Research Article

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Does teamwork and communication improve with simulation training? An evaluation of simulation training videos in Bihar, India

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BACKGROUND
High rates of medical error – attributed to ineffective communication among health care providers – poses a threat to patient safety. We embedded Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS™) concepts within a simulation-based curriculum and trained clinical teams providing intrapartum care in low-income settings. We evaluated whether simulation can be used to improve teamwork and communication among clinical teams.

METHODS
Nurse mentors facilitated and video-recorded simulated clinical scenarios to give health care providers (mentees) the opportunity to practice both technical and non-technical skills. Independent evaluators reviewed video-recorded simulation scenarios at midpoint and endpoint to evaluate changes in use of technical and non-technical skills. Semi-structured interviews were also conducted with nurse mentors to explore their experiences teaching non-technical skills to clinical teams.

RESULTS
Five hundred and sixty-six simulated clinical scenarios were included in the final analysis. Adoption of techniques to improve communication and teamwork, such as the 'SBAR' technique and 'think out loud', increased from midpoint to endpoint in all simulated scenarios.

CONCLUSION
Incorporation of TeamSTEPPS™ concepts into a simulation training program for health care providers improved teamwork and communication in simulated scenarios and can potentially be extended to actual emergency cases.

Key words: *Simulation, Assessment, Nurse, Mentor, India, Maternal Health, Teamwork*

BACKGROUND

The groundbreaking Institute of Medicine (1999) report, To Err is Human: Building a Safer Health System, estimated that 45,000-98,000 patients die each year in American hospitals due to medical errors (Kohn, Linda T.; Corrigan, Janet; Donaldson, 2000). Subsequent medical error

and patient safety reports by the Institute of Medicine (2001) and other institutions have highlighted poor communication, hierarchy, intimidation, and lack of team coordination as reasons for many of these medical errors (A. Wilson & Carr, n.d.). These reports shifted the emphasis of medical education models from those that prioritize individual knowledge, skill, and attitude to those that recognize effective teamwork is a crucial component in the management of emergencies (D Siassakos et al., 2010).

Simulation is an effective strategy used to train providers in emergency response and management (A. E. R. Merién, van de Ven, Mol, Houterman, & Oei, 2010; Weinberg, Auerbach, & Shah, 2009). Simulations have been shown to improve communication skills by providing a safe environment where providers can practice and receive feedback on technical and non-technical competencies (a E. R. Merién, van de Ven, Mol, Houterman, & Oei, 2010; Parsons, Zhou, Spurrier, & Makrides, 2008). Following these initial studies, the U.S. Government Agency for Healthcare Research and Quality established an evidence-based list of teamwork strategies (Baker, Gustafson, Beaubien, Salas, & Barach, 2003). Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS™), a collaborative effort between the U.S. Department of Defense and Agency for Healthcare Research and Quality, has become the standard curriculum for medical team communication and has recently been combined with simulation in many programs (Clark, Fisher, Arafeh, & Druzin, 2010; Daniels et al., 2010; Walker et al., 2012). Multiple studies conducted in high-resource settings have demonstrated the efficacy of simulation to improve communication within a clinical team, as well as between providers and patients (Anderson, Murphy, Boyle, Yaeger, & Halamek, 2006; Lane & Rollnick, 2007; Sleeper & Thompson, 2008).

Less is known about the impact of simulation on teamwork and communication in low-resource settings, such as the Indian state of Bihar. Because teamwork and communication have been shown to be essential skills in emergency management (Baker et al., 2003) in high-resource settings, it is important to understand providers' experiences learning TeamSTEPPS™ techniques and practicing these techniques in resource-constrained settings.

METHODS

Study design

We used a quantitative approach to assess adoption of TeamSTEPPS™ techniques during video-recorded simulations of emergency obstetric and neonatal situations in Bihar, India. We also conducted semi-structured interviews with nurse mentors to understand their experiences teaching teamwork and communication skills.

Study Setting

This study took place in primary health centers offering basic emergency obstetric and neonatal care (BEmONC) in Bihar, India. Bihar is a resource-poor state with a reported maternal mortality ratio of 208 (163-253) maternal deaths per 100,000 live births (MMR Bulletin Sample Registration System, 2013) and a neonatal mortality rate of 26 neonatal deaths per 1,000 live births (Sample Registration System Statistical Report 2014, 2014), both higher than the national averages. These facilities offer maternal and child health services, including antenatal, intrapartum, and postnatal care. However, these sites often face challenges in service delivery due to shortage of health care providers and supplies.

