The Efficacy of Medical Team Training: Improved Team Performance and Decreased Operating Room Delays

A Detailed Analysis of 4863 Cases

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Objectives: Medical team training (MTT) has been touted as a way to improve teamwork and patient safety in the operating room (OR).

Methods: OR personal completed a 1-day intensive MTT training. A standardized briefing/debriefing/perioperative routine was developed, including documentation of OR miscues, delays, and a case score (1–5) assigned by the OR team. A multidisciplinary MTT committee reviewed and rectified any systems problems identified. Debriefing items were analyzed comparing baseline data with 12 and 24-month follow-up. A safety attitudes questionnaire was administered at baseline and 1 year.

Results: A total of 4863 MTT debriefings were analyzed. One year following MTT, case delays decreased (23% to 10%, $P < 0.0001$), mean case score increased (4.07–4.87, $P < 0.0005$), and both changes were sustained at 24 months. One-year and 24-month follow-up data demonstrated decreased frequency of preoperative delays (16%–7%, $P = 0.004$), hand-off issues (5.4%–0.3%, $P < 0.0001$), equipment issues/delays (24%–7%, $P < 0.0001$), cases with low (<3) case scores (23%–3%, $P < 0.0005$), and adherence to timing guidelines for prophylactic antibiotic administration improved (85%–97%, $P < 0.0001$). Surveys documented perception of improved teamwork and patient safety. A major systems issue regarding perioperative medication orders was identified and corrected.

Conclusions: MTT produced sustained improvement in OR team function, including decreased delays and improved case scores. When combined with a high-level debriefing/problem-solving process, MTT can be a foundation for improving OR performance. This is the largest case analysis of MTT and one of the few to document an impact of MTT on objective measures of operating room function and patient safety.

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The operating room (OR) is a complex environment in which effective communication and the coordination of multiple team members can be critical for safe and efficient functioning. Team members rely on one another's expertise for completing tasks successfully. They must share information rapidly when responding to expected and unexpected events. Defects in communication are cited by the Joint Commission as the principal underlying cause of human error in the OR, and improving teamwork and communication has been identified as a priority by the Institute of Medicine,[1] the Joint Commission,[2,3] and Agency for Healthcare Research and Quality.[4] To that end, an increasing number of hospitals have implemented team training programs for OR personnel.[5–22] Such programs are typically based on crew resource management (CRM), a team management technique developed in commercial aviation that emphasizes situational awareness, assertive communication, and an understanding of human factors.[23,24] CRM-based team training programs may incorporate team briefings and checklists as communication and safety tools.[7]

In 2007, the Veterans Health Administration launched the Medical Team Training (MTT) program through the National Center for Patient Safety (NCPS) for application in the ICU and the OR.[14] The Veterans Health Administration data had shown that 82% of root cause analyses cited communication failure as a contributing factor to the unwanted event.[25] The OR staff at the San Francisco VA Medical Center (SFVAMC) participated in the MTT program as a pilot site beginning in September 2006. This report analyzes our experience to date.

METHODS

Setting

The SFVAMC is an academic-affiliated hospital and regional referral center with 8 ORs. More than 3500 surgical cases are performed per year. The OR teams consist of an attending surgeon, 1 to 2 residents, an attending anesthesiologist, an anesthesia resident or CRNA, scrub nurse/tech, and a circulating nurse. Each surgical section has a designated section nurse who, when present, acts as the circulating nurse and case coordinator.

Before implementing MTT, the following safety measures were in place: preoperative checklist completed by nurses in the preoperative area; preoperative marking of all operative sites by a member of the surgical team; and a time-out discussion that verified the patient's name, procedure, and operative site. There was not at that time a thorough preoperative briefing or postoperative debriefing.

The OR staff at the SFVAMC participated in the MTT program as a pilot site beginning in September 2006. This study analyzes a total of 4863 unique operative briefing and debriefing encounters performed between September 2006 and August 2008. The MTT program consisted of a classroom learning session, checklist-guided briefings and debriefings, and formation of a problem-solving Executive Committee. Specific elements included:

Preparation

The Executive Committee was led by the Chief of General Surgery and included the OR nurse manager, OR administrator, a quality assurance facilitator (administrative support), the Chief of Perioperative Services (an Anesthesiologist), the Associate Chief of Staff for Clinical Programs, and the Chief of SPD (Sterilization, Preparation, and Distribution). One of the committee's

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goals was to implement the new program without decreasing efficiency.

Interactive Learning Session (1 Day)

For one 8-hour work day, no elective operations were scheduled, so the OR staff, attending and resident surgeons, anesthesiologists, nurses, midlevel and ancillary staff could attend an interactive learning session led by VA NCPS. The session consisted of didactic modules, videos, and role playing. Topics included an introduction to CRM, systems thinking and human factors, assertive communication, fatigue recognition and management, and training in briefings and debriefings using checklists. The course content was healthcare oriented.

