Surgical Team Training
The Northwestern Memorial Hospital Experience

Amy L. Halverson, MD; Jennifer L. Andersson, RN; Karen Anderson, MSN; Justin Lombardo, MFA; Christine S. Park, MD; Alfred W. Rademaker, PhD; Don W. Moorman, MD

Objectives: To develop and implement a team-training curriculum. We hypothesized that better interactions between personnel would lead to improved patient safety, increased efficiency, and better staff satisfaction.

Design: Prospective assessment of a team-training program.

Setting: University-affiliated hospital.

Participants: Operating room physicians, nurses, technicians, and other personnel.

Interventions: Four-hour classroom curriculum, intraoperative coaching on team-related behaviors, and follow-up feedback sessions.

Main Outcome Measures: Baseline metrics and observational data were collected for 3 months before implementing the team-training program and 6 months after a designated implementation date. A questionnaire regarding perceptions of teamwork was completed at the beginning of and 6 weeks following the team-training classroom session.

Results: Six months after implementation of team training, compliance with preoperative briefings was 66%. No changes in hospital metrics were observed. An improved perception of teamwork among the participants was demonstrated in pretraining and posttraining surveys. Perceptions of teamwork and the utility of a preoperative briefing differed among nurses, surgeons, and anesthesiologists.

Conclusions: Our team-training program resulted in moderate compliance with behaviors taught in the curriculum. Even with only moderate compliance, we demonstrated improved perceptions of teamwork.

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A N OPERATING ROOM TEAM composed of anesthesiologists, nurse anesthetists, surgeons, nurses, and technicians aims for safety and efficiency. The operating room environment requires a complex interaction of personnel and instrumentation. Suboptimal functioning of the team can lead to decreased efficiency, team member dissatisfaction, and an increased chance of error.

In the early 1990s, crew resource management was developed in the airline industry to improve cockpit crew teamwork as part of a strategy to improve aviation safety. It aimed at improving communication, adjusting attitudes, and minimizing hierarchy by encouraging input from every team member regarding "near misses," or potential adverse events and errors. The goal of crew resource management training is to transfer specific knowledge and skills and to help participants develop attitudes that are conducive to teamwork.

Recognizing that factors contributing to optimized teamwork in aviation may parallel those affecting teamwork in the medical environment led others to test the crew resource management principles in medical settings. The MedTeams Project demonstrated a decreased clinical error rate and improved attitudes toward teamwork following the implementation of a team-training program in an emergency department. A subsequent study by Awad and colleagues demonstrated improved communication in the operating room following a team-training session. In 2000, the Institute of Medicine recommended establishing team-training programs as a strategy to improve patient safety. Additionally, The Joint Commission has included improving communication among caregivers as 1 of 5 patient safety goals.
In February 2006, Northwestern Memorial Hospital developed a curriculum that taught physicians and staff in the operating room the principles developed in crew resource management. This article summarizes our experience in developing and implementing a team-training program and our observations at 6 months' follow-up.

### TEAM-TRAINING PROGRAM DEVELOPMENT AND IMPLEMENTATION

A multidisciplinary team consisting of individuals from the surgery, anesthesia, and nursing departments as well as senior personnel from the quality and education departments developed a 4-hour team-training curriculum to teach basic concepts of teamwork and communication to physicians and staff. The curriculum was adapted from a preexisting program and consisted of lectures, videos, case scenarios, and an interactive communication exercise (D.W.M., unpublished curriculum, 2005).

The curriculum was divided into 4 main modules, which covered the importance of teams, what makes a well-functioning team, communication skills, and an implementation plan. The team competencies that were taught included leadership, mutual performance monitoring, creating a shared mental model, and individual accountability. The structure and function of preoperative briefings and postoperative debriefings were discussed. Specific communication techniques covered in the curriculum included repeating important information such as verbal medication orders, call-outs of critical information, the use of a standardized framework for conveying information about a patient or situation, and the use of standard terminology to communicate the escalating severity of a situation. The importance of transfer of information with personnel changes and announcing these handoffs to the group were also discussed.

The curriculum was taught to a group of 40 trainers, who in turn taught the curriculum to the rest of the trainees. These trainers included attending surgeons from various specialties, including general surgery, orthopedics, surgical oncology, and gynecologic oncology as well as anesthesia attending physicians, operating room nurses, and surgical technologists. Approximately 20 hours were spent in trainer sessions. Additional coaching was provided as needed to individual instructors.

