
Operating Room Teamwork among Physicians and Nurses: Teamwork in the Eye of the Beholder

Martin A Makary, MD, MPH, J Bryan Sexton, PhD, Julie A Freischlag, MD, FACS, Christine G Holzmueller, BLA, E Anne Millman, MS, Lisa Rowen, RN, DNSc, Peter J Pronovost, MD, PhD

- BACKGROUND:** Teamwork is an important component of patient safety. In fact, communication errors are the most common cause of sentinel events and wrong-site operations in the US. Although efforts to improve patient safety through improving teamwork are growing, there is no validated tool to scientifically measure teamwork in the surgical setting.
- STUDY DESIGN:** Operating room personnel in 60 hospitals were surveyed using the Safety Attitudes Questionnaire. Surgeons, anesthesiologists, certified registered nurse anesthetists, and operating room nurses rated their own peers and each other using a 5-point Likert scale (1 = very low, 5 = very high).
- RESULTS:** Overall response rate was 77.1% (2,135 of 2,769). Ratings of teamwork differed substantially by operating room caregiver type, with the greatest differences in ratings shown by physicians: surgeons ($F[4, 2058] = 41.73, p < 0.001$), and anesthesiologists ($F[4, 1990] = 53.15, p < 0.001$). The percent of operating room caregivers rating the quality of collaboration and communication as “high” or “very high” was different by caregiver role and whether they were rating a peer or another type of caregiver: surgeons rated other surgeons “high” or “very high” 85% of the time, and nurses rated their collaboration with surgeons “high” or “very high” only 48% of the time.
- CONCLUSIONS:** Considerable discrepancies in perceptions of teamwork exist in the operating room, with physicians rating the teamwork of others as good, but at the same time, nurses perceive teamwork as mediocre. Given the importance of communication and collaboration in patient safety, health care organizations should measure teamwork using a scientifically valid method. The Safety Attitudes Questionnaire can be used to measure teamwork, identify disconnects between or within disciplines, and evaluate interventions aimed at improving patient safety. (*J Am Coll Surg* 2006;202:746–752. © 2006 by the American College of Surgeons)
-

Errors in the operating room (OR) can have catastrophic consequences for patients, families, caregivers and entire institutions. Retained sponges, wrong-site operations,

Competing Interests Declared: None.

Supported by the Agency for Healthcare Research and Quality, grant numbers 1UC1HS014246 and 1PO1HS1154401.

Presented at the American College of Surgeons 91st Annual Clinical Congress, San Francisco, CA, October 2005.

Received November 15, 2005; Revised January 20, 2006; Accepted January 30, 2006.

From the Departments of Surgery (Makary, Freischlag, Millman, Pronovost) and Anesthesiology (Sexton, Holzmueller, Pronovost), Johns Hopkins University School of Medicine; Department of Health Policy and Management (Makary, Millman, Pronovost), Johns Hopkins Bloomberg School of Public Health; Department of Nursing (Rowen, Pronovost), John Hopkins University School of Nursing, and the Johns Hopkins Quality and Safety Research Group (Makary, Sexton, Holzmueller, Millman, Pronovost), Johns Hopkins Medical Institutions, Baltimore, MD.

Correspondence address: Martin A Makary, MD, MPH, Department of Surgery and Health Policy and Management, Johns Hopkins University School of Medicine, Johns Hopkins Medical Institutions, 4940 Eastern Ave, Bldg A-5, Baltimore, MD 21224. email: mmakary1@jhmi.edu

mismatched organ transplants or blood transfusions can be the result of interpersonal dynamics, where communication and collaboration breakdowns occur among OR team members.¹⁻³ The Joint Commission on Accreditation of Healthcare Organizations recently identified breakdowns in communication as the leading root cause of wrong-site operations, and other sentinel events.⁴ Teamwork is an integral component of a culture of good communication in the OR⁵ and, accordingly, is an important surrogate of patient safety. To this end, the 1999 Institute of Medicine report on medical error concluded that hospitals need to “promote effective team functioning” as one of five principles for creating safe hospital systems.⁶ The Joint Commission on Accreditation of Healthcare Organizations proposed that hospitals measure culture beginning in 2007. A reliable and widely used measurement tool for the OR setting does not currently exist.

