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**Simulation-based Nurse Mentoring to Promote Preeclampsia
Care: What is the Impact in Bihar, India?**

By

Julia Raney
2018

Thesis Advisor: Dr. Urania Magriples

Abstract

Background:

Inadequately treated, severe preeclampsia and eclampsia (PE/E) may rapidly lead to severe complications in both mothers and neonates and are estimated to cause 60,000 maternal deaths globally each year. Simulation-based training where health providers review basic emergency obstetric and newborn care through highly realistic cases have demonstrated promising results in low- and middle-income countries (LMIC). Two international simulation training programs, Helping Mothers Survive and PRONTO International, have demonstrated improved overall use of evidence-based practices (EBPs) in active management of third stage of labor and hemorrhage management, though individual skills varied. However, the impact of simulation training on use of EBPs for PE/E diagnosis and management in such settings has not been reported.

Methods:

PRONTO International's simulation-based training was embedded within a statewide maternal and newborn health quality improvement project in Bihar, India. This mixed methods study evaluated change in the use of evidence-based clinical skills by nurse mentees during simulated cases at primary health clinics (PHC). We compared the proportion of skills completed during mentees' first and last participation in simulated severe preeclampsia and eclampsia cases. Semi-structured interviews were conducted with nurse mentors to explore barriers and enablers to high quality preeclampsia care in Bihar. Qualitative data were analyzed using the thematic content approach.

Results:

A total of 39 matched pre- and post-training simulation video pairs, including 94 nurse mentees from 33 PHCs, were analyzed. Results demonstrated a significant increase in the number of 'key history questions asked' from 1 to 2 ($p=0.03$), which demonstrates improvement in nurse mentees' ability to gather histories and make preeclampsia diagnoses. Additionally, 'key management steps completed' increased from 2 to 3 ($p=0.03$), reflecting mentees increased rates of antihypertensive administration and foley catheter and intravenous catheter insertion. Key barriers to preeclampsia care included knowledge gaps, resource shortages, hierarchy between nurses and physicians, poor relationships between nurses and patients, and fear of retaliation from patients' families. Strategies that facilitated high quality care included case-based and participatory learning, promotion of teamwork and communication, and effective leadership.

Conclusion:

Simulation-based training increased the use of clinical skills by nurse mentees in simulated severe preeclampsia and eclampsia cases. Barriers affect all aspects of clinical management, and must be addressed in order to improve care. Teamwork, communication, and leadership are key mechanisms to facilitate high quality preeclampsia care in LMICs.

Acknowledgements

I am very grateful to all of my colleagues working at the PRONTO office in Patna, Bihar. They were instrumental in the design and execution of this study, and I very much appreciate all their hard work and expertise. I owe a special thanks to Amelia Christmas, who spent many long afternoons and Skype calls discussing preeclampsia simulations, evaluations, and her experiences working with nurse mentors throughout Bihar. Her expertise was invaluable. Additionally, I am very grateful for the video analysis team including Praicey Thomas, Rebecka David, and Rohit Srivastava for their great efforts in video uploading and coding. Additionally, I would like to thank all of the all of the nurse mentors for their tireless efforts in promoting obstetric and neonatal care throughout Bihar.

I am hugely appreciative of all my PRONTO UCSF colleagues for their tremendous support in designing and completing this study. A big thank you Rakesh Shah for his statistical wisdom and for guiding me through complex statistical concepts. I am also very grateful to Melissa Morgan for continuous support of my qualitative analysis. Mona Sterling also played a critical role in the qualitative analysis. She greatly supported transcriptions and the development of the thematic coding framework. I would also like to acknowledge Hilary Spindler's support. Her check-ins and encouragement helped me overcome many obstacles along the way. Dilys Walker provided tremendous conceptual and clinical expertise as well as excellent leadership. Thank you!

I would like to thank my thesis adviser, Dr. Urania Magriples, who provided advice during the writing of this manuscript and guided me through many drafts. This thesis was made much stronger because for her insight and revisions.