Intervention

In 2014, the University of California San Francisco (UCSF), PRONTO International (PRONTO) (www.prontointernational.org) and the University of Utah partnered with CARE India and the Government of Bihar to adapt and integrate PRONTO's highly-realistic simulation into the 'Apatkaleen Matritva evam Navjat Tatparta' (AMANAT), translating to 'Emergency Obstetrical and Neonatal Readiness', a program to improve the quality of obstetric and neonatal services in Bihar, India. In order to address teamwork and communication between providers, PRONTO's curriculum developers embedded TeamSTEPPS™ concepts within its simulation curriculum resulting in a curriculum which allowed mentees to practice both technical and non-technical skills in a scenario that felt like a real emergency. A cohort of 80 nurse mentors facilitated AMANAT to train health care providers (mentees) at 320 designated BEmONC facilities in Bihar, India. The program was rolled out in four phases between January 2015 and January 2017, with 80 BEmONC facilities per phase. Prior to roll-out, PRONTO master trainers trained nurse mentors to conduct and video record simulations, facilitate video-guided debriefing sessions, introduce TeamSTEPPS™ concepts, and conduct post-event debriefing after live births.

The 80 nurse mentors worked in groups of two to form 40 pairs. Each nurse mentor pair visited four assigned BEmONC facilities for one week each month over the course of six to eight months. During each visit, mentors were instructed to facilitate simulations with mentees for at least three specified clinical scenarios, including normal spontaneous vaginal deliveries (NSVD), postpartum hemorrhage and neonatal resuscitation. Nurse mentors were also instructed to introduce teamwork and communication techniques (Table 1) to mentees and to encourage practice by selecting and facilitating activities related to teamwork and communication (Table 2). Each teamwork and communication activity contains a structured debrief to guide the nurse mentor in a debrief that relates the activity to clinical practice. The simulation and team training activities provided mentees with opportunities to practice technical competencies for the management of a variety of neonatal and obstetric emergency cases, and

Table 1. Definitions of teamwork and communication techniques

Communication Skill	Definition
Call for help	When the primary provider asks for help or asks someone to go get help (this includes calling for doctor).
Check back	Using closed-loop communication to ensure that information conveyed by the sender is understood by the receiver, as intended.
SBAR	SBAR is a brief communication technique that includes at least three of the following: Situation, Background, Assessment (diagnosis), and Recommendation about a patient or case, which is used to update new team members about critical information or a change in clinical status. This can be done in person with the second provider, or over the phone during the referral process.
Think out loud	"Transparent thinking" indicates that anything the provider is thinking or observing is said out loud, this allows all team members to know the status of the patient and the plan of care. It is not said to anyone in particular and is not a direct command or request.
Teamwork Skill	**Definition**
Provider delegates task	Provider delegates a task by giving any order that does not overlap with any of the reported clinical indicators (e.g., one provider asks another provider to: administer misoprostol, take blood pressure, set up materials, take vital signs, place IV, reposition patient, etc.)
Provider offers to do task	Provider offers to do any task that does not overlap with any of the reported clinical indicators (e.g., provider offers to: take blood pressure, set up materials, insert a catheter, take vital signs, place IV, reposition patient, etc.)

non-technical competencies to improve teamwork and communication.

Participants

We enrolled all AMANAT mentees, which included staff nurses, Auxiliary Nurse Midwives and General Nurse Midwives in four phases at the 320 participating BEmONC facilities. We also conducted semi-structured interviews with 20 nurse mentors, who were purposively selected from the total pool of 80 nurse mentors. All nurse mentors had bachelor's degrees and had been trained on PRONTO's methodology which includes concepts from TeamSTEPPS™. Interview participants were selected from a variety of BEmONC facilities and districts across Bihar to ensure results from the study were representative of the diverse population. Data from Phase 1 of the intervention was omitted because there was no baseline data collected; therefore, only data from 240 facilities are included in this analysis.