Abbreviations and Acronyms

CRNA = certified registered nurse anesthetists
 OR = operating room
 SAQ = Safety Attitudes Questionnaire

Attitudes about teamwork are associated with error reduction behaviors in aviation,⁷ with patient outcomes in intensive care units,⁸⁻¹⁰ and with nurse turnover in the OR.¹¹ Good teamwork is associated with better job satisfaction,¹² and less sick time taken from work.¹³ Discrepant attitudes about teamwork have been suggested as a considerable source of nurses' dissatisfaction with their profession¹⁴ that has led to the critical nursing shortage.¹⁵ They might be a root cause of errors in operations, and surgeons are increasingly pressured to prevent negative outcomes.⁵ In the name of patient safety, there has been a plethora of new programs and training—with varying degrees of success. These initiatives represent a stride in the right direction, but they are void of reliable metrics to measure their effect on teamwork. We developed and validated a survey to measure teamwork in the surgical setting. In this study, we used this tool to compare ratings of teamwork within and between OR caregivers.

METHODS

Our survey, the Safety Attitudes Questionnaire (SAQ)¹⁶ is a refinement of the Intensive Care Unit Management Attitudes Questionnaire.^{17,18} The latter was adapted from the Flight Management Attitudes Questionnaire¹⁹ and its predecessor, the Cockpit Management Attitudes Questionnaire.²⁰ These surveys are reliable, sensitive to change,²¹ and the elicited attitudes shown to predict performance.^{7,22,23} There is a 25% overlap in item content between the SAQ and Flight Management Attitudes Questionnaire. We improved content validity and created an OR version of the SAQ after reviewing the literature on teamwork in the OR, conducting focus groups, and asking OR caregivers to review the survey for content relevance. Previous research suggested differences in perceptions of OR teamwork by OR caregiver type,¹⁷ and, to this end, we focused on the ratings of teamwork that OR caregivers give to one another. We used the communication and collaboration section of the SAQ, where the respondent is asked to “describe the quality of communication and collaboration you have experienced

with: eg, surgeons, anesthesiologists, surgical technicians, certified registered nurse anesthetists (CRNA), and OR nurses” (1 = very low, 2 = low, 3 = adequate, 4 = high, 5 = very high).

The SAQ (Operating Room Version) was administered to all OR caregivers in a Catholic health system comprised of 60 hospitals in 16 states in July and August of 2004. No one was excluded and OR caregivers included surgeons, anesthesiologists, surgical technicians, CRNAs, and OR nurses. Random sampling was not used because small sample sizes in caregiver positions within a hospital, instead, highly representative response rates were sought from each institution. Surveys were administered during preexisting departmental and staff meetings, with a pencil and return sealable envelope to maintain confidentiality. Individuals not captured in preexisting meetings were hand-delivered a survey, pencil, and return envelope. All surveys were anonymous to the caregiver's name but not to caregiver type or hospital.

Statistical analysis

Using ANOVA, we tested for differences in ratings of communication and collaboration (previously called *teamwork ratings*) that surgeons, anesthesiologists, surgical technicians, CRNAs, and OR nurses gave to each other. In addition to the means used in ANOVA, we also present the percent rating teamwork highly (high or very high) for each caregiver type. All statistical analyses were performed using SPSS version 12.0.

RESULTS

Of 2,769 questionnaires handed out in 60 hospitals (222 surgeons, 1,058 OR nurses, 564 surgical technicians, 170 anesthesiologists, and 121 CRNAs), a total of 2,135 surveys were returned, for an overall response rate of 77.1% (range across hospitals of 57% to 100%). OR nurses (79%) had the highest response rate and CRNAs had the lowest (67%) (Table 1). Average respondent was 43 years old with 10 years of experience at the current hospital. Surgeons (8.6% women) and anesthesiologists (12.7% women) were predominantly men.