On a personal note, I would like to thank my sister Catherine Raney, for championing this project, and helping me make sense of the enormous amount of qualitative data. A special thanks to my partner, Daniel Geller, whose support I could not have gone without.

I was supported by the Yale Office of Student Research Short-Term Funding Grants. PRONTO International led by Dilys Walker is funded by the Bill and Melinda Gates Foundation. The funding body had no role in study design, data collection, analysis and interpretation of the data, or writing of the manuscript.

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Introduction:

Globally, an estimated 275,000 maternal deaths occurred in 2015 [1]. Hypertensive disorders of pregnancy (HDP), including preeclampsia and eclampsia (PE/E), are the second leading cause of maternal death in women under age 35 after maternal hemorrhage. Together, maternal hypertensive disorders and hemorrhage account for over half of all maternal deaths, with the majority occurring in low-resource settings [1].

Preeclampsia, the precursor to eclampsia, develops in 2-8% of pregnancies globally. Incidence varies significantly worldwide. The WHO estimates that the incidence of preeclampsia is seven times higher in low-resource countries than high-resource countries [2]. Further, the incidence of eclampsia is much higher in low-resource countries, varying from 1 in 100 cases to 1 in 1700 compared to 5-7 per 10,000 deliveries in high resource countries [3].

The pathogenesis of preeclampsia, the most lethal of the HDP, is not entirely understood, but is thought to be related to disturbances in placentation at the beginning of pregnancy, followed by generalized inflammation and progressive endothelial damage [4]. Though debate continues as to exact criteria, it is generally accepted that preeclampsia constitutes new onset hypertension during pregnancy (diastolic > 90 mm Hg) with substantial proteinuria (0.3 g/24 h) after 20 weeks of pregnancy. Preeclampsia is considered severe if any of the following are present: severe hypertension ($\geq 160/110$), thrombocytopenia (platelet count $< 100,000$ /microliter), impaired liver function (elevated liver enzymes,

severe epigastric or right upper quadrant pain), progressive renal insufficiency (serum creatinine > 1.1 or a doubling), pulmonary edema, cerebral or visual disturbances [5]. Eclampsia, a severe complication of preeclampsia, is the development of new convulsions in a preeclamptic patient. It is associated with high rates of perinatal and maternal morbidity and mortality [4].

Mortality related to PE/E can be prevented with swift diagnosis, effective management, and timely delivery [6, 7]. Antihypertensives decrease the risk of maternal stroke [8] and magnesium sulfate reduces the risk of seizures by half compared to placebo in women with moderate to severe preeclampsia (OR 0.41 95%, CI 0.29 – 0.58) [7]. However, evidence-based interventions are sparsely implemented in many low- and middle-income country (LMIC) settings, leading to poor outcomes for both mothers and neonates [9, 10].

Several diagnostic obstacles contribute to the low implementation of EBPs. First, the diagnostic complexity can be challenging for relatively low-skilled providers [11]. Additionally, many clinics lack diagnostic equipment such as accurate blood pressure measurement tools, urine protein strips or lab capabilities to assess serum creatinine, platelet function, or liver enzymes [12].

Diagnosis is not the only barrier. Many facilities in LMICs can rarely administer appropriate medications, magnesium sulfate and antihypertensives. Several studies exploring barriers to magnesium sulfate administration in LMICs have found fear of side effects, low magnesium sulfate availability, and lack of training to be significant

obstacles to treatment administration [10-12]. Furthermore, several countries such as Pakistan and Nigeria have regulations that prevent certain providers like nurses from administering magnesium sulfate [13, 14]. Administration of antihypertensives presents additional challenges because decreasing blood pressure too quickly can cause hypotension and decrease fetal circulation [12].