Each 4-hour team-training class was led by a physician and a nonphysician (nurse or surgical technologist) instructor. One or 2 facilitators from the Department of Quality were present at each session. Thirty-six teaching sessions were conducted with approximately 30 trainees in each session. Each class included individuals from various disciplines to foster shared understanding among the various team members. Trainees included attending physicians, house staff, and nurses working in the operating room.

Personnel from the preoperative and postoperative patient care areas and the patient scheduling, pharmacy, operating room radiology, central sterile supply, and housekeeping departments were also included. The team-training class was mandatory for all trainees. The hospital enforced this requirement by suspending clinical privileges for all attending physicians who did not comply. Resident physicians and nurses were assigned to a specific session and excused from any clinical responsibilities during that time. Operating room staff were not allowed to work unless they attended a team-training class. A specific implementation date was designated for 4 weeks after completion of the training sessions. For 2 weeks following the implementation date, selected instructors performed intraoperative coaching. The primary purpose of the coaching was to facilitate teams in performing a preoperative briefing and a postoperative debriefing.

Individuals were given several options for reporting conflict and poor team behavior. These included paging or e-mailing coaches, discussing problems with their managers, or using an anonymous reporting system. Any identified problems that properly addressed by a teamwork leadership group and inappropriate behavior was reported to managers, department chiefs, or the hospital chief of staff as appropriate.

### EVALUATION OF EFFECTIVENESS

Three information sources were used to assess the effectiveness of the team-training program, including hospital metrics, teamwork attitude surveys, and direct intraoperative observation. The utility of performing a preoperative briefing was assessed by questionnaire and direct observation. Baseline safety metrics included the number of wrong side and site events or close calls and the frequency of timely antibiotic administration. Efficiency metrics included the frequency of cases starting on time and the turnover time between cases. At the beginning of the training session, participants were asked to fill out a survey to assess perceptions of teamwork and communication in the operating room. This survey was readministered via e-mail to all participants 6 months after program implementation. A second survey regarding the utility of the briefing was distributed and collected at nursing, surgery, and anesthesia department meetings approximately 6 months after implementation.

Hospital-based Department of Quality personnel carried out direct observation of operating room team performance 3 months before initiating the team-training program. A checklist was developed to standardize the observation of specific behaviors. These behaviors included patient identification by the circulating nurse, the performance of a briefing in addition to a “time-out” before starting an operation, and a debriefing at the conclusion of an operation. The announcement of change of personnel, ie, handoffs, was also observed. Subsequent observation was performed at 2 weeks and 6 months following implementation of the team-training program. Cases were observed during a 4-week period so that about 2 cases a day were observed. Cases were distributed across all days of the week as well as across times within the day, surgical specialty, and surgeon within specialty. A similar sampling scheme was used for both preobservation and postobservation. This methodology allowed for a more representative sample of cases, which enhanced the ability to generalize the results beyond this sample.

Data on compliance with the briefing and debriefing were obtained at 2 weeks and 6 months following implementation. Standard hospital metrics were recorded at 6 months postimplementation. Pretraining and posttraining data were compared using the Fisher exact test, with P < .05 indicating statistical significance.
A total of 1150 individuals went through the training course during a 2-week period. Reducing the volume of available operating room time during the training period was necessary to allow anesthesia and operating room staff to attend. Local hotel and hospital conference facilities were used to accommodate the volume of participants.

Eighty hours of direct observation, spanning 39 operative procedures, was performed 3 months prior to the team-training implementation. Observed procedures included 14 different surgical subspecialties. During this baseline period, no formal briefings were observed. However, the exchange of relevant information was observed at the beginning of some cases (Table 1).

Two weeks after the implementation date, intraoperative observation found that a preoperative briefing was being performed in 86% of cases. At the repeat observation period, 6 to 8 months following the implementation of the team-training program, preoperative briefings were performed in only 66% of the cases observed (Table 1). Compliance with all required elements in time-outs increased from 47% before team-training implementation to 86% during the 6 months after the training observation period. There was a 38% and 20% compliance with announcing handoffs in circulating nurses and in surgical technologists and scrub nurses, respectively. No handoffs were announced by members of the anesthesia department.

We observed an increase in the percentage of on-time first-case starts from 69% to 76%. A concomitant process to improve workflow for first cases was implemented; therefore, changes in first-case start times may not be attributable to team training. There was no significant change in timely prophylactic antibiotic administration or turnover times.

An improved perception of teamwork was observed in 14 of 19 questions on the teamwork attitude survey for the group overall (Table 2). On both the pretraining and posttraining administrations of the survey, attending surgeons tended to have greater perceptions of teamwork compared with nursing and anesthesia staff.

