Simulation-Based Communication Training for General Surgery and Obstetrics and Gynecology Residents

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BACKGROUND: There is a critical relationship between team communication and patient safety in the operating room (OR), but limited opportunities are available to help OR trainees develop the communication skills needed to be good team players. The purpose of this study was to evaluate the effectiveness of a simulation-based communication-training program developed for general surgery and obstetrics and gynecology residents.

METHODS: Following a group lecture on diagnostic laparoscopy, 34 residents independently completed a laparoscopy case on a patient simulator followed by a structured debrief that targeted team-based communication skills. Integrated into the case were 2 events (bradycardia and OR fire) that provided additional opportunities for the resident to communicate with his/her team. The mean Likert scale score for 11 post-training survey questions were calculated to determine residents' reaction to the training. Additionally, mean scores of observer ratings of communication performance after the simulation were calculated and analyzed using separate Wilcoxon Sign-Rank tests and kappa statistics.

RESULTS: Of the 41 GS and ObGyn residents, 34 (83%) participated in the training. 18 (53%) residents completed the simulation once and 16 (47%) completed it twice. Overall, residents had a positive reaction to the training program (average survey score = 4.56 of 5) and participation in the program improved their ability to use effective communication techniques during the bradycardia and OR fire events ($p < 0.05$, $\kappa = 0.61$).

CONCLUSIONS: Residents had a positive reaction to the training program and participation in the program improved their ability to use effective communication techniques throughout the procedure. (J Surg Ed 76:856–863. © 2018 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

ABBREVIATIONS: OR = operating room, EBAT = event-based approach to training, DL = diagnostic laparoscopy, RMH = Riverside Methodist Hospital, GS = general surgery, OBGYN = obstetrics and gynecology, KSAs = knowledge, skills, and attitudes, PGY = post-graduate year

KEY WORDS: Simulation, surgery, obstetrics and gynecology, residency training, teamwork, communication

COMPETENCIES: Medical Knowledge, Professionalism, Interpersonal and Communication Skills

INTRODUCTION

Surgery, like other high stress and high risk fields, is an interdependent process carried out by teams of individuals from highly diverse backgrounds in terms of expertise, training, and experience.[1] A surgical team, for example, has staff and trainees from at least 3 health care professions—surgery, anesthesiology, and nursing. All these individuals have received advanced training in their respective disciplines, but have generally not received formalized training on how to interact and communicate with one another. There is growing evidence of a critical relationship between communication and patient safety in surgery. In fact, ineffective communication was found to contribute to more than 40% of errors made in surgery,[2] and attending surgeons were identified as the most common team member involved in the miscommunication.[3] From this data, it can be postulated that improved team communication would result in improved outcomes in surgery.

Simulation has been recommended by the medical community to train and assess communication skills,[4,5] but compared to other medical specialties[6-13] surgery has been slow

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in adopting simulation for training communication. The purpose of this study was to evaluate the effectiveness of a simulation-based communication training program developed for general surgery (GS) and obstetrics and gynecology (ObGyn) residents. The program was developed using an event-based approach to training (EBAT) methodology and validated *Team Strategies and Tools for Enhancing Performance and Patient Safety* (TeamSTEPPS) techniques.[14] It was hypothesized that residents will have a positive reaction to the training program, and that participation in the program will improve residents' ability to use effective communication techniques.

For this study, 5 learning objectives were developed based on 5 teamwork and communication techniques endorsed by the Agency for Healthcare Research and Quality and Department of Defense through their (TeamSTEPPS) program.[15-18] These techniques are briefs/time out, debriefs, call-out, check-back/closed-loop, and empowerment/engagement. *Briefs* are short (3 - 5 minutes) team meeting held during the perioperative phase of care to discuss essential team information such as team membership and roles, clinical status of the patient, team goals, pitfalls and barriers as well as issues affecting team operation. *Debriefs* are short (3 minutes or less) team meetings held at the end of the procedure to review key events and discuss what worked well and what did not work well.[18] This information exchange session is designed to improve team performance and effectiveness through lessons learned and reinforcement of positive behaviors. *Call-out* is a method used to communicate critical information to all team members simultaneously during an emergent event.[18] Critical information called out in these situations help team members anticipate and prepare for vital next steps in patient care. *Check-back or closed-loop communication* is a strategy used to verify and validate information exchange. It involves 3 steps: (1) the sender initiates a message, (2) the receiver accepts the message and confirms what was communicated, and (3) the sender verifies that the message conveyed was understood by the receiver as intended.[18] Finally, *engagement or empowerment* is a strategy that is used to encourage team members to speak up when they recognize insufficient communication or miscommunication that could potentially lead to a patient adverse event.[18]

METHODS

Participants

Between February and May 2015, communication training was offered to GS and ObGyn residents at Riverside Methodist Hospital (RMH). Residents were enrolled in a prospective, institutional review board approved study. Participation in the training program was completely voluntary and each resident provided informed consent to participate.