A third challenge to implementing high quality PE/E care is the fact that few facilities have the capacity to provide cesarean sections or complete efficient referrals. The WHO recommends delivery within 24 hours for severe preeclampsia and 12 hours for eclampsia [4]. However, many clinics lack the obstetricians and anesthesiologists needed to perform cesarean sections [3, 15]. Instead, these women must be referred to larger hospitals, and many clinics lack the infrastructure, health information systems, and ambulances to complete safe transfers [16].

In 2015, an estimated 64,000 maternal deaths occurred in India alone [1]. In 2005, the Government of India implemented Janani Suraksha Yojana (JSY), a nationwide program to increase the number of births occurring in health facilities [17]. Following implementation of JSY, institutional deliveries increased dramatically from 18.8% in 2002 to 51.9% in 2012 [18]. However, increases in institutional delivery rate were associated with absent to modest reductions in maternal and neonatal mortality rates [19, 20]. The lack of improved maternal and child health outcomes shows that increasing institutional deliveries independently is insufficient. Instead, an effective health intervention must also address the skills of health providers working in these facilities.

Future trainings should focus on the provision of obstetric emergency training including PE/E management.

Previous studies have explored the capacity of health providers to manage severe PE/E in Indian primary care settings. The Community Level Interventions study for Preeclampsia (CLIP) in Karnataka, India found that, while nurses and community health workers were familiar with the clinical severity of PE/E, large knowledge gaps existed regarding disease etiology and medication route and dosage [21]. Nurses in Karnataka's rural PHCs believed HDP was caused by caused by psychological conditions such as stress, fear, and tension. They most frequently recommended rest, tetanus vaccinations, and decreased salt intake as treatment. Additionally, despite familiarity with magnesium sulfate, none of them had ever administered it themselves. In addition to knowledge gaps, another identified barrier to providing high quality PE/E care was that many PHCs experienced significant supply and staff shortages. A survey of 131 PHCs in Karnataka found very low availability of essential diagnostic tests and treatments. Availability of treatment medications such as magnesium sulfate (17.7%) and Nifedipine (29.2%) were very low, and the availability of diagnostic tests like urine albumin strips (60.8%) was not universal [22]. In Bihar, a rural Indian state and the poorest region in all of South Asia [24], these challenges are likely more severe.

Simulation-based training has been shown to be effective in promoting the use of evidence-based practices (EBP) in emergency obstetric care in low-resource settings.

Two international simulation training programs, Helping Mothers Survive (HMS) [24]

and PRONTO International [25], have demonstrated improved overall use of evidence-based practices (EBPs) in active management of third stage of labor (AMTSL) and hemorrhage management, though individual skills varied [26, 27]. For example, PRONTO's two-day training program in rural Guatemalan clinics led to, maternal hemorrhage management, newborn practices, and significant improvements in evidence-based routine delivery care [26]. Furthermore, preeclampsia-focused simulation programs in high-resource settings have demonstrated promising results. A U.S. study of nurses and obstetric residents demonstrated significantly increased eclampsia management scores when taught with simulations versus didactics [28]. Additionally, a British study evaluating the impact of simulation and skills training on eclampsia management amongst highly trained teams of midwives and doctors also demonstrated significant improvement in simulated clinical skills and efficiency [29]. However, the effectiveness of simulation-based training on diagnosis and management of PE/E in low-income settings has not been reported. To be effective in this context, interventions consider baseline knowledge and skills of care providers [12, 14, 30], as well as challenges inherent in magnesium sulfate administration and monitoring [15, 31].

PRONTO International developed an innovative simulation-based training program to address the need for provider training in PE/E diagnosis and management in Bihar. Simulation training was embedded within AMANAT, a large-scale nurse mentoring program developed by CARE India [32] and the Government of Bihar. AMANAT is a large quality improvement project targeting maternal and neonatal care throughout Bihar.

AMANAT was implemented across a total of 320 PHCs across Bihar between 2015 and 2017.

