disagree) to "5" (strongly agree). The questionnaire was voluntary and anonymous. The response rate (the number of completed questionnaires over the number of attendees in the Learning Sessions) was 309/384, or 80%. The percentages of professions represented are displayed in Figure 1.

Scale development

Factor analysis was conducted on the final version of the MTT questionnaire, using Principal Component Analysis with Varimax rotation software (SPSS version 12.1 for Windows; SPSS, Inc). Factor analysis is a statistical method that builds "factors" of intercorrelated questions. The theory behind it is that questions that ask about the same concept should be similar, so are correlated to each other. Using factor analysis to statistically identify factors provides evidence of the validity of the concepts the factors represent, because the factors have been independently discovered. Four factor subscales were identified. Further item analysis resulted in the removal of four questions from the questionnaire because of relatively low factor scores.

The final subscales, questions, and alpha scores (a statistic that measures the degree to which each subscale is measuring a similar principle) for the respondents are displayed in Table 1. The first subscale is "organizational culture" (alpha = 0.786) and represents the perception that the clinician is supported by the organization and feels comfortable interacting with others on the clinical team. The second subscale, "communication," (alpha = 0.819) represents the perception that clinicians make efforts to exchange critical information. The third subscale, "teamwork," (alpha = 0.858) represents the perceptions that there is mutual respect, appreciation, and collaboration on the clinical team. The fourth subscale, "human factors awareness," (alpha = 0.842) represents an understanding of basic human factors principles, such as the tendency for people to make mistakes and the effects of fatigue on human performance.
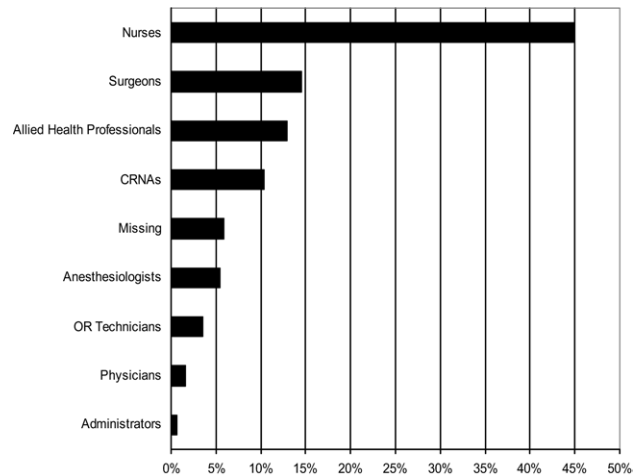

Figure 1. Percentage of professions among identified operating room staff (n = 309). The category "physicians" represents physicians who are neither surgeons nor anesthesiologists.

The questionnaire was further validated in a separate study conducted at the Michael E DeBakey VA Medical Center in Houston, TX. After enrolling in the Medical Team Training program and initiating briefings and debriefings in the OR, the Houston facility tracked improvements in communication using the MTT questionnaire. Significant improvements in communication were documented by repeat application of the MTT questionnaire to surgical staff. These improvements were also associated with more timely administration of prophylactic antibiotics and enhanced deep vein thrombophlebitis prophylaxis.[15]

The Institutional Review Board (IRB) at Dartmouth College approved this project (CPHS #16923).

Analysis

Questionnaire responses for operating room personnel from three major categories—surgeons, anesthesiologists and certified registered nurse anesthetists (CRNAs), and operating room nurses—were aggregated for the six medical centers and compared using analysis of variance (ANOVA) analysis. The subscale scores were compared across the three clinician groups using Bonferroni post hoc probes. Multivariate analysis of variance (MANOVA) analysis was conducted to detect differences between facilities. All analyses were conducted using SPSS version 12.1 for Windows (SPSS, Inc).

RESULTS

Table 2 displays demographic data on the VAMCs involved in this study. The final analysis was conducted on 233 OR staff members self-identified as either nurses (n = 139), anesthesiology providers (anesthesiologists or CRNAs;

Table 1. Items and Coefficient Alpha for Medical Team Training Questionnaire (n = 283)

Items	Alpha
Organizational culture	0.786
Medical Team Training for staff meets one of our organization's key strategic goals.	
Our health-care facility has a nonpunitive method of investigating adverse events.	
I like my job.	
Our team views problems from a systems perspective rather than as "someone's fault."	
Our team leadership is open to feedback and input from all team members.	
Health-care personnel should always monitor each other for signs of stress and fatigue.	
I am comfortable intervening in a procedure if I have concerns about what is occurring.	
Communication	0.819
Our team routinely briefs procedures before starting them.	
Our team routinely debriefs procedures after completing them.	
Our team has a specific way of ensuring that all members understand all important communications.	
Workload and task distribution are clearly communicated in our work environment.	
During surgical and diagnostic procedures, everyone on the team is aware of what is happening.	
Teamwork	0.858
Everyone on our team is comfortable giving feedback to other team members.	
Morale on our team is high.	
Our team members understand each other's strengths and weaknesses.	
Our team members have mutual respect for each other.	
Our team has a successful method for resolving conflicts between team members.	
I know the first and last names of all members of my surgical team during the conduct of procedures in the OR.	
The surgeon and anesthesiologist maintain open channels of communication during procedures in our OR.	
Our team has a shared vision of how to improve.	
Human factors awareness (scale reversed)	0.842
Competent clinicians never make mistakes.	
Less experienced staff should not question the decisions of more experienced staff.	
Nurses should not question decisions made by attending physicians.	
Fatigue does not affect my ability to perform my work tasks effectively.	
When I am interrupted, my patient's safety is not affected.	
Stress and distractions do not affect my ability to perform my work tasks effectively.	