An additional follow-up survey queried 156 selected individuals (95 nurses, 34 anesthesia resident and attending physicians, and 27 surgical resident and attending physicians) as to whether preoperative briefings were useful. Thirty-seven percent reported that they had communicated would have led to an increased risk for the patient or a delay in the case. Examples include an antibiotic allergy identified just prior to antibiotic infusion, the recognition of the error that heparin was administered intravenously instead of subcutaneously, and the need for rapid-sequence induction in a patient with achalasia. The most commonly reported errors were related to improper patient positioning and equipment availability. Seventy-two percent of respondents reported in-

### Table 2. Overall Results of Perception of Teamwork Survey

<table>
<thead>
<tr>
<th>Survey Item</th>
<th>Responses, %</th>
<th>Baseline</th>
<th>6-mo Follow-up</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>“We regularly evaluate how we are working together as a high-performance team”</td>
<td>38</td>
<td>44</td>
<td>.003</td>
<td></td>
</tr>
<tr>
<td>“Our team acknowledges conflict and deals with it when it arises”</td>
<td>52</td>
<td>66</td>
<td>.02</td>
<td></td>
</tr>
<tr>
<td>“People in this organization can speak up without fear of retribution”</td>
<td>42</td>
<td>54</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>“NMH encourages open and honest communication among employees and physicians at all levels”</td>
<td>49</td>
<td>64</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>“All operations start with a team briefing”</td>
<td>41</td>
<td>54</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>“All operations end with a team debriefing”</td>
<td>17</td>
<td>24</td>
<td>.02</td>
<td></td>
</tr>
<tr>
<td>“Most members of the operating team speak up and state their information with appropriate persistence until there is some clear resolution and decision”</td>
<td>48</td>
<td>70</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>“The leaders of the operating team keep all team members well informed, especially during nonroutine situations”</td>
<td>46</td>
<td>63</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>“Team concept and environment for open communications established and/or maintained; team members listen with patience, do not interrupt or ‘talk over,’ do not rush through briefing, and make eye contact as appropriate”</td>
<td>44</td>
<td>58</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>“Department leadership listens to staff and cares about our concerns”</td>
<td>49</td>
<td>58</td>
<td>.01</td>
<td></td>
</tr>
<tr>
<td>“If I perceive a problem with the management of a patient, I will speak up, regardless of potential impact on me”</td>
<td>86</td>
<td>91</td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td>“I sometimes feel uncomfortable telling OR members from other disciplines that they need to take some action”</td>
<td>42</td>
<td>30</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>“I always ask questions and expect valid responses when I feel there is something about a patient’s care I do not understand”</td>
<td>89</td>
<td>93</td>
<td>.02</td>
<td></td>
</tr>
<tr>
<td>“Despite our high-stress, high-performance environment, I am fulfilled in my job”</td>
<td>74</td>
<td>81</td>
<td>.02</td>
<td></td>
</tr>
<tr>
<td>“The only people qualified to give me feedback are others of my own profession or those in a position of the same hierarchical level”</td>
<td>11</td>
<td>9</td>
<td>.58</td>
<td></td>
</tr>
<tr>
<td>“All team members of the OR are qualified to give me feedback”</td>
<td>80</td>
<td>85</td>
<td>.09</td>
<td></td>
</tr>
<tr>
<td>“I would not hesitate to ‘stop the line’ for clarification if I thought a safety issue existed”</td>
<td>93</td>
<td>94</td>
<td>.33</td>
<td></td>
</tr>
<tr>
<td>“My talents and abilities are fully used in my current position”</td>
<td>68</td>
<td>69</td>
<td>.67</td>
<td></td>
</tr>
<tr>
<td>“We each take responsibility for the team being successful; all team members operate inside the same purpose and vision as the leader”</td>
<td>70</td>
<td>75</td>
<td>.09</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: NMH, Northwestern Memorial Hospital; OR, operating room.
We developed and implemented a team-training program with the goals of improving safety, efficiency, and staff satisfaction. We aimed for a curriculum that could be generalized to other procedural areas, such as interventional radiology and interventional cardiology. The measurement of the success of a team-training program may include assessment of trainee reaction (eg, did they think it was worthwhile?), the extent of increased trainee knowledge, the extent of performance/attitude change, and the impact on organizational effectiveness and patient safety. While various tools have been proposed to assess team behavior, there is no consensus on an optimal method to measure improved performance.6-12 We did demonstrate improved perceptions of teamwork following the team-training program. These results are interpreted with the realization that we had a low return rate on the surveys and the observed differences may reflect biases of the individuals who completed the surveys. The surveys on the preoperative briefing were administered and collected in the same setting, so there should be minimal selection bias. Our observation of the differences in the baseline perceptions of teamwork among surgeons, nurses, and anesthesiologists is based on responses from all participants in the initial training session. Surgeons had the highest rating of perception of teamwork at baseline and demonstrated the greatest increase in perceived supportive culture. Similar differences in perception among the health care providers have been reported previously. Sexton and colleagues13 observed differing perceptions of teamwork in operating room staff. Surgical attending and resident physicians rated the teamwork they experienced with other attending surgeons the highest, while anesthesia resident physicians, anesthesia nurses, and surgical nurses rated interactions with the attending surgeons the lowest. In a subsequent study, Makary and colleagues14 demonstrated discordant perceptions in the quality of communication in the operating room. Surgeons’ perception of the quality of communication with anesthesiologists and nurses was higher than anesthesiologists’ and nurses’ perception of communication and coordination with surgeons. Recognizing these differences in attitudes, perceptions, and expectations of different team members is an important step to improving team performance.