Training

Prior to participating in the study, all residents completed a group lecture on diagnostic laparoscopy (DL). Approximately 2 to 3 weeks after the lecture, each resident independently completed a simulated DL in a simulated operating room (OR). The OR was arranged with standard set-up for DL, including a high-fidelity patient simulator, real OR equipment and a confederate OR team comprising of an anesthesiologist, scrub nurse, and circulating nurse (Fig. 1). While the same anesthesiologist and scrub nurse participated in each case, scheduling conflicts resulted in the use of 2 different confederates for the circulating nurse role.

FIGURE 1. Simulated operating room at the Center of Medical Education + Innovation at Riverside Methodist Hospital.

Training of the confederates involved reviewing the previously published DL case scenario, learning objectives, and assessment tool,[14] as well as reviewing a scenario flowchart that included a detailed script for each confederate. Additionally, confederates had the opportunity to practice their roles via 2 mock simulations. When the simulation commenced, the scrub nurse was expected to gown and glove the resident, who was acting as the attending surgeon. During the time-out, all the confederates were expected to stop all activities and participate in the time-out by stating their names and roles and reviewing the clinical status of the patient and plan of care. If the resident failed to use call-out to alert the team that the patient was bradycardic, and/or that the patient was on fire, then the anesthesiologist was expected to do so. During the entire simulation scenario, the confederates were expected to use close-loop communication to verify and validate the information exchanged with the resident. During debrief, all confederates were expected to stop all activities and participate in the discussion around what worked well and where improvements could be made.

For each simulated DL scenario, the resident was briefed on the simulated DL case, worked with a confederate OR team to complete the case and debriefed his/her performance with 2 content experts. *Brief.* Prior to entering the simulated OR, information regarding the simulated patient, simulated environment and the resident's role and responsibilities were discussed with the resident. *Simulated DL case.* The resident entered the simulated OR as the attending surgeon and was expected to complete the simulated DL per RMH protocol. Specifically, the resident was expected to initiate and complete a time-out prior to skin incision, sign-out prior to closing and debrief prior to exiting the OR. During the procedure, the resident was expected to work with his/her confederate OR team to carry out the DL in a safe and timely manner. Integrated in the simulated DL scenario were 2 clinical events (i.e., bradycardia and OR fire) that provided additional opportunities for the resident to exchange verbal information with his/her team. The resident's completion of the simulated DL case (from time-out to debrief) was videotaped and the video recording was later used to assist evaluation of the resident's communication performance. *Debrief.* After the completion of the simulated case, the resident debriefed his/her performance with a pair of content experts—a TeamSTEPPS educator and a retired surgeon. The 3D model of debriefing was used to guide the debriefing process.[19] The debriefing process involved 3 steps: defusing, discovering, and deepening. During defusing, the resident had an opportunity to vent his/her immediate reactions (e.g., frustration, anger, disappointment, surprise, etc.) around the simulation he/she just experienced. This helped clear the slate for learning by ensuring that unsolved feelings such as anger and frustration were acknowledged and addressed. During discovering, the resident was prompted to identify, explore and analyze the mental models guiding his/her communication behaviors and then compare them with the new information introduced by the debriefers. New information included an introduction to TeamSTEPPS, and a discussion around effective communication techniques (brief, debrief, call-out, check-back/close loop communication and empowerment). Finally, during deepening, the resident was asked to cognitively apply the new information he/she learned to their clinical practice.

Immediately following the debrief, the resident was invited to complete an 11-item survey to gain insight into how the resident felt about his/her simulation experience. Approximately 2 weeks after the completion of the simulation, all residents were invited to return and complete the same simulated DL procedure.

Performance Evaluation

The effectiveness of the training program was evaluated using the first 2 levels of Kirkpatrick's model of training effectiveness—reaction and learning.[20] *Reaction* measured how the residents reacted to the training program, and it was addressed via 11-item post-training survey focused on the appearance of the simulated OR, difficulty of the simulated scenario and usefulness of the training program. The mean Likert item score as well as Likert scale score for all the items were calculated.

To facilitate with interpretation of results, a target score of 4.0 out of 5.0 was chosen to indicate that residents had a positive reaction to the simulation training.