PRONTO simulation training has four unique aspects that aim to overcome the challenges associated with PE/E management in low-resource settings. First, simulations are conducted in situ, so that the simulations are as real-life as possible. Second, the intervention was high-dose. It consisted of trainings one week per month over 8 months for a total of 8 weeks of training. Third, the training program emphasized teamwork and structured communication. Fourth, to maximize simulation learning, PRONTO rigorously emphasizes the learner-centered debrief model, where participants are encouraged to reflect on their behavior, review practice guidelines, discuss teamwork and communication skills, and consider how they will apply what they learned to real-life clinical practices.

The purpose of this analysis was to assess the impact of the simulation based training program on use of EBPs for PE/E diagnosis and management among nurses in Bihar. Specifically, we aimed to evaluate changes in the use of EBPs by nurse mentees in PE/E cases (Part 1), and explore barriers and enablers to high quality PE/E care in Bihar (Part 2).

Hypothesis:

We hypothesized that simulation training would improve mentees' skills in diagnosis and management of PE/E. Specifically, we believed that mentees would increase the number of EBPS they used in PE/E simulations. With our semi-structured interviews, we sought to better understand barriers and facilitators to high quality preeclampsia care.

Methods:Study design:

This mixed methods study included a quantitative evaluation of changes in the use of EBPs by nurse mentees in PE/E simulations, and a qualitative exploration of perceived barriers and enablers to high quality preeclampsia care among nurse mentors.

Setting:

Bihar has a population of over 100 million, which is 88.7% rural [33]. The maternal mortality rate (MMR) is 208 per 100,000 live births in Bihar, compared to 167 per 100,000 for India as a whole [33]. This falls short of India's 2015 Millennium Development Goal (MDG) of 140 per 100,000 live births [34]. Bihar has the lowest literacy rate of India (61.8%) as compared to the national average (74.0%) [35]. The female literacy rate of India is 65.46% and 53.3% in Bihar [35]; of note, low female literacy rates have been shown to be moderate predictors of maternal mortality globally [36].

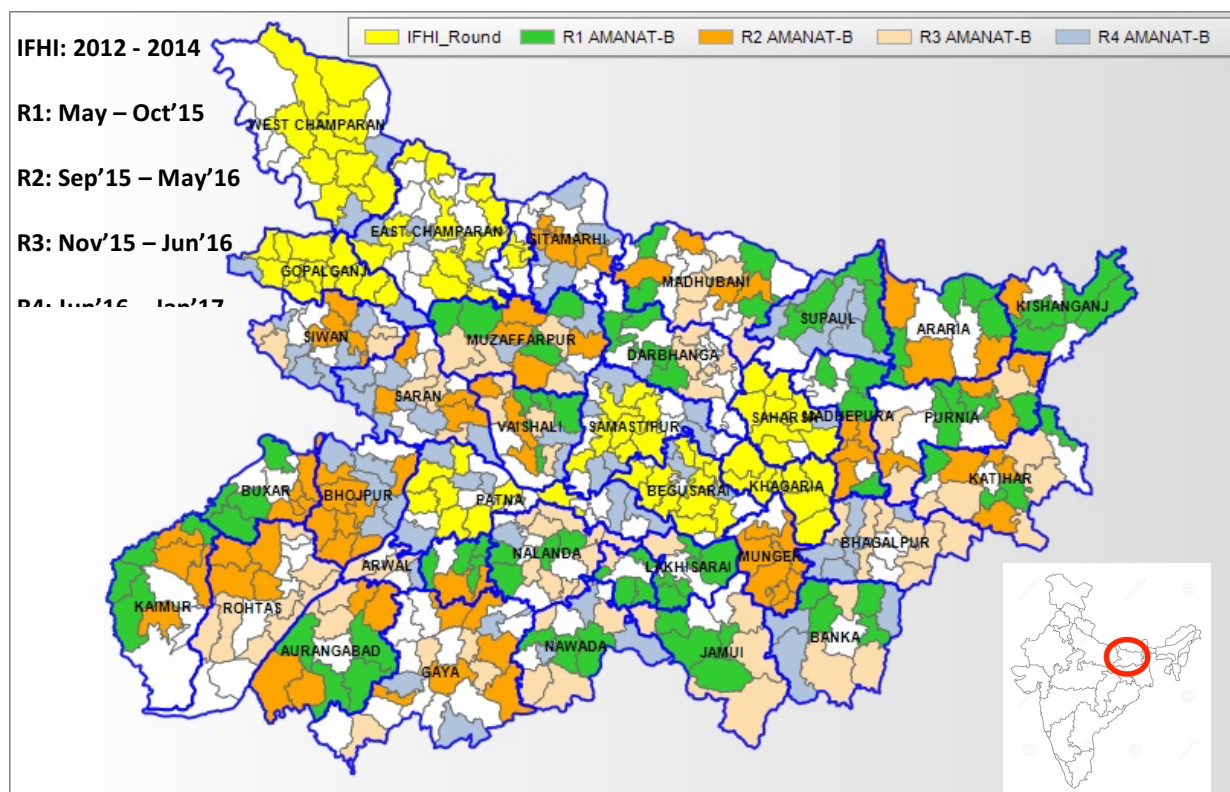
PHCs serve as the first point of contact for the majority of labor and deliveries in the region [33]. PHCs cover a population of approximately 51,000, and are staffed by a doctor or medical officer-in-charge (MOIC) and one auxiliary nurse midwife (ANM) at any given time. An average of 175 deliveries occur each year per PHC. Frequently, one ANM is responsible for the entire PHC, including emergency care and labor and delivery [33]. No PHCs have the capacity to perform cesarean sections. If surgical intervention is necessary, mothers must be transferred to public District Hospitals (DH) or private clinics. Specialists such as obstetricians, anesthetists, and pediatricians staff DHs, which are typically 1-2 hours away and serve catchment areas of one million.