Procedures

Quantitative

Independent evaluators reviewed video-recorded simulations and assessed use of teamwork and communication techniques at midline (week 3 or 4 of mentoring)

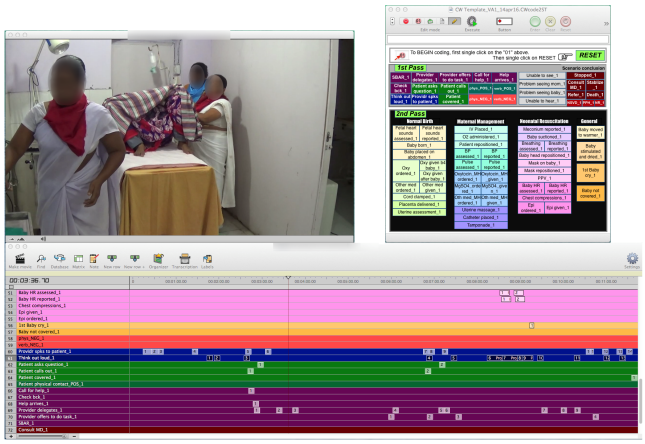
Table 2. Teamwork and communication activities, learning objectives and frequency of use by Phase (each Phase contains 80 facilities).

Name of Activity	Learning Objective	Phase 2	Phase 3	Phase 4
Animal Line Up	Team building and non-verbal communication	20	8	28
Back to Back	Closed loop communication (call-out and check-back)	20	9	29
Balls in Air	Situation monitoring and mutual support	15	8	23
Birthday Line Up	Team building and non-verbal communication	25	17	42
Blind Square/ Triangle	Communication, mutual support and leadership	10	7	17
Connections	Gets participants thinking about what makes an effective team and introduces the concept and need for clear communication	11	19	30
Helium Stick	Communication, mutual support, problem solving, leadership	5	5	10
Human Knot	Trust, leadership, communication, mutual support	24	22	46
Making Changes	This activity focuses on how making changes can be difficult or uncomfortable	31	87	118
Napkin Fold	Transparent thinking (thinking-out-loud) and problem solving	18	6	24
SBAR Activity	Practice using the SBAR communication technique using given case scenarios	58	33	91
Take as Much as You Need	Icebreaker or end of week reflection activity	2	4	6
Two Challenge Rule Activity	Practice using the communication technique known as "two challenge rule"	6	4	10
Two Truths and A Lie	Builds cohesion as team members discover new things about each other	36	17	53

and endline (after the completion of the phase). Researchers decided not to conduct true baseline simulation assessments because all participants lacked familiarity with simulation-based training and needed time to adapt prior to evaluation. Mentees were randomly selected to play the role of the provider for the following clinical scenarios: 1) normal spontaneous vaginal deliveries, 2) normal spontaneous vaginal deliveries with postpartum hemorrhage, and 3) normal spontaneous vaginal deliveries with neonatal resuscitation. Each simulated scenario was video-recorded, and videos were sent to a data manager in Patna, the state capital, until time for analysis (Dyer et al., 2018). Each video was analyzed by a video analyst, a Patna-based nurse, fluent in Hindi and English and trained on the definitions of each indicator included in the code windows. The video analyst watched each video twice: first to evaluate use of teamwork and communication techniques and, second, to evaluate

use of evidence-based clinical practices using codes designed for use in Studiocode™ video analysis software (Figure 1). The code indicators were selected based on the learning objectives in the curriculum and were reviewed by clinical, simulation, and team training experts from UCSF, PRONTO International, and the University of Utah (Table 1).

Figure 1: Example of Studiocode™ code window with teamwork and communication buttons



For each phase of program implementation, a randomly selected sample of 5-10% of simulation videos were blindly double-coded, and an average inter-rater reliability score was calculated.

Qualitative

Interviews with nurse mentors were conducted between June and August 2016. Time spent on interviews ranged from 40 to 60 minutes. The interview guide was developed in English, translated to Hindi, and then translated back to English to ensure accuracy of translation (Regmi, 2010). Interviews were conducted in the language of the participant's preference. Interviews were conducted by two female interviewers, both of whom had been previously trained in qualitative research methodology and interviewing techniques. Two pilot interviews, which were not included in the final analysis, were conducted to identify unclear questions and refine the interview guide. Interviews were held in private rooms at primary health centers to ensure anonymity and confidentiality.