Learning measured how residents' knowledge, skills, and attitudes changed as a result of the training, and it was addressed by comparing the communication performance of residents who completed the simulated DL twice. Two TeamSTEPPS master trainers, who were blinded to the residents PGY level, program and order of the videotaped simulation, scored each resident's videotaped performance using a previously developed communication checklist.[14]

Separate independent samples t tests were used to compare baseline characteristics of participants, including simulation training exposure, residency program, sex, PGY level, and age.

Separate Wilcoxon Sign-Rank tests were used to determine if residents use of effective communication techniques increased between the first and second simulation. Specifically, during the time-out and debriefing phases of the simulated procedure, as well as during the bradycardia and OR fire events. Kappa statistics was used to assess

interobserver agreement. The interpretation of the Kappa value was based on the commonly cited scale, with Kappa < 0 = less than chance agreement; 0.01 to 0.20 = slight agreement; 0.21 to 0.40 = fair agreement; 0.41 to 0.60 = moderate agreement; 0.61 to 0.80 = substantial agreement; 0.81 to 1.00 = almost perfect agreement.[21]

In addition to the checklist, the total number of times the residents utilized *call out* and *check back* during the completion of each simulated DL were computed. Two additional Wilcoxon Sign tests were conducted to determine if there was a significant increase in the overall use of these communication techniques. All data were analyzed using IBM SPSS Statistics 23 software (IBM SPSS Software, Armonk, NY). Results were said to be significant if $p < 0.05$.

RESULTS

Descriptive

Of the 41 residents enrolled in the GS and ObGyn residency programs at RMH, 34 (83%) participated in the training. Eighteen (53%) residents completed the training once and 16 (47%) completed it twice. Descriptive information for residents who completed the training once, twice, and the cumulative total is presented in Table 1.

Table 2 shows the EBAT checklist scores of participants by the number of simulation training exposure (1 versus 2), PGY level (upper versus lower), sex (males versus females), residency program (surgery versus obstetrics and gynecology), and age (above 29 years versus below 29 years). There were no significant differences in EBAT checklist scores on any baseline characteristics, $p > 0.05$.

Reaction

Residents' (n = 34) responses to the different aspects of the training program after the first simulated DL scenario are presented in Table 3. Overall, residents had a positive reaction to the training program (mean score = 4.56 $\pm$ 0.57).

Learning

Mean communication scores for residents (n = 16) during the first and second simulated DL are presented in Table 4. Residents' use of effective communication techniques increased significantly during the bradycardia event ($Z = -1.95$, $p = 0.05$), but not during the time-out ($Z = -1.36$, $p = 0.17$) or debriefing phases of the DL ($Z = -0.60$, $p = 0.55$). The mean communication score for the second OR fire event was not computed because 11 (69%) residents used *check back* to prevent the fire from taking place during the second simulation. Mean Kappa value was 0.61 (range = 0.175 - 1), $p = 0.02$, indicating that there was substantial agreement between the 2 observers.

The mean number of times residents (n = 16) utilized *call out* and *check back* during the completion of the first and second simulated DL procedure are presented in Table 5. Residents' use of call out ($Z = -3.44$, $p < 0.01$) and check back ($Z = -2.72$, $p < 0.01$) increased significantly from the first to the second simulated DL.

DISCUSSION

As hypothesized, residents had a positive reaction to the training program. Specifically, they reported that the simulation closely resembled that of a typical OR in

TABLE 1. Descriptive Information for Residents Who Completed the DL Simulation Once (n = 18), Twice (n = 16), and the Cumulative Total (n = 34)

	Residency Program	PGY Level	Mean Age	Sex
Residents who completed DL simulation once (n = 18)	General surgery = 12 ObGyn = 6	PGY 1 = 7 PGY 2 = 3 PGY 3 = 1 PGY 4 = 5 PGY 5 = 2	28.89 $\pm$ 3.14	Males = 8 Females = 10
Residents who completed DL simulation twice (n = 16)	General surgery = 10 ObGyn = 6	PGY 1= 4 PGY 2 = 4 PGY 3 = 4 PGY 4 = 2 PGY 5 = 2	28.43 $\pm$ 1.55	Males = 9 Females = 7
All resident participants (n = 34)	General surgery =22 ObGyn = 12	PGY 1= 11 PGY 2 = 7 PGY 3 = 5 PGY 4 = 7 PGY 5 = 4	28.68 $\pm$ 2.50	Males = 17 Females = 17

TABLE 2. EBAT Checklist Scores of Residents by Number of Simulation Training Exposure, Residency Program, Sex, PGY Level and Age