Teamwork ratings

Teamwork ratings for each OR caregiver differed considerably by caregiver type, with the largest differences in perceptions of teamwork between physicians and non-physicians. Table 2 shows the mean ratings of teamwork and ANOVA results. Physicians had the lowest overall

Table 1. Characteristics of Respondents Surveyed and Response Rates by Operating Room Caregiver Position

Position	Response rate		Age (y)*	Women		Experience in position (y)*	Working at current hospital (y)*
	%	Returned/administered		n	%		
Surgeon	73	222/305	48.3 ± 9.92	8.6	19	17.4 ± 9.41	12.3 ± 9.20
Anesthesiologist	77	170/220	45.8 ± 9.31	12.7	21	15.8 ± 8.18	10.6 ± 8.60
CRNA	67	121/181	44.6 ± 10.71	50.0	63	14.7 ± 12.32	9.5 ± 9.35
OR nurse	79	1,058/1,335	43.3 ± 10.85	89.0	942	13.9 ± 10.04	10.7 ± 8.69
Total	77	2,135/2,769	42.6 ± 11.3	68.5	1,462	13.7 ± 10.47	10.0 ± 9.08

*Values are mean ± SD.

CRNA, certified registered nurse anesthetist; OR, operating room.

ratings of teamwork (3.68 of 5.00) and OR nurses (scrub and circulating) were given the highest ratings of teamwork (4.20 of 5.00). This, despite the fact that surgeons and anesthesiologists rated teamwork within their own discipline the highest, their group received the lowest ratings overall. In addition, OR nurses, who were given the highest overall ratings of teamwork, rated teamwork with surgeons as only 3.52 of 5.00, relative to the higher ratings surgeons gave OR nurses (4.42 of 5.00).

Each OR caregiver rated teamwork with their own colleagues highly within their peer group at their hospital. Surgeons rated teamwork among surgeons highly, with 85.2% describing the teamwork with surgeons as “high” or “very high” (Fig. 1). Similarly, anesthesiologists rated teamwork among anesthesiologists very highly and CRNAs rated CRNAs very well (scores were 95.8 and 92.7, respectively). In fact, surgeons perceived that everyone in the OR is doing a good job in terms of teamwork (Fig. 2). Figures 3A, 3B, and 3C display the contrast between surgeons and nurses, surgeons and anesthesiologists, and anesthesiologists and nurses, respectively, and Figures 4A and 4B demonstrate interposition differences in teamwork among all members of the OR. Such differences underscore the disconnect in teamwork and the methodological barrier in aggregating measures of teamwork in surgery.

DISCUSSION

Substantial discrepancies in perceptions of teamwork exist in the OR, with physicians rating the teamwork of others as good, and at the same time, nurses perceive teamwork as poor. These findings mirror similar results of discrepant attitudes about collaboration between physicians and nurses in intensive care units.¹⁸

Based on our findings, surgeons and anesthesiologists appear more satisfied with physician–nurse collaboration than nurses. Nurses did not reciprocate the high ratings of teamwork given by physicians. This might have been a result of fundamental and long-standing differences between nurses and physicians, including status, authority, gender, training, and patient-care responsibilities. It might also be a result of different ideas of what constitutes effective teamwork. Discussions with respondents during survey feedback presentations highlighted that nurses often describe good collaboration as having their input respected, and physicians often describe good collaboration as having nurses who anticipate their needs and follow instructions. Historically, there are differences between the expectations that physicians and nurses bring to a communication encounter. Nurses are trained to communicate more holistically, using the “story” of the patient, and physicians are trained to communicate succinctly using the “head-

Table 2. ANOVA Results for Teamwork Ratings by and of Each Operating Room Provider Type

Ratings of	df	F	p Value	Mean ratings* of teamwork by				Overall
				Surgeons	Anesthesiologists	CRNAs	OR nurses†	
Surgeons	4, 2058	41.73	≤ 0.001	4.38	4.03	3.72	3.52	3.68
Anesthesiologists	4, 1990	53.15	≤ 0.001	4.39	4.80	4.25	3.85	3.96
CRNAs	4, 1571	37.36	≤ 0.001	4.37	4.58	4.67	3.94	4.04
OR nurses	4, 2061	12.93	≤ 0.001	4.42	4.31	4.10	4.25	4.20
Surgical technicians	4, 2044	6.17	≤ 0.001	4.36	4.17	3.95	4.07	4.10

*1 = very low; 5 = very high.

†Scrub and circulating.

CRNAs, certified registered nurse anesthetists; df, degrees of freedom; OR, operating room.