Briefing/Debriefing Protocol

Existing checklists and minimum Joint Commission on Accreditation of Healthcare Organizations requirements were reviewed and judged not to contain all desired elements (for our purposes), so a 1-page, briefing/debriefing checklist was created with input from all members. The new form (Fig. 1) included a detailed preoperative briefing and postoperative debriefing, a numerical case scoring system (scale 1–5) with defined anchors and a section to record plans for follow-up of issues requiring the committee's attention.

The briefings and debriefings were initiated on General Surgery and were progressively implemented on the other sections over 7 months. A member of each surgical section (specialty) attended

San Francisco VAMC OR Briefing / Debriefing Form

Date:	Surgical Section:	VA staff surgeon: □ Yes □ No	CASE #:
SF VAMC	Surgical Section Charge RN on procedure team: □ Yes □ No		SF VAMC

Confidential: This document is confidential and privileged information from quality management activities under the provisions of 38 U.S.C. 5705 and its implementing regulations. This material shall not be disclosed to anyone without authorization as provided for by that law or its regulations. The statue provides for fines up to $20,000 for unauthorized disclosures.

OR Briefing	
Introductions of team members and names on whiteboard. If anyone identifies a concern during the case, please inform the team.	
TIME OUT / Surgical Items:	Anesthetic management Items:
Name / SS# verification Procedure verification Laterality / Position Estimated length of operation	□ NKA, □ yes Allergies_____ □ yes □ NA IV antibiotics □ yes □ NA Re-dose discussed □ yes □ NA Special precautions *(HIV, HCV, MRSA, etc)*
Surgeon's description of procedure Conduct of operation, critical aspects of case equipment/supplies, implants/grafts, medications	Pain management (e.g. local anesthetic; multimodality) Temperature control
□ yes □ NA Pre-op Imaging reviewed & verified □ yes □ NA Fluoro, x-ray or ultrasound needed	□ yes □ NA DVT Prophylaxis □ yes □ NA Beta Blockade □ yes □ NA Glycemic control □ Pertinent lab Results
□ yes □ NA Pathology notified for frozen section	□ yes □ NA Type & cross or screen □ yes □ NA Blood availability
□ yes □ no Pre-op surgery checklist completed	□ yes □ NA Special (cell-saver, Jehovah's witness, etc.)
Nursing / Anesthesia: plan for breaks and handoffs (team member to introduce her / himself when switching)	
Post-op disposition Bed availability	Issue(s) identified:
OR Debriefing	
How did the case go overall? (1) □ Major issue(s) (e.g. hand-off, equipment, delays, communication problems) that impacted case - need post-op plan for f/u (2) □ Minor issue(s) that impacted case – need post-op plan for f/u (3) □ Major/minor issues with post-op plan for f/u, no impact on case (4) □ Major/minor issues but resolved by team intra-op, no need for f/u, no impact on case (5) □ No problems – case went well	
Recognition of good teamwork! (If so, please provide an example):	
Intra-op hand-off issue(s)? □ Yes □ No (please indicate what the issue was):	
Delays: □ Pre-op delay(s), specify:_____ □ Procedural delay(s), specify: _____ □ Equipment/instrument malfunction □ Equipment/instrument/supplies not available □ Need to revise "Pick List" □ Pick list revised □ Other:_____	Identified issue referred to: □ SPD □ form filled out □ Biomed □ work order request □ Surgical Section □ Anesthesia Service □ Nursing Service □ Other:_____
□ Methodical wound exam performed	□ Sponge/sharps/instrument count correct
□ Wound class verified/corrected *(surgeon & nursing)* □ Procedure performed verified for surgical package *(surgeon & nursing)*	
□ Issue(s) requiring follow-up:	

FIGURE 1. San Francisco VAMC OR Briefing/Debriefing Form.

the weekly MTT meetings. A representative of the organizing group worked with each specialty as it came on board.

Preoperative briefings were conducted in the OR before the incision was made. It was led by the surgeon with opportunities for all team members to provide input. The purposes were for the entire team to understand the key goals; to ensure that preparation was complete; to cite specific needs, critical steps, and possible difficulties; and to promote teamwork.

Postoperative debriefings were conducted after the operation was over but before the team left the OR. The purposes were to review team performance, including any miscues, and to identify problems. Key elements included identification of case delays, issues requiring follow-up, recognition of good teamwork, and assigning an overall score to the team's performance (Fig. 1).

Data from the briefing/debriefing forms were entered into a secure database for quality improvement review. Minor revisions were periodically made to the form based on experience or adoptions of new safety initiatives (eg, prevention of OR fires).

MTT Implementation Team

The MTT Executive Committee (described above) met weekly for the first 2 years and monthly thereafter to monitor compliance and identify and correct issues that needed improvement. The committee monitored compliance with the MTT process by comparing MTT forms submitted with the OR schedule. Members of the MTT implementation team worked with any sections significantly below the 100% goal to improve compliance. The team also reviewed the most recent group of forms to identify problems, implement plans for problem correction, and identify potential systems issues.

Follow-up and Feedback

Completion rates for briefings/debriefings (compliance rates) were monitored for each surgical specialty and included in monthly reports. Progress was discussed periodically with the surgical, anesthesia, nursing, and NCPS staff.