Medical Team Training scale: overall alpha = 0.881.
OR, operating room.

n = 49), or surgeons (n = 45, Fig. 2). Table 3 displays the results of the ANOVA analysis for each of the 4 subscales across the 3 professional groups. There was a significant difference among professions on perceptions of organizational culture, communication, and teamwork. Post hoc probes (Table 4) revealed a general pattern that surgeons' perceptions differ from those of nurses and anesthesia providers, and nurses and anesthesiologists tend to have similar perceptions of teamwork, communication effectiveness, and organizational culture.

MANOVA analysis of the 6 individual VA facilities revealed a significant interaction effect between facility and

Table 2. Demographic Data

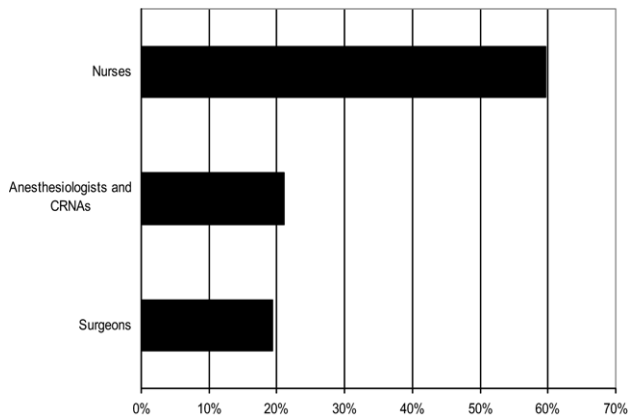| VAMC	Surgical cases/year (fiscal year 2005 data), n	Medical school affiliation	Authorized beds, n	Cardiovascular surgery and university affiliate	Neurosurgery programs
1	4,051	Yes	237	No	No
2	1,771	Yes	59	No	No
3	5,365	Yes	237	Yes	Yes
4	4,422	Yes	585	Yes	Yes
5	2,952	Yes	191	Yes	Yes
6	2,241	Yes	119	No	No

VAMC, Department of Veterans Affairs Medical Center.

Figure 2. Breakdown of professional groups analyzed (n = 233).

profession (F = 1.98, p < 0.001). This finding indicates that five of the six operating rooms repeated the same basic pattern in which the perceptions of nurses and anesthesiologists were relatively similar and both differentiated from surgeons. One facility (no. 4) had a very different pattern of responses. In facility 4, the surgeons were much more aware of problems with organizational support, situational awareness, and communication.

DISCUSSION

Communication failures in the operating room are not uncommon and can jeopardize patient safety.[16,17] Consequently, assessment of communication effectiveness in surgical teams will enable timely problem solving and potential interventions in the provision of surgical care. Our questionnaire instrument is a useful means for identifying a pattern of differences among surgical teams in their perceptions of organizational culture, teamwork, and communi-

cation effectiveness. We are able to differentiate between OR staff members with different communication styles. The most common pattern is that nurses and anesthesia providers tend to perceive their environment similarly, and both differ significantly from surgeons' perceptions. In addition, surgeons perceive the environment more positively than the other two groups do.

More specifically, our findings revealed that surgeons are more likely to report their perceptions of a strong organizational culture for patient safety. For example, this category includes the item, "I am comfortable intervening in a procedure if I have concerns about what is occuring." Surgeons may believe this to be the case; nurses and anesthesia providers are less likely to report the same. Surgeons also rate teamwork and communication during their procedures more favorably relative to nurses and anesthesia providers in those procedures. An example would be the differential responses to the following question: "During surgical and diagnostic procedures, everyone on the team is aware of what is happening." This disparity between surgical team members signals a problem if the surgeon perceives that other team members are well informed when they are reporting the opposite. Surgeons also report higher ratings on teamwork effectiveness with responses such as, "morale on our team is high," and "everyone on our team is comfortable giving feedback to other team members." Again, nurses and anesthesia providers are less likely to report their agreement with the surgeons. If surgical team members have disparate perceptions about how well they are communicating or collaborating with each other, how is it possible for them to be collaborating optimally with other members of the surgical team for the care of their patients?

Table 3. Means, Standard Deviations, and ANOVA Results for Professional Groups on Four Subscales of the Medical Team Training Questionnaire

Subscale	Nurses	Surgeons	Anesthesiologists and CRNAs	F score	p Value
n	139	45	49		
Organizational culture					
Mean	3.21	3.64	3.23	6.24	0.002
SD	0.68	0.89	0.62		
Communication					
Mean	2.87	3.41	2.72	10.38	0.00005
SD	0.78	0.86	0.72		
Teamwork					
Mean	2.91	3.41	2.72	10.16	0.00006
SD	0.76	0.84	0.64		
Human factors awareness					
Mean	3.58	3.43	3.72	1.31	0.273
SD	0.92	0.76	0.82		

CRNA, certified registered nurse anesthetist.