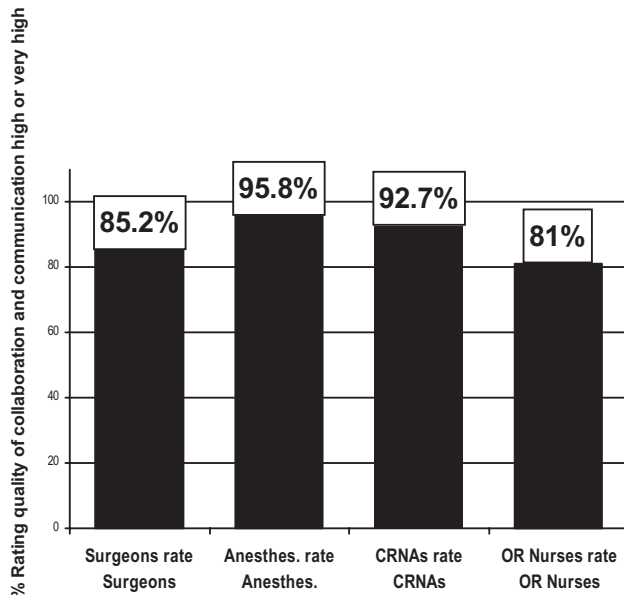


Figure 1. Teamwork as viewed within peer groups by operating room caregiver role. Anesthes., anesthesiologist; CRNA, certified registered nurse anesthetists; OR, operating room.

lines.²⁴ Differences in communication expectations and techniques might have roots in medical and nursing educational cultures.

Approachability

Good teamwork-related behaviors can lead to better patient outcomes.²⁵ One of the best-studied laboratories of this science has been the aviation industry. Research in commercial aviation has demonstrated important ties between teamwork and performance.²⁶ The link between teamwork and safety was most obvious after plane crash investigations exposed cockpit crew members' reluctance to question a captain's performance as a root cause of aviation accidents. Surveys to assess culture in the cockpit and predict performance were subsequently developed.²⁷ We applied the aviation model to a cultural assessment of teamwork in medicine and found similar intimidation or lack of approachability barriers.¹⁷

Nurse hesitancy to express concerns

The willingness of personnel to speak up about a patient-safety concern is an important part of safety in the operating room. The traditional hierarchy of surgery has often discouraged speaking up to a surgeon, and nurses can be hesitant to confront a surgeon on issues of patient care because they might have less training or experience in dealing with a patient's medical condition.

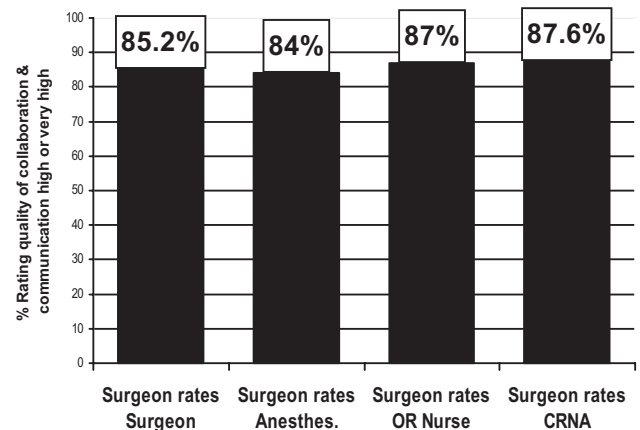
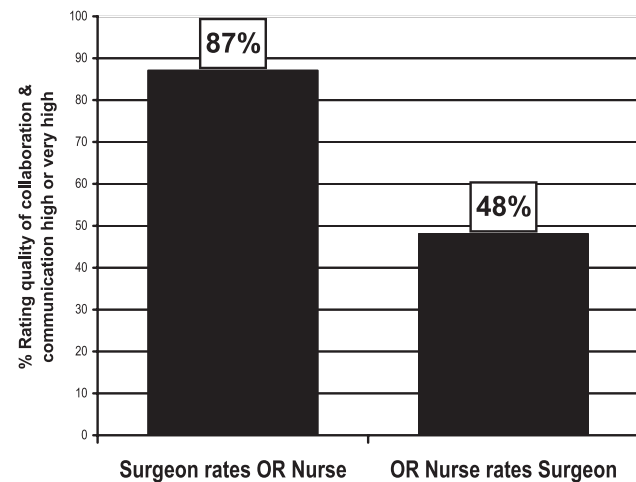


Figure 2. The surgeon's view of operating room (OR) teamwork by OR caregiver role. Anesthes., anesthesiologist; CRNA, certified registered nurse anesthetists.