Evaluation

Safety Attitudes Questionnaire

A pre/post design was used to assess safety culture using a validated anonymous questionnaire[16] consisting of 6 domains, each comprising ~8 questions. The Safety Attitudes Questionnaire (SAQ) was completed by the OR staff before the Interactive Learning Session and again 12 to 17 months later. Baseline and follow-up domain scores were calculated and compared; the data did not allow for paired comparisons. The San Francisco MTT group added 3 additional questions to the SAQ completed after MTT to measure staff perceptions of the effects of MTT.

Case Delays

Two data sources were used to examine the influence of the program on OR case delays: (1) case delay data routinely collected in the VA electronic surgical record (N = 7573), and (2) data from the new briefing/debriefing forms (N = 4863). The data in the electronic surgical record allowed delay rates to be examined before the initiation of MTT; case delay frequencies (recorded in the VA electronic surgical record) were evaluated for 1 year before and after the start of the program. Data from MTT briefing/debriefing forms were compared for 3 periods: months 1 to 3 (used as a proxy for baseline) (Period 1); months 11 to 14 (1-year into the program) (Period 2); and months 21 to 24 (Period 3) (the final follow-up status). Delay rates, case scores, number of issues requiring follow-up, cases with low case score (score <5 and score <3), handoff issues, equipment issues, and types of delays were compared. Case delays, issues requiring follow-up, and mean case score were plotted for the 3-month periods using standard error graphs to depict changes in frequency and mean.

Statistical Analysis

Statistical analysis was performed using analysis of variance for interval parametric data, the χ^2 test for ordinal and nominal data, the Mann Whitney *U* Test for nonparametric ordinal data, Pearson or Spearman correlation for bivariate comparisons of ordinal and interval data. The Yates correction for continuity was used for those variables compared in a 2 × 2 table. Monthly delay frequencies before, during, and after implementation of MTT were plotted in a statistical control chart (Shewhart p-chart, SPC XL 2007). Statistical analysis was performed using the SPSS statistical program (SPSS version 12). The project evaluation was approved by our institutional review board; the MTT program itself was a quality improvement project and thus did not require research ethics review.

RESULTS

MTT briefings and debriefings were progressively implemented on all surgical sections over a 7-month period. The distribution of surgical specialties studied is shown in Figure 2. General Surgery had the most cases, partly because it started first. Compliance rates were 95% to 100% for all surgical sections. A recent audit of compliance rates for September 2009 to February 2010 showed an overall compliance rate of 95%, with 70% of individual surgeons achieving 100% compliance.

Attitudes and Perceptions

Scores on the SAQ improved in all domains, with a statistically significant improvement in perceptions of management (P = 0.003) and working conditions (P = 0.004) (Fig. 3). A majority (79%) of respondents thought that the program had led to improved patient safety and the sense of collegiality in the OR (75%); 58% felt that ad hoc issues were being better addressed (Fig. 4). Differences

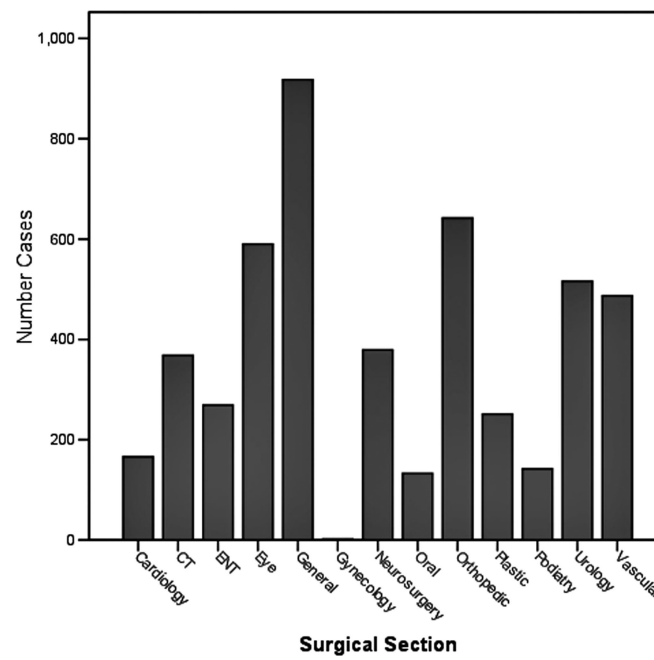

FIGURE 2. Distribution of surgical specialties among MTT cases analyzed.

