Research Article

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Choosing a simulation assessment tool: A comparative analysis in Bihar, India

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BACKGROUND

To explore whether clinical, teamwork, and interpersonal skills of nurses could be monitored inexpensively at scale, we compared two simulation measurement tools at 160 primary health care facilities in Bihar, India. The aim was to determine if the less expensive, less resource-intensive real-time assessment tool (RTAT) could be used in place of the more expensive, more resource-intensive video coding tool.

METHODS

Embedded in a large-scale ongoing nurse mentoring program “AMANAT”, we conducted a cross-sectional study comparing the measurement tools to assess clinical performance in normal and emergency obstetrical and neonatal simulations. The RTAT consisted of a series of seven global questions related to clinical identification, management, use of evidence-based practices, communication and teamwork. We also analysed the simulations using a video coding tool, which included 80 clinical, teamwork and communication indicators. We calculated the means and standard errors for each indicator using both tools. We calculated the Cohen’s kappa coefficient to determine the level of agreement between the two tools.

RESULTS

We analysed paired data from the two tools for 222 simulations in three types of scenarios: normal spontaneous vaginal deliveries, neonatal resuscitations and post-partum haemorrhages. The mean scores on the RTAT were generally higher than those on the video coding tool. The kappa coefficients for all indicators indicated no agreement between the two tools.

CONCLUSION

RTAT performed poorly against the video coding tool to measure the clinical skills of nurses in simulated normal and complicated births at primary health care facilities in Bihar.

Key words: Simulation; assessment; tools; nurse; mentor; India

BACKGROUND

Simulation is fast becoming an important strategy for training care providers to respond adequately and appropriately to obstetrical and neonatal emergencies (Eppich, et al., 2011; Villemure, et al., 2016; Lateef, 2010). In recent years, trainings in low-resource settings have increasingly used simulation for events such as postpartum haemorrhage (PPH) (Walker, et al., 2016; Lutgendorf, et al., 2017; Nelissen, et al., 2014) and neonatal resuscitation (NR) (Bang, et al., 2016). Simulation training has been found to improve self-efficacy, clinical knowledge, technical performance (Schmidt, et al., 2013), team communication and most importantly, patient outcomes (Zendejas, et al., 2013).

A wide variety of tools, both paper-based and electronic, have been used to assess the effectiveness of simulation training, including changes in the use of evidence-based practices, measurement of clinical skills, and teamwork and communication (Merién, et al., 2010). Currently, there is no consensus regarding the best way to measure and analyse provider practices, skills, and teamwork/communication during high-stress simulations (Qayumi, et al., 2014). Additionally, efforts to measure the effectiveness of obstetric and neonatal simulation behavioral and clinical performance in low-resource settings to date are limited, both in small evaluations and at a larger scale.

For simulation training to have the greatest impact, it must be disseminated at scale to providers on the front lines of maternity and newborn care. However, assessing complex simulations with many facilitators presents unique challenges for monitoring programme fidelity. Being able to assess the quality of simulations is of critical importance in low-income settings, such as the state of Bihar, India (Multidimensional Poverty Index 2016), where primary health clinics often struggle with resource allocation and maintenance, staffing shortages (Sharma 2015) and less-skilled staff (Chauhan 2016). To our knowledge, no previous study has conducted a comparison of a global real-time assessment tool and a delayed assessment of video recordings in a resource-limited setting.

To explore whether clinical, teamwork and interpersonal skills of auxiliary nurse midwives (ANM) and general nurse midwives (GNM) could be monitored inexpensively at scale, we compared two independent simulation measurement tools. We aimed to determine if the less expensive, less resource intensive, paper-based real-time assessment tool (RTAT) could be used in place of the more expensive, more resource-intensive video-coding tool to evaluate simulation performance accurately. The dissemination of these results is important because they help to establish best practices and lessons learned in the area of health-related monitoring and evaluation where continued strengthening of the use of data for decision-making is critical.

METHODS

Study design

We conducted a cross-sectional study comparing a paper-based assessment tool completed in real-time (RTAT) assessing the performance of ANMs and GNMs at participating primary health clinics during normal and emergency obstetrical and neonatal simulations with a video-coding tool completed retrospectively by non-trainers reviewing video recordings. Master nurse mentors completed the RTAT and trained clinical video analysts who reviewed and coded performance using the video recording of the same simulation. They were blinded to each other's assessments.