Most participants embraced the team-training concepts in theory; however, during the 6-month period after the implementation date, we observed decreased compliance with preoperative briefings. One of the main challenges with performing the preoperative briefing is finding the right moment when all team members are present and engaged. Each attending surgeon was allowed to determine the most appropriate time to conduct the briefing as long as it preceded the time-out. Nursing staff were encouraged to prompt the surgeon when he or she did not initiate a briefing. The performance of a preoperative briefing was encouraged but not required. The hospital administration and team-training leaders felt that assessing the perceived benefits of the preoperative briefing was important before making briefings mandatory.

Figure 1. Responses by department to the following questions regarding cases in which preoperative briefings were not performed: “Has there been anything brought up during any of your cases that did not involve a briefing, that if mentioned in a briefing, could have been resolved prior to the start of the case?” (nursing vs anesthesia, P=.07; nursing vs surgery, P<.001; anesthesia vs surgery, P=.002). “Did the lack of communication contribute to increased tension in the room?” (nursing vs anesthesia, P=.99; nursing vs surgery, P<.001; anesthesia vs surgery, P<.001). “During cases where a briefing was not performed, did you know everyone in the room?” (nursing vs anesthesia, P=.04; nursing vs surgery, P=.19; anesthesia vs surgery, P=.002).

Figure 2. Observed benefits by department of preoperative briefings in response to the following questions: “Have you observed that the overall communication during the case was good because of the briefing?” (nursing vs anesthesia, P=.08; nursing vs surgery, P=.03; anesthesia vs surgery, P=.77). “Have you gained a clear understanding of the overall plan of care (nursing, anesthesia, surgery) because of the briefing?” (nursing vs anesthesia, P=.21; nursing vs surgery, P<.001; anesthesia vs surgery, P=.02). “Have you experienced a greater degree of familiarity among the team members because of the briefing?” (nursing vs anesthesia, P=.5; nursing vs surgery, P=.004; anesthesia vs surgery, P=.06). “Have you experienced a greater sense of teamwork because of the briefing?” (nursing vs anesthesia, P=.13; nursing vs surgery, P<.001; anesthesia vs surgery, P=.11).

Increased tension in the room owing to information that could have been communicated during a briefing (Figure 1). Overall, 75% of individuals surveyed stated that they had experienced a greater sense of teamwork because of a briefing (Figure 2). The perceived benefit of performing a briefing was higher in nurses and anesthesia providers than in surgeons.
Anesthesia providers' lack of compliance with the handoffs may in part be because the definition of a handoff is not always clear. An attending anesthesiologist may not consider providing break relief to a resident physician or nurse anesthetist as a handoff. A resident physician who remains in a case while the anesthesia attending physician changes may also not feel the need to announce a handoff. Even when the handoff is recognized as such, anesthesia providers reported feeling reluctant to interrupt the surgeon to announce the handoff.