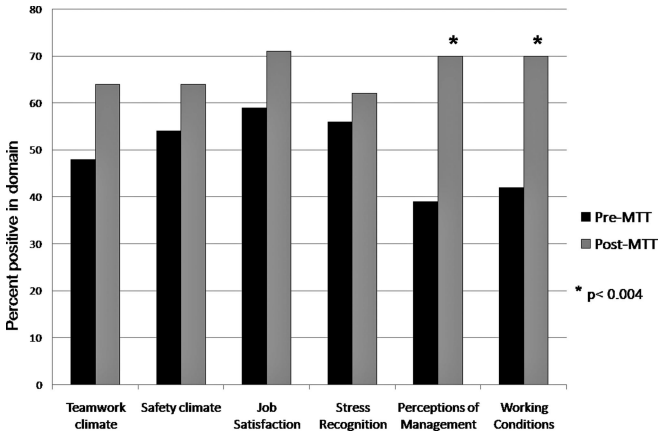

FIGURE 3. Safety Attitudes before and after MTT implementation: Safety attitudes of operating room staff before (n = 72) and after (n = 44) MTT implementation. Bars represent the percent of respondents scoring ≥75 in each of the 6 domains (positive for the domain). Each domain is made up of 8 related questions (not shown).

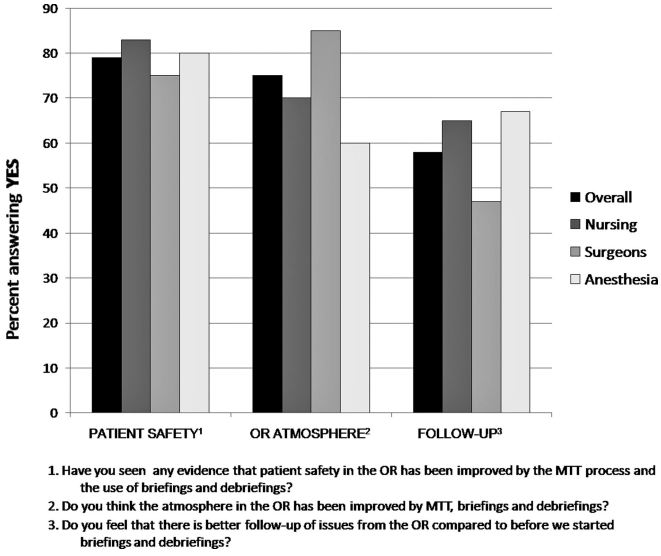

FIGURE 4. OR staff perceptions of effects of MTT: Operating room staff perceptions of effects of MTT (n = 49) 12 months after initiation. The graph shows positive responses to the 3 questions in the figure.

between surgeons, anesthesia and nursing providers were not statistically significant.

Case Delays (Data From VA Electronic Surgical Record)

Data from the VA electronic surgical record show the proportion of cases with any delay decreased from 32% (the year prior to MTT initiation) to 19% following full MTT initiation ($P < 0.001$; OR, 0.54; 95% CI, 0.47–0.61) (Fig. 5).

Case Delays, Case Scores, and Case Issues (Data From Briefing/Debriefing Forms)

Delays and issues requiring follow-up decreased sharply soon after the program started and remained low through month 24 (Fig. 6). Case scores rose soon after implementation and continued to increase throughout the follow-up period (Fig. 7). Improvement was also seen for cases with low scores, delay rates, equipment issues, and issues requiring follow-up. Comparisons showed (Table 1) that cases with any delay decreased from 23% to 10% ($P < 0.0001$) at 1 year and were sustained at 8.0% at 24 months ($P = 0.09$). Delay rates decreased from 23 to 11 per 100 cases ($P = 0.005$). Types of delays that declined included nursing delays (2.7%–0.2%, $P = 0.001$), preoperative delays (16%–7.7%, $P = 0.004$), and equipment delays (4.5%–0.9%, $P = 0.006$). The combined measure "equipment-related delay or issue" decreased (24%–6.8%, $P < 0.0001$), as

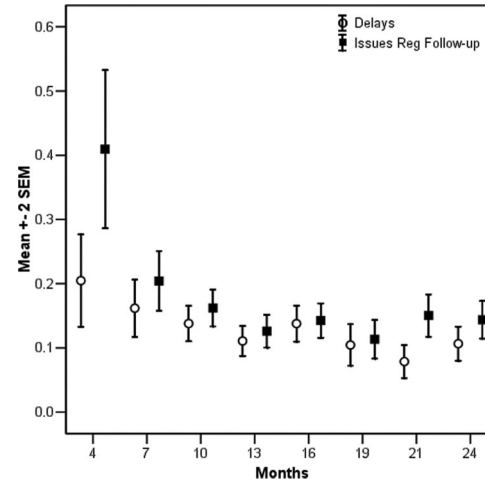

FIGURE 6. Impact of MTT on delays and issues requiring follow-up over time: Proportion of cases with delays (open circles) or issues requiring follow-up (closed squares). Data are proportions not percentages (eg, 0.4 would be 40%). Error bars are ±2 SEM.