Setting

Working closely with Government of Bihar, between 2014 – 2017, CARE India implemented the nurse mentoring intervention (AMANAT) in 320 Basic Emergency Obstetric and Neonatal Care (BEmONC) facilities located across all 38 districts in the state of Bihar, India. As part of a large health system-strengthening effort, the AMANAT intervention was aimed at improving nurses' skills and overall quality of the childbirth practices in public sector facilities (Das, et al., 2016). In addition to the training by CARE India, nurse mentors received a total of 10 days of training in obstetric and neonatal emergency, simulation facilitation and teamwork and communication, conducted by a team of experts from PRONTO International. After being trained, nurse mentors were deployed across the state to provide mentoring and simulation training to ANM and GNM nurse mentees. AMANAT spanned four phases covering 80 facilities per phase, with mentoring spanning one week per month over eight months.

For the current analysis, we used data from 160 BEmONC facilities that received AMANAT training during the second and third phases of the program, as these two phases had paired scenarios available from both data sources. Implementation of these two phases was partially overlapping in time. The second phase spanned from September 2015 to May 2016. The third phase spanned from November 2015 to July 2016.

Study population

The study subjects in the simulation scenarios included 6-8 ANM/GNMs working at each facility who were asked to participate in the AMANAT program as 'mentees'. After the completion of higher secondary level of education, to become an ANM, two years of pre-service training is mandatory while for GNM this training spans three years. ANM/GNM clinic staff members were selected based on willingness to work in the primary health clinics labour room, interest level in participation, perceived ability to be a quick learner and likelihood of not retiring in the next two years.

Study procedures

The RTAT was a paper form completed by evaluators at each facility at two time points during the 8-month program. The first time point was at the midpoint (month 3), and the second time point was at the endpoint (month 8). The evaluators were master nurse mentors who worked for the project and supervised the nurse mentors assigned to the facilities for mentoring. All evaluators were provided with written instructions in the form of standard operating procedures. The standard operating procedures instructed the evaluators to complete the tool immediately after observing each of three mandatory simulations at the two assessment time points, thus resulting in a potential for six completed forms for each facility. The mandatory simulations included a normal spontaneous vaginal delivery (NSVD), an NR and a PPH.

Real-time assessment tool (RTAT)

The RTAT consisted of a series of seven global questions related to clinical identification, management, use of evidence-based practices, communication and teamwork as observed during the simulated scenario. Responses were recorded on a 5-point Likert scale ranging from 'Strongly Agree' to 'Strongly Disagree'. The RTAT tool was developed by a team of clinical content experts at the University of California San Francisco (UCSF), the University of Utah and PRONTO International.

The RTAT consisted of seven statements: (1) clinical site staff were highly competent at identifying complication(s) in the simulation; (2) clinical site staff identified the complication in a timely manner in the simulation; (3) clinical site staff correctly managed complications in the simulation; (4) clinical site staff maximized use of evidence-based practices during the simulation; (5) clinical site staff communicated well with each other during the simulation using Team Strategies and Tools to Enhance Performance and Patient Safety (Team STEPPS™) (Agency for Healthcare Research and Quality, 2017) communication rules; (6) clinical site staff communicated with kindness and respect with the patient during the simulation; and (7) clinical site staff demonstrated good teamwork during the simulation.