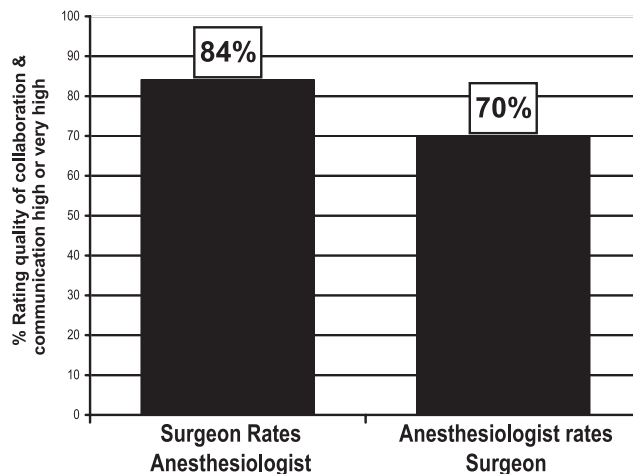
In addition, there might be social barriers involving race, gender, and socioeconomic status. A nurse's perception of the surgeon as unapproachable might have detrimental consequences for OR safety, as early signs or predisposing conditions of adverse events might be suspected by nurses but are not voiced because of a disinclination to speak up to the physician. Such conflicts for nurses not only have implications for patient care, but also contribute to job dissatisfaction and nursing turnover.^{12,28} The goal of creating a culture of safety is aimed at encouraging any member of the OR team to surface and mitigate issues that can lead to patient harm. A secondary goal is to promote a positive working environment in which good teamwork enhances job satisfaction.

A mandate to measure culture

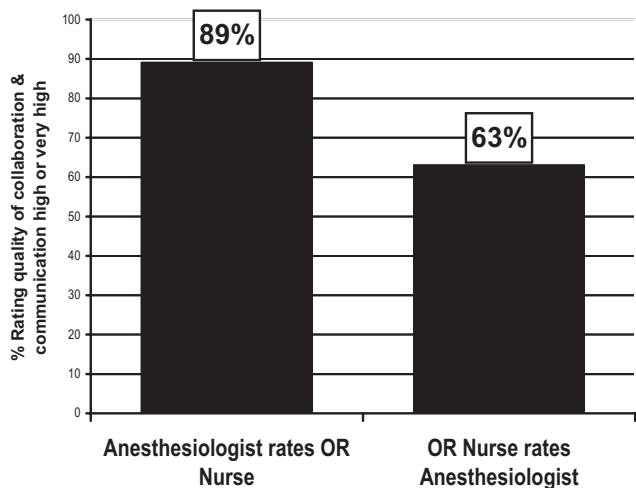
The Joint Commission on Accreditation of Healthcare Organizations proposed that hospitals measure culture beginning in 2007, citing the recent identification of culture as an important factor of a hospital system. This proposal has spurred some hospitals to begin looking for a scientific means to measure culture. The SAQ is a psychometrically valid and reliable instrument to accomplish this goal in the surgical setting. Here, we demonstrated that OR teamwork is in the eye of the beholder, and can be measured using OR caregiver ratings of each other from the communication and collaboration section of the SAQ. With the rush to implement safety programs in the health care setting, we maintain that it is important to distinguish meaningful programs from impractical and ineffective initiatives that do not apply to surgeons or the OR. To this end, the SAQ can



A



B



C

Figure 3. (A) Differences in teamwork perceptions between surgeons and operating room (OR) nurses. (B) Differences in teamwork perceptions between surgeons and anesthesiologists. (C) Differences in teamwork perceptions between anesthesiologists and OR nurses.

serve as a way to evaluate new safety programs aimed at improving teamwork.