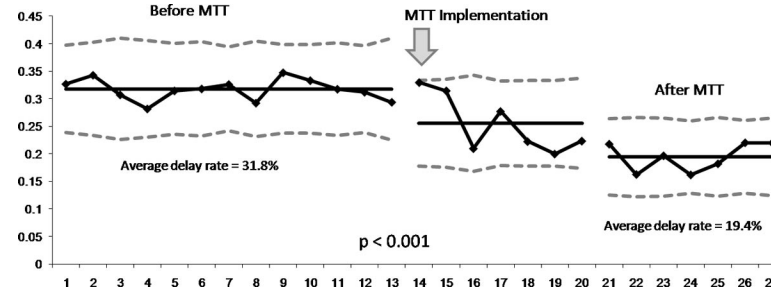

FIGURE 5. Monthly delay rates before, during and after MTT implementation (data from VA electronic surgical record): p Chart for monthly delay rates before, during and after MTT implementation. Data from VA electronic surgical record (n = 7573). Dashed lines represent upper and lower control limits (3 sigma). $P < 0.001$, average delay rate, before versus after MTT implementation.

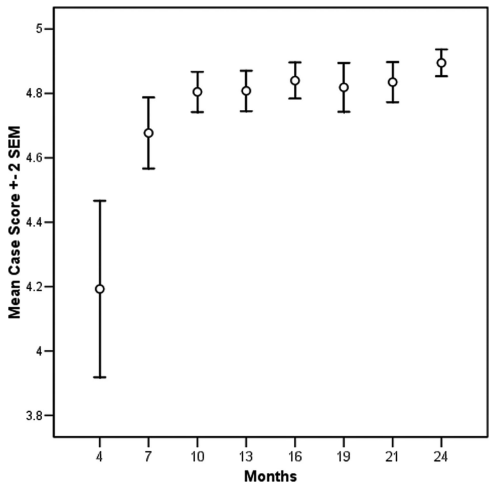

FIGURE 7. Impact of MTT on mean case score over time.

did equipment availability problems (14%–4%, $P < 0.0001$) and equipment malfunction problems (7%–2.7%, $P = 0.019$). The number of issues requiring follow-up decreased from 44 to 9 per 100 cases ($P < 0.001$) at 1 year, and then increased to 14 per 100 at 2 years; this was still lower than in Period 1 ($P < 0.001$). Reported handoff issues decreased from 5.4% to 0.3% ($P < 0.001$) (Table 1). When comparing Period 3 with Period 2, there were no changes in the rates of delays, equipment issues/delays, or handoff issues. In regression analysis controlling for differences in representation of surgical sections between the periods, improvements in delays, issues requiring follow-up, equipment related issues/delays, and cases with low scores were maintained.

Mean case score increased from 4.07 (±1.5 SD) in months 1 to 3, to 4.82 (±0.75 SD) at 1 year ($P < 0.0001$, Mann Whitney), and to 4.87 (±0.56 SD) at 2 years. Cases with scores <3 decreased from 23% during the first 3 months, to 4.6% at 1 year ($P < 0.0001$), and to 3% at 2 years. Appropriate and timely administration of prophylactic antibiotics improved (from 85%–97%, $P < 0.0001$).

Executive Review

The committee identified and addressed a number of systems problems, including equipment changes, need for additional equipment to avoid flash sterilization, surgeon parking shortage, changes in blood gas procedure for the OR, changes in protective lead for fluoroscopy cases, and medication ordering issues.

The most important system issue identified was an obstacle to obtaining medications for use in the preoperative area or the OR. The hospital had separate pharmacy formularies for inpatients and outpatients. Since most surgical patients entered the hospital (and hence the electronic system) as outpatients, the electronic medication ordering system did not allow ordering of inpatient medications for them in the preoperative areas or the OR. A cumbersome, unreliable, and potentially error-prone work-around using text orders had been developed.

To solve this problem, the committee brought together a multidisciplinary team composed of staff from IT, pharmacy, administration, and the ambulatory surgery unit nursing. Most of them were already aware of this long-standing problem and voiced pessimism that it could be solved. Through a series of meetings and pilot trials, a solution was enacted, which electronically assigned preoperative surgical patients to a specialty operative clinic with privileges to receive inpatient medications. This allowed clinicians to use the electronic medication ordering system and pharmacy to dispense OR medications without requiring inpatient status.

DISCUSSION

Evidence for the effectiveness of CRM-based programs in improving patient safety in the OR is limited, and their impact on overall OR function (delays, disruptions, equipment problems) has not been thoroughly studied. There have been reports of increased safety-related practices and improved communication after team training,[11] preoperative briefings,[12,21,22] and of improved performance metrics (prophylactic antibiotics, DVT prevention).[7,21,22] Most findings, however, relate to changes in perceptions of communication and safety culture.[5,7,11,16,19,23] Many studies contain few observations[13] or evaluate programs within subsystems of an institution, and follow-up is short.[20] Few studies have evaluated the

TABLE 1. Changes in Delays, Teamwork, and Issues Requiring Follow-Up Across 3 Time Periods Following MTT