Video coding tool

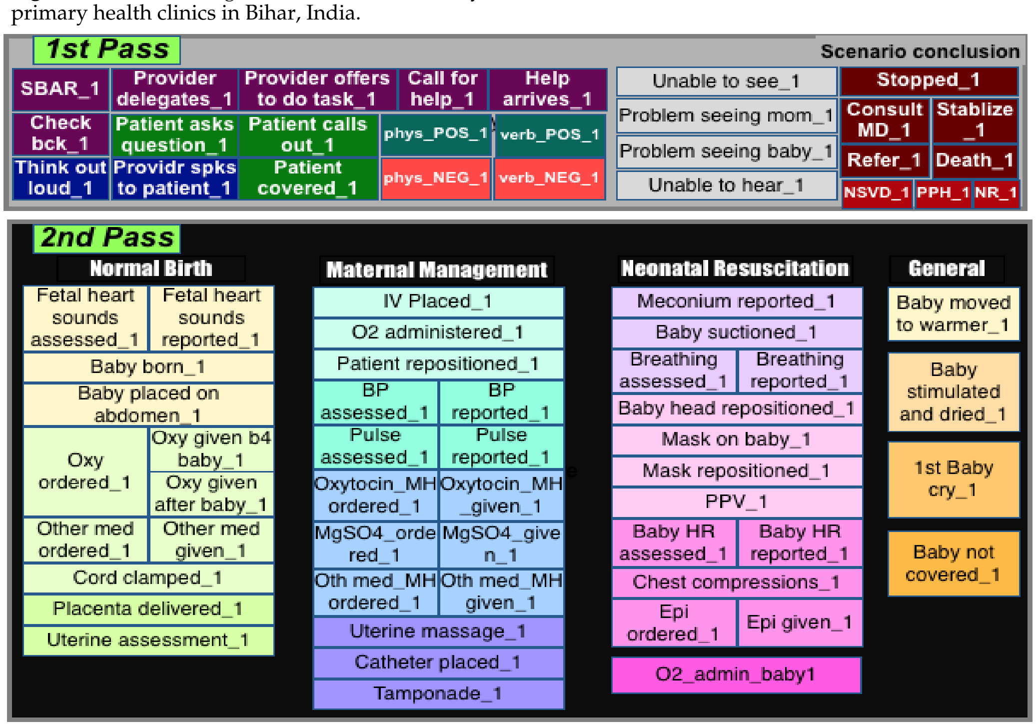
Each simulation scenario was also video recorded. The videos were analysed using the video coding tool created in Studiocode™ video analysis software (Vosaic, Inc., Lincoln, Nebraska, USA). The video coding tool included 80 clinical evidence-based practices (EBP), teamwork and communication indicators and was developed by the same team of clinical-content experts as the paper form.

Data management

We photographed the RTAT form using the evaluator's smart phone and emailed it to staff at the PRONTO project office in Patna for data entry into Qualtrics, an online survey tool (Qualtrics, Inc., Provo, Utah, USA). The electronic forms were stored in a folder on an encrypted project computer and maintained by the project team in Patna. After the results were entered manually into Qualtrics, they were exported to Excel where the data were cleaned and managed at UCSF.

Two nurses who had gone through simulation facilitator training were trained together on the video analysis process and coded the videos in the Patna office using Studiocode™. The indictors coded for in the video analysis process are shown in Figure 1. To ensure reliability in coding, 12% of the videos were blindly double-coded. The average inter-rater reliability score for clinical EBPs was 94% and for teamwork and communication was 81%. Data were exported from Studiocode™ into Excel for cleaning and management, merged with data from the RTAT and transferred to RStudio (Boston, Massachusetts, USA) for analysis at UCSF.

Figure 1: "Video coding tool" used for video analysis of NSVD, NR and PPH simulation scenarios at primary health clinics in Bihar, India.



Statistical analysis

We paired data from both tools so that for each simulation we had results of both the RTAT and video coding tool. We selected three indicators from the RTAT for analysis based on ability to map indicators onto the video coding tool. For example, for an NSVD simulation, the video coding tool indicators 'fetal heart sounds assessed', 'baby placed on abdomen', 'baby stimulated and dried', 'oxytocin given after baby born', 'cord clamped', 'placenta delivered' and 'uterine tone assessed' were mapped onto the RTAT indicator 'Clinical site staff maximized use of EBPs during the simulation' (Table 1).

Table 1. Mapping of video coding tool indicators to RTAT by simulation scenario type at primary health clinics in Bihar, India.