Baseline Characteristics		Mean ± SD	t (df)	p Value
Simulation training exposure	One (n = 18)	20.14 ± 2.90	−0.05 (32)	0.96
	Two (n = 16)	20.19 ± 3.37		
Residency program	General surgery (n = 22)	20.27 ± 3.49	0.28 (32)	0.78
	OBGYN (n = 12)	19.96 ± 2.81		
Sex	Females (n = 17)	19.76 ± 3.6	−0.75 (32)	0.46
	Males (n = 17)	20.56 ± 2.49		
PGY level	Upper: PGY 3-5 (n = 16)	19.39 ± 3.12	−1.58 (32)	0.12
	Lower: PGY 1-2 (n = 18)	21.03 ± 2.84		
Age	29 years and above (n = 16)	19.78 ± 2.62	−0.77 (32)	0.45
	Below 29 years of age (n = 18)	20.59 ± 3.57		

TABLE 3. Residents' Response to the Post-training Survey (n = 34) After the First Simulated DL

Survey Question	Mean ± SD
Physical appearance of the simulated operating room (/5)	4.75 ± 0.44
Physical appearance of the surgical team (/5)	4.82 ± 0.39
Physical appearance of the surgical equipment (/5)	4.71 ± 0.46
Total appearance score (/5)	4.76 ± 0.37
I feel the simulation was effective in improving my communication skills (/5)	4.50 ± 0.64
I feel the simulation was effective in improving my leadership skills (/5)	4.39 ± 0.69
I am more comfortable addressing bradycardia after this simulation (/5)	4.61 ± 0.50
I am more comfortable addressing OR fire after this simulation (/5)	4.39 ± 0.69
Total instructional score (5)	4.47 ± 0.50
I feel engaged in the simulation experience (/5)	4.71 ± 0.46
I feel the simulation was challenging (/5)	4.07 ± 0.86
I feel that participation in this simulation was a valuable use of my time (/5)	4.64 ± 0.56
Total engagement score (/5)	4.47 ± 0.46
I would like more simulation similar to this setup be incorporated in my training (/5)	4.50 ± 0.64
Mean survey score	4.56 ± 0.57

terms of physical appearance, surgical equipment and team membership. Residents indicated that the training program was useful in improving their communication and leadership skills, and comfort addressing bradycardia and OR fires. Although the simulation was challenging, residents stated that they felt engaged in the training experience. They reported that the training was a valuable use of their time and recommended that more simulations similar to this setup be incorporated into their residency training.

As hypothesized, participation in the training program improved residents' ability to use effective communication techniques. Improvements consisted of increased use of *call out, check back*, and *engagement* strategies during the bradycardia event. There was also an increased in the use of *check back* at the end of the DL procedure to ensure proper handling and placement of the laparoscope, which prevented the OR fire from taking place during the second simulation. Although improvements were observed during the bradycardia

TABLE 4. Residents' Communication Scores on the First and Second Simulated DL Procedure (n = 16)

Events	EBAT Checklist Score During the First Simulated DL Mean ± SD	EBAT Checklist Score During the Second Simulated DL Mean ± SD	p Value
Time-out phase (/16)	14.03 ± 2.27	13.40 ± 1.98	p = 0.17
Bradycardia event (/5)	2.28 ± 1.18	2.97 ± 0.74	*p = 0.05
OR fire event (/4)	0.81 ± 1.00	n/a	n/a
Debriefing phase (/4)	2.44 ± 1.44	2.81 ± 1.26	p = 0.55

* Significant at $p \leq 0.05$.

TABLE 5. Number of Times Residents Use Call Outs and Check Backs During the First and Second Simulated DL (n = 16)

Communication Technique	First Simulated DL Mean ± SD	Second Simulated DL Mean ± SD	p Value
Call outs	2.94 ± 1.95	5.25 ± 2.05	*p < 0.01
Check backs	3.31 ± 1.44	5.06 ± 2.29	*p < 0.01

*Significant at p < 0.05.

and OR fire events, communication score did not change during the time out and debriefing phases of the procedure. One possible explanation for this result is that 3 months prior to the implementation of our training program, RMH implemented a new Surgical Safety Checklist and all residents at RMH received formal training on how to carry out a safe and effective time out and debrief. As a result, the residents that participated in our training program were already effective at communicating standard safety checks.

It is recognized that for training programs to be effective, it must incorporate the following 4 elements: (1) be built upon a theoretical framework, (2) incorporate structured events that allow learners the opportunity to exhibit the targeted behaviors, (3) assess performance, and (4) provide feedback.[8,9] The simulation program presented in this article incorporated all 4 of the above elements.