	Months Following MTT Implementation				
	Period 1 1–3 mo N = 112	Period 2 11–14 mo N = 1166		Period 3 22–24 mo N = 1323	
	Number (%)	Number (%)	*P** vs. Period 1	Number (%)	*P** vs. Period 2
Any delay	26 (23.2%)	117 (10.0%)	<0.0001	106 (8.0%)	0.09
Preoperative delay	18 (16.1%)	90 (7.7%)	0.004	90 (6.8%)	0.42
Nursing delay	3 (2.7%)	2 (0.2%)	0.001	6 (0.5%)	0.38
Surgeon delay	3 (2.7%)	40 (3.4%)	0.88	26 (2.0%)	0.03
Anesthesia delay	4 (3.6%)	16 (1.4%)	0.16	12 (0.9%)	0.035
Patient delay	0 (0%)	6 (0.5%)	0.97	7 (1.3%)	0.82
Equipment issue or delay	27 (24.1%)	79 (6.8%)	<0.0001	93 (7.0%)	0.87
Equipment not available	16 (14.3%)	47 (4.0%)	<0.0001	39 (2.9%)	0.17
Equipment malfunction	8 (7.1%)	31 (2.7%)	0.019	51 (3.9%)	0.12
Hand-off issues	6 (5.4%)	4 (0.3%)	<0.0001	1 (0.1%)	0.193
Mean no. issues/case requiring follow-up	0.44 (SEM 0.066)	0.09 (SEM 0.009)	<0.001†	0.14 (SEM 0.010)	<0.001†

*P are Yates χ^2 (continuity correction) unless otherwise indicated.
†t test.
MTT indicates medical team training; SEM, standard error of the mean.

effect on OR functioning (delays, problems) of a team training program implemented across an entire medical center (all services, all ORs), and the sustainability of improvements is unconfirmed. Finally, none have described the pattern of changes over time for OR functioning following team training.

One exception to the above remarks are the beneficial effects of the WHO surgical safety checklist.[21,22] Studies using the WHO surgical safety checklist report decreased morbidity and mortality with adherence to 6 safety measures including the use of: preoperative evaluation of airway status; pulse oximetry; 2 IVs; prophylactic antibiotics within 60 minutes; identification of the patient, operative site, and procedure; and completion of a sponge count.[21,22] These 6 safety measures were standard of care at our hospital prior to the start of the MTT process (most are standard of care at modern medical centers). The WHO surgical safety checklist, however, is an important global safety initiative. All of the items on the WHO surgical safety checklist are present on our MTT briefing/debriefing form, but there are additional items on our form.

Medical team training experts, across all domains, recommend the use of Kirkpatrick's topology to gauge a program's effectiveness.[5,26,27] The lowest Kirkpatrick level consists of trainees' subjective perceptions of the program. The second level relates to the knowledge (principles, facts, skills) acquired by trainees and the extent to which training leads to desired attitude changes. The third level relates to behaviors: does the intervention change behavior on the job? The fourth level concerns the effect of training on improved safety, error reduction, or increased productivity.[5,26] The majority of previous team training studies in healthcare have examined the lowest level of Kirkpatrick's topology: perceptions of healthcare workers.[5,7,11,16,19,23] And even when higher levels were examined, evidence of objective improvement has been sparse.

It has been difficult to measure effects of team training on outcomes because of the low frequency of adverse events and limitations in study design. In high-risk settings other than the OR, such as emergency departments,[8] labor and delivery units,[9] neonatal suites,[10] and global medical centers,[21,22] there is evidence that clinical errors[8] and adverse outcomes have decreased.[9,21,22] In the OR, direct observation has shown increases in safety-related practices and improved communication after team training[11] and preoperative briefings,[12] perceptions of improved safety including decreased risk of wrong-site surgery,[28] and improvement in performance metrics (prophylactic antibiotics, DVT prevention).[7] The current study documented improvements in prophylactic antibiotic administration.

Our MTT process demonstrated benefits across all levels of Kirkpatrick's topology: positive perceptions of safety and perceived collegiality; knowledge and attitude changes in the SAQ; perception among staff that patient safety had improved; durable behavior changes in the performance of briefings and debriefings; sustained improvements in delays, case scores, equipment problems, and fewer issues requiring follow-up; appropriate antibiotic administration; and major systems changes across the institution.

Delays decreased by 50%, and the number of issues requiring follow-up by 65%. There were improvements in the frequency of hand-off issues and equipment-related problems; and case score increased. These changes occurred early and continued for the subsequent 2 years, so it seems likely that they are direct results of the intervention.

A key feature was high-level participation by the multidisciplinary executive committee. Regular meetings with representatives of all stakeholders allowed quick responses to issues identified on the debriefing form. In an analysis of CRM programs in healthcare, Salas et al enumerated some of the principles of success: organizational support, backing of key leaders, team training, acquiring required resources, facilitating application of teamwork skills on the job, and measuring the effectiveness of team training.[5,29,30] Most of these were present in this effort.

Another key element in the success of our program, and in its adoption by members of the OR staff, was the fact that we did not create additional complex steps in the MTT process. One of our implementation goals was that MTT would not cause a reduction in OR efficiency. To achieve this, we incorporated the MTT process into our "time-out" process that was already in place. The "time-out" became part of the preoperative briefing, along with the other preoperative briefing elements. With this, the preoperative briefing occurred prior to the start of the procedure (surgical incision), but we did not mandate a separate step (in the preoperative area or preinduction) prior to the usual "time-out" event.