Data analysis

Quantitative

Simulation assessment videos from Phases 2-4 were paired by facility and clinical scenario; 566 videos were taken at midline and endline from 215 BEmONC facilities. Because most indicators involved communication between two providers, videos in which there was only one provider were excluded from the analysis. The percentage of videos in which mentees used indicators of interest – including 'call for help,' 'check back,' 'SBAR' (Situation, Background, Assessment, and Recommendation), and 'provider offers to do task' – at least once were assessed using McNemar's Test for paired proportions. The average number of times mentees used 'think out loud' and 'provider delegates task' during simulations at midline and endline were compared using a paired t-test. Analyses were conducted for all scenarios and stratified by NSVD and complicated scenarios. Statistical significance was assessed at the 5% level. The quantitative data analysis was conducted using Stata version 13 (StataCorp, College Station, TX).

Qualitative

Interviews were primarily conducted in English, although Hindi was also used. Interviews were transcribed and, when necessary, translated to English by three specialists fluent in English and Hindi. To ensure data quality, two independent staff double-checked all transcriptions and translations. Any uncertainties were discussed and reconciled prior to analysis. Data was analyzed using the thematic content approach (Green & Thorogood, 2014), which consists of four steps: 1) familiarization; 2) identifying codes and themes; 3) coding the data; and 4) organizing codes and themes. The thematic content approach is often used in qualitative research to present the main elements of the participants' descriptions (Green & Thorogood, 2014). The research team read all transcripts and developed the preliminary coding scheme together. Two interviews were double-coded and any inconsistencies were discussed and resolved to develop the final coding framework. The remaining interviews were coded using this revised framework.

Ethical considerations

The Institutional Review Board of the Indian Institute of Health Management Research (IIHMR) in Jaipur and the Committee for Human Research at UCSF approved the study (Approval 14-15446). Written informed consent was obtained from all participants.

RESULTS

Quantitative

Performance from 566 simulations were evaluated in this study. We found that mentees' use of 'SBAR' and 'think out loud' increased from midline to endline in all simulations. On average at endline, 'think out loud' was used in two more instances than it was used during midline. Use of 'SBAR' increased from 44.9% to 64.0% from midline to endline. When stratifying by type of simulation, we found that use of 'SBAR' remained statistically significant across NSVD and complicated scenarios, while 'think out loud' remained significant in complicated scenarios only. 'Provider delegates task' trended upward and was significant in NSVD scenarios, and trended downward and was significant in complication scenarios (Table 3).

Table 3: Results of paired video analysis

	Midline	Endline	p-value
All Simulation Assessment Videos	566	566	
Communication Skill	n (%)	n (%)	
Call for help	502 (88.7)	517 (91.3)	0.063[a]
Check back	196 (34.6)	180 (31.8)	0.267[a]
SBAR %	254 (44.9)	362 (64.0)	**<0.001**[a]
Think out loud [mean (s.d.)]	10.96 (7.7)	12.86 (8.2)	**<0.001**[b]
Teamwork Skill			
Provider delegates task [mean (s.d.)]	5.39 (4.8)	5.11 (4.3)	0.327[b]
Provider offers to do task	163 (28.8)	166 (29.3)	0.833[a]
Normal Spontaneous Vaginal Deliveries	185	185	
Communication Skill	n (%)	n (%)	
Call for help	162 (87.6)	165 (89.2)	0.513[a]
Check back	60 (32.4)	55 (29.7)	0.569[a]
SBAR %	71 (38.4)	109 (58.9)	**<0.001**[a]
Think out loud [mean (s.d.)]	8.03 (5.1)	8.94 (5.0)	0.070[b]
Teamwork Skill			
Provider delegates task [mean (s.d.)]	4.11 (3.4)	5.11 (4.3)	**0.016**[b]
Provider offers to do task	51 (27.6)	52 (28.1)	0.904[a]
Complication Assessment Videos	381	381	
Communication Skill	n (%)	n (%)	
Call for help	340 (89.2)	352 (92.4)	0.070[a]
Check back	136 (35.7)	125 (32.8)	0.337[a]
SBAR %	183 (48.0)	253 (66.4)	**<.001**[a]
Think out loud [mean (s.d.)]	12.39 (8.3)	14.77 (8.7)	**<.001**[b]
Teamwork Skill			
Provider delegates task [mean (s.d.)]	6.01 (5.3)	5.11 (4.3)	**0.013**[b]
Provider offers to do task	112 (29.4)	114 (29.9)	0.863[a]

s.d. - Standard Deviation
[a] McNemar's test
[b] Paired t test

The average inter-rater reliability score across the two video analysts for teamwork and communication codes was 81%. This average remained consistent throughout the course of the study.