Improving teamwork

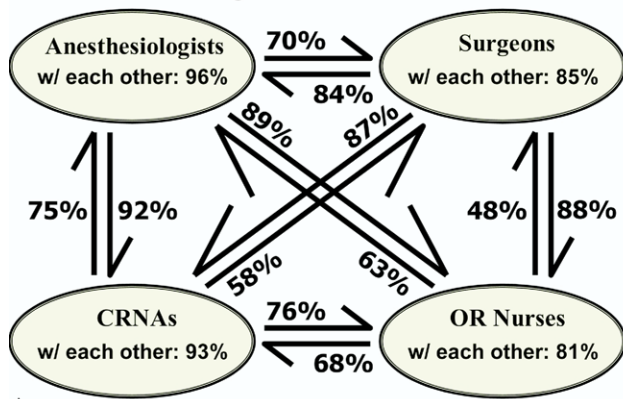
Although we can measure teamwork, these results will only be informative if teamwork scores are responsive to interventions. Indeed, we have found this to be true in both the ICU and OR.²³ We advocate strategies such as OR briefings and debriefings (or cross-checks), which are aimed at minimizing discrepancies in teamwork perceptions. At the Johns Hopkins Hospital, we have begun using OR briefings and debriefings as a means of improving teamwork and communication in the OR, with the goal of improved performance and safety. We encourage performing a brief discussion at the time of surgical “time-out” to review names and roles of the

team members, the operative plan and potential issues for the case, and a debriefing to learn lessons from the case for future patients. At our institution, it has been our experience that briefings and debriefings improved the culture of teamwork within and between departments. Although results need to be sustained to be meaningful, early feedback from OR personnel on the use of briefings and debriefings has been very positive.

Limitations

We recognize several limitations to our study. First, staff perceptions of communication can vary over time and can be influenced by acute events within the OR. Given the large number of hospitals we sampled, such differences likely had minimal influence on the results. Second, although originally designed to be a baseline assess-

% Reporting Good Collaboration



A
Figure 4. (A) Percentage (rounded) of operating room (OR) caregivers reporting a “high” or “very high” level of collaboration with other members of the OR team. (B) The best teamwork scores were recorded by anesthesiologists when they rated their teamwork with other anesthesiologists (“high” or “very high” 96% of the time). The lowest teamwork ratings were recorded by nurses when they rated their teamwork with surgeons (“high” or “very high” 48% of the time). CRNA, certified registered nurse anesthetists.

Caregiver Position Being Rated

Caregiver Position Performing Rating	Caregiver Position Being Rated			
	Surgeon	Anesthesiologist	Nurse	CRNA
Surgeon	85	84	88	87
Anesthesiologist	70	96	89	92
Nurse	48	63	81	68
CRNA	58	75	76	93

B

ment, many of the hospitals had already implemented specific interventions aimed at improving patient safety. Consequently, even though the results identify substantial opportunities for improvement, the results might be higher than expected for a true baseline assessment. Third, selection bias among respondents might have influenced our results. Nevertheless, our average response rate was 71%, suggesting that this bias is likely small.

In conclusion, we submit that teamwork is an integral component of patient safety in the OR and put forth our findings as a starting point for additional study of the best means to improve culture within our profession. Responses to the SAQ can be used to assess teamwork and identify disconnects between or within disciplines, and can provide benchmarks for departments of surgery or hospitals seeking to measure their teamwork climate.

Author Contributions

Study conception and design: Makary
 Acquisition of data: Sexton
 Analysis and interpretation of data: Sexton, Millman
 Drafting of manuscript: Makary, Sexton, Holzmüller, Millman
 Critical revision: Holzmüller, Millman, Rowen, Pronovost
 Statistical expertise: Sexton

Obtaining funding: Sexton, Pronovost
 Supervision: Makary, Freischlag, Rowen, Pronovost

Acknowledgment: We thank Andrew Knight from the University of Pennsylvania Wharton School for his work and expertise in data management and statistical analysis.

REFERENCES

- Gawande AA, Studdert DM, Orav EJ, et al. Risk factors for retained instruments and sponges after surgery. *N Engl J Med* 2003;348:229–235.
- Gibbs V, Auerbach A. The retained surgical sponge. Rockville, MD: AHRQ;2001:43:255–258. Available at: www.ahrq.gov/clinic/ptsafety/pdf. Accessed November 1, 2005.
- Edmonds CR, Liguori GA, Stanton MA. Two cases of a wrong-site peripheral nerve block and a process to prevent this complication. *Reg Anesth Pain Med* 2005;30:99–103.
- Joint Commission on Accreditation of Healthcare Organizations. Sentinel events: evaluating cause and planning improvement. Oakbrook Terrace, IL: Joint Commission on Accreditation of Healthcare Organizations; 1998.
- Saull NM. Universal protocol for preventing wrong site, wrong procedure, wrong person surgery. *J Perianesth Nurs* 2004;19:348–351.
- Kohn L, Corrigan J, Donaldson M. To err is human: building a safer health system [Institute of Medicine Report]. Washington, DC: National Academy Press; 1999.
- Helmreich RL, Foushee HC, Benson R, Russini W. Cockpit resource management: Exploring the attitude-performance linkage. *Aviat Space Environ Med* 1986;57:1198–1200.
- Baggs JG, Schmitt MH, Mushlin AI, et al. Association between