The principal limitation of this study was lack of a contemporary control group, but the historical controls are sufficient to make the conclusions reasonable.

Although this and similar programs have been promoted as "team training," it is clear in retrospect that teamwork per se, as generally conceived, has only been responsible for a portion of the desirable effects. Sociologists identify 2 types of teams: (1) intact (permanent) teams: teams with a relatively stable membership, whose members have a shared history of working together; and (2) ad hoc teams: teams made up of members purposively assembled for the task on hand, whose members do not have a shared history of working together.[27] OR teams are predominantly ad hoc teams, although, depending on the time of day and surgical section, they can have aspects of intact teams. Teams are described by Salas et al[29–31] as groups that share a (cognitive) common ground and can solve unique problems by coordinated action in a dynamic setting, where protocols and checklists are inapplicable. Teamwork in this sense may in some cases be a critical aspect of patient care in the operating room. A good example was the arterial switch operation for transposition of the great vessels, which was analyzed by Reason and his colleagues[32] in Great Britain more than a decade ago. Permanent trained OR teams were associated with the best results. Teams of this caliber would undoubtedly improve outcomes for most complex operations, a concept that has not yet been fully embraced. Clearly, however, teams like this cannot be produced by the kind of program being reported here. Nevertheless, much of substantial value has resulted.

One explanation is that the process of engaging so many people in data gathering and interpretation created a huge new feedback loop for the OR systems, which in turn led to a multitude of revisions in the standard procedures. In particular, it provided the all-important negative feedback critical to self-correcting performance in systems. Beneficial changes occurred in the following areas that do not depend on coordinated team action: accuracy of preference cards, appropriate scheduling of breaks during an operation, decrease in hand-off issues, reduction of unnecessary delays, resolution of previously intractable administrative issues (eg, the pharmacy system previously described), use of checklists (eg, the feedback form), and an optimism that everyone, not just the few who are nominally in charge, can influence the system. A close validated analogy is the use of After Action Reviews in the military, which have been credited as contributing greatly to the development of high levels of group proficiency in training for combat.[33]

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Discussions

DR. JOHN R. CLARKE (PHILADELPHIA, PA): Teamwork involves shared goals, shared responsibilities, shared mental models, and sharing changes through situational awareness. It involves watching out for each other, mutual respect, and empowerment of all team members. Four parts of this study warrant emphasis.

One is the importance of the leadership. You can see that the leaders were involved in the education and the solution. The Second, paradoxically, I think, is that the use of a bottom-up approach to develop the checklist rather than a top-down approach probably contributed to the reported compliance with the checklist. The Third is that debriefing before departing the OR focused the debriefing on the conduct of the procedure rather than on the condition of the patient, a usual focus and a typical handoff, which I am sure occurred after that. The fourth—and I think perhaps the most important—is that the implementation team made system improvements that permanently corrected the problem, so you did not have to deal with the same work-around every time.

How would you compare your checklist to the WHO's checklist? Your checklist appeared quite comprehensive, yet did not include some important elements, such as fire risk, for instance. What determined your limit and how long a briefing and debriefing should take?

Was the compliance based on self-reporting or was it based on independent observation? Self-reporting would predictably give you a higher compliance rate.

Finally, the training began in 2006; it lasted for 7 months, and the study ended in 2008. Undoubtedly, there was turnover. How many members of the OR team at the end of the study received training, and how many of them began their employment after the training ended?

DR. JOSEPH COFER (CHATTANOOGA, TN): It looked like you achieved excellent compliance among the general surgery service, but variable compliance among the other services. If so, what do you intend to do about that? We are experiencing that same problem. Our

general surgeons will cooperate, but the neurosurgeons and orthopedic surgeons will not.

Second, we cannot get an anesthesia attending to show up for the preoperative checklist briefing. Did you ask the attending anesthesiologists and attending surgeons to speak or were these the chief residents or midlevel residents?

For general surgeons, this works well, and really has made a difference, but if you cannot get the anesthesia service involved, I think it becomes a real problem.

Dr. Richard Shemin (Los Angeles, CA): At UCLA, we instituted a similar process, and there was no doubt that a briefing totally changed the culture and improved the process. We would agree with all the data you presented. However, the debriefing continues to remain a challenge. Often, the attending surgeon has already left the room. In addition, to refocus the team at the end of the operation is often difficult, but it is very important to identify the missteps and plan improvements.

Is a formal tool that must be filled out and reviewed by a high level executive committee what leads to the high level of compliance in the debriefing component of your process?

Dr. Carlos A. Pellegrini (Seattle, WA): Previous team performance studies have clearly shown the advantages of team training and preparation for the members of the team. This study shows that there is an advantage to the hospital as well and to the patients in addition to that that accrues to the team.

In your manuscript, it says that this was an initiative of the entire VA system. Are these results the same as seen in all the other VAs? Is that a phenomenon that can, in other words, be exported to all hospitals?

Second, I could not understand who assigns the score at the end of the procedure. Is this done by 1 person or does the team review and vote?