Qualitative

Overall perception of teamwork and communication skills training

The majority of nurse mentors felt that teamwork and communication skills were valuable aspects of the training program.

"They realized that, if we worked as a team, we can do our work well.... In the beginning, know they used to never talk… But at the end of the training, they used to talk and communicate very well like, 'Sister, this has happened for the patient'... " (Age, 22, mentor for 9 months)

Teaching and practice of teamwork and communication skills

Simulation was the primary method used to teach teamwork and communication skills to mentees in the cohort. At first, the majority of mentors felt that mentees used these skills more commonly in simulations than in real cases.

"They are very interested... to learn it, but then they don't use it... In real scenario… that time they are totally blind." (Age 33, mentor for 18 months)

One mentor discussed how she and her co-mentor used demonstration to teach communication techniques during real cases.

"Initially they used to think communication technique is only for simulation... We brought change in ourselves saying that it is not only for simulation, but for our daily lives too... like if any patient comes in the morning, we used to give the handover takeover of that patient, that time we have to use all the communication techniques. If you both have to be on duty, if someone comes suddenly then you have to use it, so they got used to it... make them do like, 'Sister, tell me, what is SBAR?'" (Age 22, mentor for 9 months)

Three mentors identified games and activities as a way to teach teamwork and communication skills, as well as to help mentees understand why these are important.

"We are keeping some games... they are refreshing... like an energizer... and they learn from it... When we are doing one or two teamwork activities, when we are doing the third one, they will ask us, 'What is the meaning of this?... You people teach us from this, so we know something is there behind these activities.'" (Age 24, mentor for 12 months)

Use of specific communication techniques

Although most mentees reportedly used the SBAR technique, they struggled with it and often forgot one or more components. Despite this, mentors generally felt that mentees gained at least a basic understanding of why SBAR is important for patient care.

"Actually, the most important thing is they have at least learned that, 'If I am calling someone, then I have to tell them about what is the patient's case.'" (Age 23, mentor for 10 months)

Half of mentors stated that mentees use think-out-loud and call-out for help. One mentor described how think-out-loud is often mistaken for call-out, while another explained that some mentees do not want to ask for help because they are overconfident about their clinical skills.

"Think out loud and call out... this many people do not understand. They think call out is same as think out loud... like, 'I am giving oxytocin now,' so this is call out… They will think this to be think out loud and it means to speak loudly." (Age 22, mentor for 9 months)

Almost half of mentors stated that mentees use the check-back technique. Two mentors described how mentees struggled to understand this concept, though one said this improved over the course of training.

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"If they are going for check back, they think that they are checking this sister.... means they don't know the actual purpose about check back." (Age 25, mentor for 18 months)

The two-challenge rule was the least common communication technique discussed, with only two mentors reporting use by mentees. Four mentors stated that mentees struggled with this technique. One described how mentees often get confused and worry about what other providers might think.

"We do role play and my partner shows them how to do two challenge rule, but still they used to forget... we have confusion then we have to ask the third person... they used to feel that whom should they ask and, even if we ask, what will then that person think, so like this bit of an ego problem happens." (Age 22, mentor for 12 months)

Barriers to teamwork and communication

Over half of mentors felt that interpersonal conflict related to rivalry and hierarchy among nurses was a significant barrier to teamwork and communication.

"If two seniors are there and one of them is made the sister in-charge... it becomes a problem... ego issues happen." (Age 22, mentor for 9 months)

Relatedly, mentors explained that nurses with the General Nurse Midwife (GNM) certification often have a negative attitude towards nurses with the Auxiliary Nurse Midwife (ANM) certification.

"Education things matter a lot when GNM is working with ANM… GNM is the A grade, ANM is the low… she will be thinking… 'I have GNM, she is the ANM, so she doesn't know anything, I can do better than her'… That challenge will be there." (Age 23, mentor for 18 months)

Mentors described several individual characteristics among nurses that negatively affected teamwork and communication, including lack of motivation, fatigue, and lack of interest and/or sense of responsibility, particularly among nurses assigned to non-labor wards.