The AMANAT program

The AMANAT nurse mentoring program was implemented across Bihar between August 2015 and January 2017, consisting of four geographically-distinct 8-month phases. Each phase included 80 PHCs (Figure 1).

Figure 1. Geographic distribution by phase (R1-R4) of AMANAT Nurse Mentoring intervention across facilities in Bihar. Blue lines highlight districts and the colored shading demarcates the regions where the project was implemented by round.

(Source Shah R, Walker D. Impact of simulation training on complication management in Bihar. *Lancet Glob Health*. 2018. In review)



A total of 120 nurse mentors participated in the program. Mentors were college-educated nurses recruited from across India. Prior to beginning the program, mentors completed four weeks of AMANAT mentor training with CARE India, including one week of training in simulation facilitation and debriefing, led by the PRONTO team. This was followed by a four-day refresher training four months later. Mentors were provided a menu with SimPacks™ (simulation and debriefing guides for each scenario) from which they could choose scenarios that they thought would be most helpful for their mentees. Figure 2 demonstrates a mentor training practicing the eclampsia simulation.

Figure 2. Eclamptic simulation during a mentor training in Bihar, India.



Mentees were nurses working at PHCs, who had either an Auxiliary Nurse Midwife (ANM) or General Nursing and Midwifery (GNM) degree, which require 18 months and 3 years of nursing training, respectively, following completion of secondary school. Six to eight nurses at each PHC were selected to participate in AMANAT training, for a total of 3,422 mentees across the 4 phases. Through AMANAT, mentees received training in Basic Emergency Obstetric and Neonatal Care [37].

Implementation

During each phase, 40 mentor pairs rotated between four PHCs, visiting each for one week per month over the course of the 8-month mentoring period. Mentors facilitated obstetric and neonatal emergency simulations during each visit. All simulations were

video-recorded. Each simulation was followed by a debrief, where mentees were encouraged to reflect on the simulation and consider how to apply what they learned to their clinical practice. The curriculum included a total of 31 obstetric and neonatal emergency simulation scenarios. In week 4, mentors focused on HDP, reviewing key aspects of PE/E diagnosis and management through didactics, skills stations, and simulations. Time-permitting, mentors provided additional PE/E teaching and simulation training in weeks 5 through 8.