Third, did you encounter resistance on the part of surgeons, nurses, administration, etc, in the implementation of this new feature? None was listed in the manuscript. When we began implementing the WHO checklist, which, as you know, started at Brigham and Women's and at the University of Washington, we saw significant resistance on the part of some surgeons to following the checklist. Have you observed this, and what happens if someone simply wants to "opt out" of following this system?

Dr. Merril T. Dayton (Buffalo, NY): I applaud Dr. Wolf and his coauthors on a "systems" study, which we conduct far too infrequently in surgery.

How do you "incentivize" surgeons to participant in this exercise? Is it money? Is it recognition? Are you relying on altruism? I think studies like this are always very difficult to conduct if you cannot obtain volume.

A second question relates to whether or not the San Francisco VA has a highly unionized nursing staff. What happens if the period of analysis occurs during a break for one of the unionized nurses? Similarly, what happens if 1 nurse starts the case, but it lasts so long that a totally different set of nurses finish the case? How do you deal with these kinds of issues?

Dr. Phil Glick (Buffalo, NY): How scalable is this system? I was not aware that other VAs were using it, so how does it work from system to system? More importantly, it looked like this system only had about 10 cases a week. How does it scale up to an operating room that handles 5, 10, or 20, and are they planning to open this up at the other UCSF hospitals?

Dr. Kirby I. Bland (Birmingham, AL): Drs. Wolf, Way, and Stewart, your presentation briefly looked at your process improvement and the sustainability of that measure, but what is your experience with this process in time; what is its durability and response over months or years? Do you have any data yet in that process?

Dr. Lygia Stewart (San Francisco, CA): I want to thank everyone for their questions, and thank Dr. Clarke for discussing our paper. Dr. Clarke asked about the WHO checklist. I want to begin by saying that I think the World Health Organization's safety checklist is a very important contribution, particularly in the area of global health. You can see that it has made a major impact. We looked at all the different checklists available when we devised our checklist. The World Health Organization's checklist is very important for global health, but for surgery, as practiced in America, I felt it did not contain all of the elements that we needed. There are some areas on the checklist that represent standard practice in the United States, like making sure a pulse oximeter is placed, making sure you list the procedure performed, and labeling specimens correctly. Those kinds of things were already well in place before we started our process. Our checklist contains pretty much what is present in the World Health list and more. It includes a very robust debriefing process. We really wanted to see whether the medical team training made a difference, so we included the debriefing process, hoping that we might find some issues that we could fix. We also created an opportunity to close the loop by including a place on the form where you could say whether an issue had been sent to nursing, or anesthesia, or SBD, etc, so when the executive committee met, we could see where the process of fixing the issue began.

You asked specifically about fire rescue. Interestingly, this document has become a living, breathing document. We now use the back page for the fire risk assessment. So you are right; that is an important element, which we just recently added to our form.

The briefing and the debriefing does not take very long, and it really is just an extension of the time out, the whole team engages, and it has become part of the culture. It is led by the surgeons.

Many people asked how we managed to involve the surgeons. First, we rolled the system out sequentially. When we started a service, we would bring in some of the surgeons, and some of the nurses. We would say, "We are going to start the medical team training on your service next. Here's what we are going to do." We monitored how they were doing and gathered their feedback. Second, the briefing process was incorporated into the time-out process. We made it easy for the teams to come together by setting the preoperative briefing during the "time out" when the team was already together.

With regards to compliance monitoring, someone collects these forms, looks at the OR cases and determines whether we have a form for every case. It is interesting that this has become part of the culture at our medical center.

With regards to Dr. Cofer's question about compliance among the various surgery sections, actually, we did not find that general surgery was more compliant than the other sections. General surgery handles more cases but the involvement percentage for many of our surgical specialties is 100%.

Also, the anesthesia service gets involved, generally, when we do the debriefing, which is again led by the surgeons, and there is an opportunity for everyone to make a comment. This really has become a full team effort.

Dr. Pellegrini asked about the other VA hospitals. The VA rolled this system out, and gave us a great deal of freedom in how we designed the process. They asked us to perform a preoperative briefing, and they did not mandate a postoperative briefing. We

could design our own form and apply it how we chose to; setting up our committees was largely left to us.

We did hold meetings with the National Center for Patient Safety group on a regular basis to see how we were doing, but my impression was that they were not directing the processes. They are currently looking at the overall VA experience.

The score is assigned mostly by the surgeons, but the nurses can also assign the score. The anesthesiologists can assign a score. Anybody can participate in assignment of the score and most often, it is discussed.

Finally, Dr. Dayton asked about the union nurses and the change of shift. One of the most interesting elements of this study was that the handoff issues almost evaporated immediately. I was unsure whether it was because we included a line item on the form that required people to indicate, "yes" or "no," there was or was not a hand-off issue, or whether the medical team training just brought everybody together. It is very common to start with 1 nurse and finish with another, especially if you start your case in the middle of the morning. Whenever this occurs, the current team at the time carries out the debriefing and it has not been a problem at all.