While most participants indicated that the session was worthwhile, some individuals openly expressed dissatisfaction with the new expectation of having to perform a preoperative briefing. Helmreich and Wilhelm observed in their experience that approximately 10% to 20% of trainees will have a negative response to crew resource management training. Individual surgeons in urology and neurosurgery were the most resistant to accepting the preoperative briefing. Neither of these specialties were represented in the core group of team-training teachers. This absence of a designated leader from these specialties may have been a factor in the willingness of surgeons in these groups to adapt. We also did not include resident physicians in our core group of 40 trainees. Resident physicians may have provided valuable perspective and leadership that would have facilitated implementation and improved long-term sustainability. We interviewed resistant individuals who were in leadership positions to better understand the reasons for resistance to performing briefings. The most frequently reported reason for not performing a briefing was lack of recognition of the benefits of a briefing for the surgeon. Team-training leaders met one-on-one with surgeons to help them appreciate how to use briefings to their advantage. One example of an element of a briefing that was felt to be most beneficial for surgeons was assessing the experience of nurses and surgical technologists with the specific procedure so that back-up help could be arranged for inexperienced staff if needed. Also during the briefing, surgeons can designate a critical point in the operation during which there should not be a change in nurses or surgical technologists.

In the process of developing and implementing this program, we learned several lessons, some of which others have identified. Specific points warrant emphasis. Supportive leadership is the foundation to a successful team-training program. Our initial step in developing this program was obtaining approval from hospital administration and department chairs. A team-training endeavor of this magnitude requires a tremendous commitment from human and capital resources. Additionally, commitment from leaders to serve as role models during the initial implementation phase is important.

There was not always consensus on curriculum content. In particular, the concept of who is the leader in the operating room and what that designation implies sparked extensive discussion both during the development of the curriculum and some of the initial training sessions. We designated surgeons to lead the briefings and also emphasized the importance of situational leadership.

After development and implementation, sustainability remains an ongoing challenge. Institutions must ensure that nonverbal messages about the importance of team training match those that are spoken. Team-training classes are taught throughout the year and new physicians and operating room staff are required to attend a team-training class within 6 months of their date of hire. Our institution's reinforcement of good team behavior includes written positive feedback to individuals who are consistently top performers in terms of teamwork. Any instances of poor team behavior are addressed promptly with the appropriate individuals and their superiors. Initially after team training and during the follow-up period, the preoperative briefing was not mandatory. After reviewing the reports of near misses identified during briefings and the results of interviews and follow-up surveys regarding preoperative briefings, the hospital administration has now made briefings mandatory. The circulating nurses record in the electronic intraoperative nursing record whether a briefing was performed. This allows hospital leadership to track compliance with the briefings. Compliance with briefings will be evaluated as part of attending physicians' peer review. Ongoing coaching by operating room nurse managers is being done to support compliance with nurse and surgical technologist handoffs.

The initial team-training session is just the first step in cultivating a culture in which the various components of good teamwork are recognized and valued. Learned knowledge does not necessarily translate into improved attitudes or effective behavior. Any team-training program needs a strategy for reinforcement through enforcing expectations of team-related behaviors and continued teaching. In addition to ongoing training for new physicians and hospital staff, we are planning additional teaching sessions, covering topics like appropriate assertiveness and conflict avoidance, to reinforce the principles taught in the initial team-training session.

Perceptions of teamwork vary among different disciplines. In our experience, a team-training program resulted in improved perceptions of teamwork from physicians and operating room staff. The implementation of a successful team-training program extends beyond the several-hour training session. Ongoing education and reinforcement of teamlike behaviors are necessary.

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Author Contributions: Dr Halverson had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Halverson, Anderson, Lombardo, Park, and Moorman. Acquisition of data: Halverson, Andersson, and Lombardo. Analysis and interpretation of data: Halverson, Park, and Rademaker. Drafting of the manuscript: Halverson. Critical revision of the manuscript for important intellectual content: Ander-

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Announcement

The Archives is pleased to announce the appointment of distinguished surgeon Justin B. Dimick, MD, MPH, to our Editorial Board.

Justin B. Dimick, MD, MPH, received his medical degree from The Johns Hopkins University and completed his residency in general surgery at the University of Michigan, Ann Arbor. Dr Dimick received a master’s degree in public health and completed a fellowship in outcomes research at the Dartmouth Institute for Health Policy and Clinical Practice, Hanover, New Hampshire. Dr Dimick is certified by the American Board of Surgery and practices general and gastrointestinal surgery at the Ann Arbor Veterans Affairs Hospital. He is presently an assistant professor of surgery at the University of Michigan and a research scientist at the Michigan Surgical Collaborative for Outcomes Research and Evaluation. His research, largely focused on developing better quality measures, is currently funded by the Agency for Healthcare Research and Quality. He is an advisor to the Leapfrog Group and the Institute of Medicine on issues related to quality measurement. Dr Dimick also serves on the Measurement and Evaluation committee of the National Surgical Quality Improvement Program and the executive committee of the Surgical Outcomes Club.