Part 1: Evaluating change in the use of EBPs by nurse mentees in simulated PE/E cases

We evaluated change in the use of EBPs by nurse mentees in video-recorded PE/E simulations across all four phases of the AMANAT program. Two simulated PE/E scenarios were included, both involving a 17-year-old woman complaining of severe headache. If checked, mentees learned she has blood pressure (BP) of 170/112, with 3+ (brisk) reflexes, 2+ bilateral edema, and 3+ urine protein. In the second case, after a few minutes, the woman progresses to have an eclamptic seizure. Videos were matched by simulation type (severe preeclampsia or eclampsia) and facility. PHCs with two or more videos from the same simulated scenario were included, unless two videos occurred on the same day. If three videos were available, the first and last completed videos were selected.

EBP indicators were selected by clinical simulation experts from UCSF, PRONTO International, and CARE India, and merged into a coding window in Studiocode™ (Figure 3). Videos were coded in Bihar by Hindi-speaking simulation experts. After

coding, clinical indicators were excluded if they were determined to be reflective of simulation artifact. For example, ‘verbalizes correct diagnosis’ was removed because mentees often struggled with the English word “preeclampsia” and frequently misstated this term despite completing the correct diagnosis and management steps.

Fourteen binary clinical indicators, categorized by subgroup, were included in the final analysis of both scenarios: 1) ‘key history questions asked’ (headache, blurry vision, epigastric pain, gestational age); 2) ‘key diagnostic evaluations completed’ [BP, heart rate (HR), fetal heart rate (FHR), clonus or deep tendon reflexes (DTR), edema, urine protein]; and 3) ‘key management steps completed’ [intravenous (IV) catheter placed, Foley catheter inserted, magnesium sulfate given, antihypertensive given]. For eclampsia simulations, ‘key airway management steps completed’ (oxygen administered, patient repositioned laterally) was included as a fourth subgroup. Composite scores were calculated for each subgroup. In addition, mentees were evaluated on whether they correctly administered the 4 gram (g) intravenous (IV) and 10 g intramuscular (IM) doses of magnesium sulfate. Two key time-interval indicators were also assessed: ‘time from BP measurement to magnesium sulfate given’ and ‘time from BP measurement to antihypertensive given.’ If a skill was not performed (i.e. magnesium sulfate not given), this observation was excluded from the ‘time interval’ analysis. For example, if magnesium sulfate was administered in 33 of 38 PE/E simulations, the time to administration would be calculated only for the 33 videos.

Sixteen videos (20.5%) were randomly selected for double coding to assess inter-rater reliability. Cohen's kappa was >0.6 for all binary variables [38], with the exception of epigastric pain (kappa=0.59), and ICC was >0.9 for both continuous variables [39]; thus, inter-rater reliability was strong.

Figure 3. Severe Preeclampsia and Eclampsia Clinical Coding Window to Evaluate Video Recorded Simulations

ASSESSMENT	Physical Exam		MANAGEMENT		Communication		
History	Checks Vital Signs		Manuevers		Techniques		
Headache_1	BP Assess_1	BP Report_1	IV Placed_1		SBAR_1		
Blurry vision_1	Pulse Assess_1	Pulse Report_1	Foley catheter inserted_1		Check back_1		
Epigastric pain_1	FHR Assess_1	FHR Report_1	Repositioned_1		Call for help_1		
Asks decrease urination_1	Exam		Oxygen given_1		Referral		
Asks GA_1	Check fundal height_1		Airway suctioned_1		Patient delivered_1		
Asks gravida_1	Check mental status_1		Medications		Patient referred_1		
Asks baby moving normally_1	Check clonus_1		MgSO4 ord_1	MgSO4 given_1	10g_1	Consultation with doctor_1	
Video Quality	Check DTR_1		AntiHTN ord_1	AntiHTN given_1	4g_1		
	Check oedema_1				Mg other_1	Nife 5mg_1	Communicate with referral hospital_1
Play video_1	Vaginal Exam (Digital)_1		Other med ord_1	Other med given_1	Nife 2.5mg_1	Communicate with patient and family about condition/plan_1	
Problem seeing_1	Urine protein test_1				AntiHTN other_1		
Unable to hear_1	Verbalizes correct dx_1				Handed over referral slip_1		
Coaching_1	Seizure_1						