"If there are two staff in labor room, they are able to do, but if at two places, 'Sister, today it's not my duty'… sometimes it happens like this... 'If I have no duty in labor room, then I will not go to work in the labor room!'" (Age 26, mentor for 18 months)

About one-third of mentors depicted staffing shortages as a significant barrier to teamwork and communication. They felt that, because there is often only one nurse on duty in the labor room at a time, it was hard for mentees to practice and utilize teamwork and communication techniques.

"The biggest challenge was the HR issues, like only one mentee is present... with whom she will practice think out loud?... Communication with patient she is able to do like, 'I am going to do delivery and I have done this or that'... Single person on duty, with whom will she maintain SBAR?" (Age 24, mentor for 9 months)

In addition to staffing shortages, several mentors explained that mentees may refuse to call other providers for help because they don't want to share monetary incentives, which are frequently provided by families of patients.

"In real scenarios, actually, call for help they cannot do because, in one shift, only one mentee is present... When we say, 'Sister, call for help,' they reply, 'Sister, we would do call for help only if I have a mentee or a staff with us,' so they can't do. Actually, they need… but first of all, there is not availability of staff; secondly, they mostly wish to manage the case by themselves, so that they could get money from the relatives... they want to keep it for self." (Age 24, mentor for 18 months)

"That's a reality... they want all the incentives... If they are calling... the incentive has to be shared... This is affecting communication." (Age 22, mentor for 18 months)

Recommendations

Several mentors discussed the importance of emphasizing why teamwork and communication are essential for patient safety as well as beneficial for nurses. One mentor illustrated the valuable role that modeling plays in teaching mentees about the purpose of specific communication techniques.

"We see that they don't help each other like, 'No, if she is working, then I will not go'... Then we said, 'Sister, you only will face problem. See, if right now a delivery is happening, then what all can you do? You will not be able to take history, neither do the delivery properly, neither care for the newborn

well. But if you try working by taking help from one another, it will be better... better for baby, also better for mother.'" (Age 26, mentor for 18 months)

A quarter of mentors recommended simplifying the SBAR, so it is easier to remember and utilize in routine practice. Several also discussed conducting activities to help mentees learn about SBAR and one mentor mentioned giving hints to help mentees with SBAR during simulations.

Other recommendations included improving staffing in primary health centers, employing more teamwork activities, incorporating non-mentee nurses in trainings, requiring nurses who don't get along well to conduct deliveries and spend time together, and appointing an individual to oversee mentees' progress in teamwork and communication skills at each primary health center.

"You will get two nurses, but they have to... see the emergency that has to see the organization that has to see the operation and that has to see the ward and delivery, so it is sometimes very difficult for the teamwork... Recommendation for me is first of all giving the manpower properly." (Age 22, mentor for 18 months)

DISCUSSION

We show that participation in PRONTO's teamwork and communication training, implemented within the AMANAT initiative, had a positive impact on teamwork and communication in simulated cases. In this study, we found a significant increase in use of the teamwork and communication techniques, including 'SBAR' and 'thinking out loud', over time across all simulation scenarios. When stratified, use of 'SBAR' increased significantly in simulated births with and without complications. While use of 'think out loud' increased in both types of simulated births, this finding was only significant in those with complications, likely because providers do more to manage complicated cases. We observed a significant increase in use of 'provider delegates task' in simulated cases without complications; however, we observed a significant decrease in this indicator in cases with complications. It is well documented that simulated scenarios can provoke substantial stress among providers (Clarke, Horeczko, Cotton, & Bair, 2014; Keitel et al., 2011). This finding may be the result of providers feeling more stressed in simulations containing a complication, leading them to delegate less frequently when scenarios become chaotic.