Theoretical Framework

The training program was designed using an EBAT methodology that draws on the science of training by systematically introducing training exercise events that are linked to training requirements and performance assessment.[22,23] Furthermore, it incorporated validated teamSTEPPS techniques that are scientifically rooted in previous team performance research that originated in other high-risk organizations including the military, aviation, and nuclear power.[16]

Events

The training scenario was carefully crafted to ensure that learning does not depend on chance interaction alone; rather, appropriate opportunities to elicit and observe the targeted behaviors were controlled through the incorporation of events. Events are defined as cues for team members to exhibit team behaviors identified as being important in the particular application.[23] In aviation training, events often correspond to routine operational or mission phases of the flight, where each phase is associated with certain responsibilities on the part of the pilot and copilot.[23] In our training program, events corresponded to specific phases of a surgical procedure (time out, debrief, and the time between time out and debrief), where each phase is associated with certain responsibilities on the part of the surgeon, anesthesiologist, scrub nurse, and circulating nurse.[14] In addition to the 3 surgical phases, we also embedded 2 clinical events (bradycardia and OR fire) to ensure that each resident had multiple opportunities to communicate with his/her team.[14]

Assessment

The effectiveness of the training program was evaluated using the first 2 levels of Kirkpatrick's training evaluation model.[20] The first level, *reaction*, is important because it helps educators understand how well the training was received by the learners and identify where improvements can be made. Residents identified one area for improvement—providing additional information during the simulation prebrief to discuss what they can and cannot do to the simulated patient. Hence, the authors plan to modify the prebrief to include this information.

The second level, *learning*, measured whether residents' knowledge, skills, and attitudes changed as a result of the training. Two teamSTEPPS master trainers observed the videotapes and scored each resident's performance using the communication checklist.[14] There are 2 advantages to the checklist. First, because targeted responses to each event were identified prior to the training, the observers knew ahead of time when the events will occur. The authors predict that this helped reduce observers' workload and allowed them to focus their attention on critical moments during the scenario. Second, the checklist was based a dichotomous "hit or miss" scoring system. Since observers were asked to rate the presence or absence of targeted behaviors, the authors predict that this helped minimize judgment required by the observers and contributed to the high inter-rater reliability score.

Feedback

The 3D Model of Debriefing was used to guide the debriefing process.[19] The model involves 3 steps: defusing, discovering, and deepening. Defusing provided an opportunity for the residents to release their emotions, which helped clear the slate for learning by ensuring that unsolved feelings such as anger and frustration were acknowledged and addressed. During discovering, the residents were prompted to identify, explore, and analyze the mental models guiding their behaviors and then compare them with the new information

introduced by the debriefers. Finally, during deepening, the residents were asked to cognitively apply the new information to their clinical practice.

Although the authors did not gather data on the transfer of knowledge from the simulated OR to the real clinical setting (level 3 of Kirkpatrick's model), informal verbal feedback at the end of the second simulation session from the residents (n = 16) suggested that they were more aware of their own communication behaviors as well as the behaviors of the members of the OR teams, and were utilizing more effective communication techniques on the job. Further studies examining the effectiveness of simulation programs should consider formally evaluating the degree to which learners' behaviors change as result of the training.

Limitations

The authors recognize that this study has several limitations. First, of the 41 residents invited to participate in the study, only 34 (83%) participated. Furthermore, of the 34 who participated, only 16 (47%) completed the second simulation. The number one factor preventing residents from participating in the study as well as returning to complete the second simulation was scheduling conflicts between training time and residents' clinical duty hours. The small sample size reduces the ability to generalize the results of this study. Therefore, additional studies of this type are warranted to increase the sample size to enhance the ability to detect the effects of simulation-based training on communication performance. A second limitation was the use of the same simulation scenario during the first and second training events. As a result, there is a possibility that the observed change in communication performance may be due to familiarity with the simulation scenario, rather than learning. It is recommended that future studies utilize different simulation scenarios to isolate the effects of learning. A third limitation was the inability of the research team to capture any additional learning that occurred between the first and second simulation. Hence, there is a possibility that other educational activities outside of the simulation-based training contributed to the observed improvement in residents' communication performance. It is recommended that future studies incorporate additional measures to isolate the effects of learning from simulation-based training.

CONCLUSIONS

As hypothesized, residents had a positive reaction to the training program and participation in the program improved their ability to use effective communication techniques. Considering that there is a critical relationship between communication and surgical safety, we hope that improving residents' communication skills will help improve surgical outcomes.

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SUPPLEMENTARY INFORMATION

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