Statistical analysis

The proportions of clinical skills, subgroup composite scores, and key time intervals completed during mentees' first and last exposures to PE/E simulations were compared using generalized estimating equations (GEE). Simulation videos were paired simulation by facility and simulation type (severe preeclampsia or eclampsia). All analyses were

adjusted for time (days) simulation performances. Regression assumptions included normality, homoscedasticity, outlier and influential analysis were examined for any violations. All analyses were conducted in R Core Team version 0.99.903 (R Foundation for Statistical Computing, Vienna, Austria) [40].

Part 2: Perceived barriers and enablers to high quality PE/E care among nurse mentors

We assessed nurse mentors' perceptions of the barriers and enablers to high quality PE/E clinical care in PHCs in Bihar, India, which were conducted in April 2017. Participants were selected by purposeful sampling using the following criteria:

- 1) Mentors were currently employed by CARE – AMANAT at the time of the interview.
- 2) Preference was given to mentors who worked in different geographic regions.
- 3) Preference was given to mentors who did not previously participate in PRONTO-related interviews.
- 4) If both mentors met these criteria, one of them was randomly selected.

The interview guide used open-ended questions exploring successes, barriers, and enablers of the preeclampsia curriculum (Appendix 1). The guide also promoted flexibility to address new and emerging themes. In-depth interviews were conducted by the first author and one team member based in Bihar. The Indian interviewer was fluent in Hindi and had qualitative research experience. All interviews were conducted in English. Pilot interviews were conducted to identify and revise unclear interview questions. Consent was attained prior to recording interviews. Interviews were held in a

private room at the PRONTO office, or if unavailable, in private hotel rooms. Interview duration ranged from 42 to 66 minutes.

Thematic analysis

Interviews were transcribed by the UCSF interviewer, with assistance from a transcription service in Bihar. To improve transcription quality, the UCSF interviewer listened to audio recordings and revised transcriptions when needed. Data were analyzed using the thematic content approach [41, 42], which consists of four steps:

- 1) Familiarization with the data.
- 2) Identifying codes and themes.
- 3) creating a coding framework and applying it to the data.
- 4) Revising and organizing codes to incorporate all emerging themes.

After reading through all the transcripts, an initial coding framework was created and discussed with the UCSF and Bihar team. In addition, two interviews were double coded by the first author and a UCSF researcher; discrepancies in coding were discussed and resolved to develop the final coding framework, which was applied to the remaining interviews.

Ethical Considerations

All participants in the simulation video analysis provided informed consent. Following a full explanation about the study by the first author and a local PRONTO employee, written consent was obtained from all interview participants. Ethical approval was granted from the Committee on Human Research at the University of California San

Francisco (14-15446) and the Institutional Review Board of the Indian Institute of Health Management Research.

Results:

Part 1: Evaluating change in the use of EBPs by nurse mentees in simulated PE/E cases

A total of 39 severe preeclampsia and eclampsia paired simulation videos were analyzed. Nurse mentees employed in the facilities where these videos occurred had an average of 12 years of experience. Simulations had a median of 2 (range 2-3) participants each. The mean duration between first and last participation in simulations was 60 days (range: one day to 125 days). The proportion of simulated PE/E cases in which mentees completed key history, diagnostic, and management steps is displayed in Table 1. The proportion of simulations in which mentees ‘asked about epigastric pain’ increased from 43.6% to 51.3% ($p=0.03$), and the proportion in which ‘Foley catheter was inserted’ trended upwards from 38.5% to 56.4% ($p=0.06$). Mentees also demonstrated improvement in two composite scores. Total number of ‘history questions asked’ increased from 1 to 2 ($p=0.03$) and total number of ‘management steps completed’ increased from 2 to 3 ($p=0.03$).