Table 4. Bonferroni Post Hoc Probes of ANOVA Analysis (n = 233)

Subscale	Professional group (1)	Professional group (2)	Mean difference (1–2)	Significance
Organizational culture	Nursing	Surgeons	−0.42406*	0.002
		Anesthesiologists and CRNAs	−0.01942	1.000
	Surgeons	Nursing	0.42406*	0.002
		Anesthesiologists and CRNAs	0.40463*	0.020
	Anesthesiologists and CRNAs	Nursing	0.01942	1.000
		Surgeons	−0.40463*	0.020
Communication	Nursing	Surgeons	−0.53659*	0.000
		Anesthesiologists and CRNAs	0.14849	0.769
	Surgeons	Nursing	0.53659*	0.000
		Anesthesiologists and CRNAs	0.68508*	0.000
	Anesthesiologists and CRNAs	Nursing	−0.14849	0.769
		Surgeons	−0.68508*	0.000
Teamwork	Nursing	Surgeons	−0.49347*	0.001
		Anesthesiologists and CRNAs	0.17326	0.508
	Surgeons	Nursing	0.49347*	0.001
		Anesthesiologists and CRNAs	0.66673*	0.000
	Anesthesiologists and CRNAs	Nursing	−0.17326	0.508
		Surgeons	−0.66673*	0.000
Human factors awareness	Nursing	Surgeons	0.14746	0.973
		Anesthesiologists and CRNAs	−0.14296	0.972
	Surgeons	Nursing	−0.14746	0.973
		Anesthesiologists and CRNAs	−0.29042	0.322
	Anesthesiologists and CRNAs	Nursing	0.14296	0.972
		Surgeons	0.29042	0.322

*The mean difference is significant at the 0.05 level.

Facility 4 did not follow the pattern found in other hospitals in our study. We did not formally assess the characteristics of the facilities or the staff. But based on our interactions with the staff in this facility, we became aware that this group had already been exposed to team training and that some of the senior leaders had experience in aviation. This may account for the difference in their responses.

These results are consistent with findings from other studies. Awad and colleagues[15] reported their baseline results from an earlier version of this questionnaire, revealing higher ratings from surgeons than anesthesiologists and nurses. Thomas and associates[18] reported teamwork survey results with critical care nurses and physicians working together who viewed the success of their teamwork with each other differently. Again, physicians reported more favorable perceptions of teamwork. DeFontes and Surbida[19] also reported that physicians viewed teamwork with nurses more positively than nurses viewed teamwork with physicians. Finally, Makary and coauthors[20] reported from a large survey study of 60 hospitals that surgical staff rate teamwork within their own profession more highly than teamwork in other domains. Surgeons rate overall teamwork more highly than nurses working in the same OR environment.

Another important component of this study was to provide further evidence of the construct validity of the MTT questionnaire. This evidence was revealed in several ways. First, the MTT questionnaire was based on a previously validated questionnaire, developed for general medical improvement teams, that was already capable of reliably differentiating between high- and low-performing medical improvement teams.[7] Second, the four subscales of the questionnaire were independently identified using the statistical method of factor analysis, suggesting that each subscale measures a unique concept that is somewhat different from the other subscales. This idea is further corroborated by the relatively high alpha scores for each of the subtests, indicating the high intercorrelation of the questions within each subscale. Third, positive changes in the questionnaire in another study[15] were associated with positive clinical changes and staff reports of improved communication. Finally, the patterns of communication identified by the MTT questionnaire were very similar to communication patterns identified in other studies[18-20] with similar types of clinicians.

There are several limitations to this study. Our data analysis was limited to six VA medical centers, and most questionnaire respondents were nurses. In addition, this was a cross-sectional study with neither followup information on

patient outcomes nor observed staff behaviors. Nevertheless, these results indicated that the MTT questionnaire may be useful in identifying differences in the perception of teamwork and communication effectiveness between health-care professionals in the surgical environment.

In our Medical Team Training program, we conduct preparation and planning conference calls with change teams from each participating facility before the Learning Session. These calls are focused on identifying communication problems among clinicians. Our questionnaire provides a helpful tool for uncovering these problems that staff may not have otherwise recognized. In addition, specific patterns of suboptimal communication can be identified and targeted for intervention in the program. These differences in perception related to teamwork and communication highlight the need for improvement in team cohesiveness and a shared mental model. One of the goals of our program is to facilitate an increased awareness of teamwork and communication challenges among clinical team members and to introduce tools for improving collaboration for safe patient care.

Author Contributions

Study conception and design: Mills, Neily, Dunn
Acquisition of data: Mills, Neily, Dunn
Analysis and interpretation of data: Mills
Drafting of manuscript: Mills, Neily, Dunn
Critical revision: Mills, Neily, Dunn

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