RTAT Indicator	Video coding tool indicator		
	NSVD	NR	PPH
Clinical site staff maximized use of EBPs during the stimulation	- Fetal heart sounds assessed - Baby placed on abdomen - Baby stimulated and dried - Oxytocin given after baby - Cord clamped - Placenta delivered - Uterine tone assessed	- Baby stimulated and dried - Baby suctioned - Baby head repositioned - Baby HR assessed - Positive pressure ventilation	- IV placed - Oxytocin administered - BP assessed - Pulse assessed - Oxytocin given for maternal haemorrhage - Uterine massage - Catheter placed
Clinical site staff communicated well with each other during the simulation (e.g. SBAR, check back, transparent thinking).	- SBAR - Check back -Think out loud - Fetal heart sounds reported - Oxytocin ordered	- SBAR - Check back - Think out loud - Call for help - Baby HR reported	- SBAR - Check back - Think out loud - Call for help - BP reported - Pulse reported
Clinical site staff communicated with kindness and respect with the patient during the simulation.	-Provider speaks to patient - Patient covered - Physical contact positive	-Provider speaks to patient - Patient covered - Physical contact positive	-Provider speaks to patient - Patient covered - Physical contact positive

*BP, blood pressure; EBP, evidence-based practices; HR, heart rate; IV, intravenous catheter; NR, neonatal resuscitation; NSVD, normal spontaneous vaginal delivery; PPH, post-partum haemorrhage; RTAT, real-time assessment tool; SBAR, situation, background, assessment, recommendation.

The indicators analysed were:

- Clinical site staff maximised use of EBPs during the simulation
- Clinical site staff communicated well with each other during the simulation
- Clinical site staff communicated with kindness and respect with the patient during the simulation.

We analysed these indicators for each of the three simulation scenarios (NSVD, NR and PPH). We rescaled data from both tools onto a 100-point scale for comparability. The means and standard errors were calculated for each measurement tool. We calculated Cohen's kappa coefficient to determine the level of agreement between the two measurement tools while taking random variation between instruments into account. We used the weighted coefficient to consider the ordered nature of the data and give higher weight to closer categories. We considered kappa values < 0 as no agreement and 0.01 – 0.20 as no to slight agreement (Fleiss & Cohen, 1973).

Ethical issues

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

RESULTS

Across Phases 2 and 3, a total of 1,342 ANM/GNM mentees were enrolled. The mentee selection criteria resulted in a convenience sample of mentees across 160 BEmONC facilities in the state of Bihar for these two phases. We collected data from both the RTAT and the video coding tool for 222 pairs of simulated scenarios (444 total). One hundred eighty-two simulations were conducted in Phase 2 of the nurse mentoring program, and 262 were conducted in Phase 3. Half of the simulations were from the mid-point assessment of each phase, and the other half were from the end-point of each phase. One hundred sixty-one (36%) of the simulations were NSVD scenarios, 147 (33%) were NR scenarios, and 126 (31%) were PPH scenarios.

In general, the mean scores on the RTAT were higher than those on the video coding tool except for "clinical site staff maximized use of EBP during the simulation" for NSVD simulations where it was 7 percentage points lower (Table 2). For both NR and PPH the means were 11 percentage points higher for the RTAT. For the indicator "clinical site staff communicated well with each other during the simulation", the mean scores of the RTAT were 33, 9 and 11 percentage points higher than the video coding tool for NSVD, NR and PPH, respectively. Results were similar for the "clinical site staff communicated with kindness and respect with the patient during the simulation" (36, 46 and 40 percentage points higher using the RTAT for NSVD, NR and PPH, respectively.

The kappa coefficients for all indicators suggest no agreement between the two tools. Of the three indicators investigated by simulation scenario type, the kappa coefficient ranged from -0.05 to 0.07.

Table 2: Correlations between real-time assessment tool and video

QUESTIONS	RTAT	Video coding tool	Cohen's kappa* (95% CI)	RTAT	Video coding tool	Cohen's kappa* (95% CI)	RTAT	Video coding tool	Cohen's kappa* (95% CI)
Clinical site staff maximized use of EBP during the simulation	81% (19%)	88% (16%)	0.050 (-0.045-0.145)	69% (22%)	58% (19%)	0.049 (-0.095-0.19)	77% (20%)	66% (18%)	0.024 (-0.117 - 0.17)
Clinical site staff communicated well with each other during the simulation	76% (20%)	43% (21%)	0.014 (-0.055-0.083)	67% (22%)	58% (21%)	-0.053 (-0.1-0.21)	76% (19%)	65% (22%)	0.07 (-0.073-0.212)
Clinical site staff communicated with kindness and respect with the patient during the simulation	85% (16%)	49% (20%)	0.014 (-0.002-0.03)	81% (17%)	35% (8%)	0.002 (-0.005-0.009)	86% (14%)	46% (19%)	0.011 (-0.002-0.025)