This study found that mentors perceived teamwork and communication skills to be valuable aspects of training for mentees in Bihar. Didactic training, activities focused on teamwork and communication techniques, and simulation were the primary methods used by nurse mentors to teach these skills. While use of SBAR by mentees in simulated cases increased, mentors described this concept as the most difficult for mentees to understand and master. SBAR is considered to be a key tool for improving medical and nursing communication and is widely used in high-income settings (Fransen et al., 2012; J. Guise & Lowe, 2006; J. M. Guise & Segel, 2008; D. Siassakos et al., 2011; Dimitrios Siassakos et al., 2013; D. Wilson, Kochar, Whyte-Lewis, Whyte, & Lee, 2017). A study in South Africa found that SBAR use for neonatal consults increased from 29% to 70% following training, and the majority of staff felt the technique improved the quality of communication and neonatal care (Raymond & Harrison, 2014). A recent study evaluating SBAR training for non-obstetric care in Malawi found that, while few trainees had previously encountered SBAR, confidence in using SBAR and the likelihood of using SBAR again was high (Chetwood, Garg, & Burton, 2018). Given the low baseline knowledge and skill level of many providers in Bihar, mentors recommended simplification of SBAR to make it easier to understand and remember.

Mentors described several barriers to use of the teamwork and communication skills taught through the PRONTO training. Many of these barriers cannot be addressed through PRONTO training but may be addressed through other complementary interventions. Hierarchical structures among nurses working in facilities negatively affected teamwork and communication, a finding supported by other studies in India (Campbell-Yeo et al., 2013; Kalyan & Vatsa, 2014). In addition, many mentees participating in this program reported attending deliveries alone, without any assistance from additional providers, and had a difficult time understanding the practical application of the teamwork and communication techniques they were learning. Mentors also described corruption-related issues affecting providers' use of 'call for help' and 'think out loud.' While deliveries in the Indian public sector are technically free of charge, women and their families are often told they need to pay the provider (Bhattacharya, 2015). Mentors described mentees not wanting to call other providers for help because they did not want to split the monetary incentives typically given by clients.

The qualitative and quantitative results of this study will inform the next iteration of the PRONTO curriculum in Bihar. In an effort to more clearly connect the teamwork activities or 'games' to clinical practice, we are strengthening the debriefing sections of these activities. On average, each facility only participated in 4.4 teamwork activities during each phase, so a better understanding of the obstacles and challenges to these activities is important. We also are providing mentors with clearer guidelines to teach teamwork and communication concepts.

This study has several limitations. Data from simulated cases does not have a true pre-training measurement, thus results may underestimate the true impact of the training on teamwork and communication indicators. We opted to forgo a true pre-training measurement in order to allow participants time to adapt to simulation prior to being evaluated using simulation. Additionally, teamwork and communication indicators can be subjective and difficult

to code. While the two video analyst nurses were trained to identify these indicators in videos and given detailed definitions, they were also relatively new to teamwork and communication concepts. Despite this, the average inter-rater reliability scores remained acceptable. The qualitative data may be biased due to social desirability, or the desire of the mentors to present a positive view to the interviewer, as well as by any assumptions or opinions the mentors may have had. We attempted to mitigate these issues by providing detailed training on study objectives and interviewing techniques to the interviewers. Lastly, we are showing an increased use of these teamwork and communication techniques in simulated cases. Whether this led to an increased use of these techniques in live births is beyond the scope of this study.

CONCLUSION

These data suggest that incorporating TeamSTEPPS™ concepts into an obstetric and neonatal provider training program increased the use of important teamwork and communication techniques in simulated scenarios. Based on experiences in other parts of the world, it is likely that training clinical teams in Bihar on teamwork and communication has the potential to reduce medical errors related to miscommunication. This strategy warrants further exploration to develop more effective, culturally sensitive training, and to better elucidate the potential it has for impact on maternal and newborn outcomes.

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CONFLICT OF INTEREST

Dilys Walker and Susanna Cohen are founding members of PRONTO International and sit on its board of directors. None of the other authors have any conflicts of interest to declare.

AUTHORS' CONTRIBUTIONS

JD analyzed the quantitative data, drafted, and revised the manuscript. MM analyzed the qualitative data, drafted the qualitative portions of the manuscript, and revised the manuscript. SC was involved in guiding the data analysis and was a major contributor to the writing of the manuscript. RG, JR, and HS provided support in data analysis and manuscript revisions. TM and AC provided input during manuscript revision. AC additionally led video data collection and trained video analysts. DW was the principal investigator and a major contributor to all aspects of this study and manuscript. All authors read and approved the final manuscript.

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