- nurse-physician collaboration and patient outcomes in three intensive care units. *Crit Care Med* 1999;27:1991-1998.
9. Shortell SM, Zimmerman JE, Rousseau DM, et al. The performance of intensive care units: does good management make a difference? *Med Care* 1994;32:508-525.
 10. Knaus WA, Draper EA, Wagner DP, Zimmerman JE. An evaluation of outcome from intensive care in major medical centers. *Ann Intern Med* 1986;104:410-418.
 11. DeFontes J, Subida S. Preoperative safety briefing project. *Permanente J* 2004;8:21-27.
 12. Posner B, Randolph W. Perceived situation moderators of the relationship between role ambiguity, job satisfaction, and effectiveness. *J Soc Psychol* 1979;109:237-244.
 13. Kivimaki M, Sutinen R, Elovainio M, et al. Sickness absence in hospital physicians: 2 year follow up study on determinants. *Occup Environ Med* 2001;58:361-366.
 14. Aiken LH, Clarke SP, Sloane DM, et al. Nurses' reports on hospital care in five countries. *Health Aff (Millwood)* 2001;20:43-53.
 15. Bednash G. The decreasing supply of registered nurses: inevitable future or call to action? *JAMA* 2000;283:2985-2987.
 16. Sexton JB, Thomas EJ, Helmreich RL, et al. Frontline assessments of healthcare culture: Safety Attitudes Questionnaire norms and psychometric properties. Technical report 04-01. The University of Texas Center of Excellence for Patient Safety Research and Practice AHRQ grant no. 1P01HS1154401. Available at <http://www.utpatientsafety.org>
 17. Sexton JB, Thomas EJ, Helmreich RL. Error, stress, and teamwork in medicine and aviation: cross sectional surveys. *BMJ* 2000;320:745-749.
 18. Thomas EJ, Sexton JB, Helmreich RL. Discrepant attitudes about teamwork among critical care nurses and physicians. *Crit Care Med* 2003;31:956-959.
 19. Helmreich RL, Merritt AC, Sherman PJ, et al. The flight management attitudes questionnaire (FMAQ). Austin, TX: University of Texas NASA/UT/FAA; 1993:93-94.
 20. Helmreich RL. Cockpit management attitudes. *Hum Factors* 1984;26:583-589.
 21. Gregorich SE, Helmreich RL, Wilhelm JA. The structure of cockpit management attitudes. *J Appl Psychol* 1990;75:682-690.
 22. Foushee H. Dyads and triads at 25,000 feet: factors affecting group process and aircrew performance. *Am Psychol* 1984;39:885-893.
 23. Pronovost PJ, Weast B, Rosenstein B, et al. Implementing and validating a comprehensive unit-based safety program. *J Patient Saf* 2005;1:33-40.
 24. Sexton BJ, ed. *The better the team the safer the world: golden rules of group interaction*. Ladenburg: Germany; 2004.
 25. de Leval MR, Carthey J, Wright DJ, et al. Human factors and cardiac surgery: a multicenter study. *J Thorac Cardiovasc Surg* 2000;119:661-672.
 26. Helmreich R, Sexton J. Group interaction under threat and high workload. In: Dietrich R, Childress T, eds. Aldershot, UK: Ashgate Publishing Limited; 2004.
 27. Helmreich RL, Wilhelm JA, Gregorich SE, Chidester TR. Preliminary results from the evaluation of cockpit resource management training: performance ratings of flightcrews. *Aviat Space Environ Med* 1990;61:576-579.
 28. Lu H, While AE, Barriball KL. Job satisfaction among nurses: a literature review. *Int J Nurs Stud* 2005;42:211-227.