*Weighted correlation coefficient
EBP, evidence-based practices; NR, neonatal resuscitation; NSVD, normal spontaneous vaginal delivery; PPH, post-partum haemorrhage; RTAT, real-time assessment tool.

DISCUSSION

We found that results from the RTAT were not equivalent to our standard video coding tool for assessing obstetrical and neonatal simulations and, with one exception, consistently overestimated trainees' skills. This was true for all three of the indicators we analysed on use of EBPs, communication and teamwork. We also found that this result was independent of whether the scenario simulated NSVD, NR or PPH. To our knowledge, this is the first study that has attempted a head-to-head comparison of a real-time simulation measurement tool against objectively coded videos in a resource-limited setting such as the BEmONC facilities we studied.

We believe that the reasons why the RTAT did not correlate with the video coding tool were multi-dimensional. Although both tools were completed by evaluators with clinical nursing backgrounds, the video coding tool required coding of objective indicators, such as whether the use of specific EBPs and teamwork/communication techniques did or did not occur during the simulation. The video analysts using the tool were also removed in both time and space from the simulation, which may have impacted their potential vulnerability to social desirability bias. In contrast to the granular indicators collected on the video coding tool, the RTAT indicators were more global and over-arching, thus requiring master nurse mentors to provide a subjective value judgment on the observations being made in real-time during the simulation at which they were also physically present. Additionally, instead of being trained on the tool, master nurse mentors were provided with instructions in the form of written standard operating procedures which might have resulted in various interpretations of the same indicators. In contrast, both video analysts were trained together in person, and they knew that the inter-rater reliability of their coding was being measured. Lastly, there were 40 different master nurse mentors who completed the RTAT, as compared to only two video analysts, thus introducing a much higher degree of variation and potential for evaluator bias.

We recognize there are several limitations to this study. First, the indicators used for analysis were retrospectively mapped across two different measurement tools. Second, neither the master nurse mentors nor the video evaluators were blinded to the assessment time point. We postulate that knowledge of the time point was more likely to bias master nurse mentors because they were completing the RTAT tool in real-time while physically present at the simulation. We believe knowing the time point was less likely to bias the video analysts because they were removed in time and space and also knew inter-rater reliability was being measured. Despite these potential limitations, observations from this study generated important insight into selecting an appropriate measurement tool for simulations.

CONCLUSION

In conclusion, our analysis suggests that the RTAT performed poorly against our chosen standard of the video coding tool for reliably measuring ANM/GNM clinical skills in simulated normal and complicated births at facilities in Bihar. We recommend future programs assessing provider behaviour use video coded data for monitoring on a regular basis whenever possible. Alternatively, we suggest that measurement tools used to monitor simulations through direct observation consider the use of instruments with objective indicators, training data collection enumerators in person and employing external evaluators for data collection. While video coded data provide an objective standard for assessing clinical behaviour in simulations, we realise it is expensive on a large scale, and, therefore, its use will likely remain limited. We encourage other groups to explore less expensive, lower resource ways to reliably measure clinical behavior in simulations.

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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

HS analysed the data, drafted, and revised the manuscript. JR, RG and JD were involved in study design, assisted with data analysis and were major contributors in writing the manuscript. SC was involved in study design and was a major contributor in writing the manuscript. AC, AG and PS were involved in curriculum design and training as well as the supervision of nurse mentors. AC, AG and PS also provided input during manuscript revision. AC additionally led video data collection and trained video analysts. MS, R. Sharma and R. Srivastava conducted all data collection and coding and provided oversight of the video coding process as well as input during the manuscript revision. AD, SS and TM provided input during manuscript revision. AD, SS and TM additionally provided input into the synthesis of the data and local contextualization. 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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