Table 1. Proportion of simulated preeclampsia and eclampsia cases in which nurse mentees completed key history, diagnostic, and management steps (N=39 matched pairs)

	First simulation	Last simulation		
History questions	n (%) [§]		Percentage change [#]	p-value
Headache	28 (71.8)	32 (82.1)	10.3	0.25 [‡]
Blurry vision	17 (43.6)	20 (51.)	7.7	0.49 [‡]
Epigastric pain	1 (2.6)	7 (17.9)	15.4	0.01 [‡]

Asks GA	8 (20.5)	12 (30.8)	10.3	0.14 [‡]
Total steps completed (median, IQR [*])	1.0 (1.0-2.0)	2.0 (1.0-2.0)	1.0	0.03 [∞]
Diagnostic tests				
BP assessed	39 (100.0)	39 (100.0)	0	NA
FHR assessed	29 (74.4)	30 (76.9)	2.6	0.08 [‡]
Fundal height measured	3 (7.7)	7 (17.9)	10.3	0.15 [‡]
Clonus or DTR	9 (23.1)	6 (15.4)	-7.7	0.44 [‡]
Edema	8 (20.5)	12 (30.8)	10.3	0.30 [‡]
Urine protein test	12 (30.8)	11 (28.2)	-2.6	0.80 [‡]
Total steps completed (median, IQR [*])	3.0 (2.0-3.0)	3.0 (2.0-3.0)	0	0.39 [∞]
Management steps				
Magnesium sulfate given	33 (86.4)	32 (82.1)	-2.6	0.74 [‡]
Antihypertensive given	22 (56.4)	28 (71.8)	15.4	0.20 [‡]
IV placed	16 (41.0)	24 (61.5)	20.5	0.08 [‡]
Foley catheter inserted	15 (38.5)	22 (56.4)	17.9	0.06 [‡]
Total steps completed (median, IQR [*])	2.0 (1.5-3.0)	3.0 (2.0-4.0)	1.0	0.03 [∞]
Airway management steps (N=13 matched pairs[^])				
Oxygen given	9 (34.6)	9 (34.6)	0	1 [‡]
Patient repositioned	19 (73.1)	17 (65.4)	-7.7	0.56 [‡]
Total steps completed (median, IQR [*])	1.0 (0.25-2.0)	1.0 (0.25-1.75)	0	0.71 [∞]

[§] n = Frequency of first and last simulated cases in which mentees completed key EBPs

[%] = Proportion of first and last simulated cases in which mentees completed key EBPs

^{*} IQR = interquartile range of total number of steps completed

[#] Difference in proportion of EBPs completed from first to last participation in simulated case

[‡] GEE logistic regression adjusted for duration (in days) between first and last simulations

[∞] GEE linear regression adjusted for duration (in days) between first and last simulations

[^] Airway management steps analyzed in simulated eclampsia cases only

A more granular look into the accuracy of the magnesium sulfate loading dose is displayed in Table 2. During their first simulation, mentees gave the correct complete dose 25.6% of the time compared to 41.0% during their final simulation ($p = 0.24$).

Table 2. Proportion of simulated preeclampsia and eclampsia cases in which nurse mentees completed IM & IV doses (N=39 matched pairs)

Clinical Skill	First Exposure		Last Exposure	
	n (%) [§]		Percentage change [#]	p-value [‡]
Magnesium sulfate 10 g (IM)	26 (66.7)	28 (71.8)	5.1	0.80
Magnesium sulfate 4 g (IV)	13 (33.3)	19 (48.7)	15.4	0.24
Correct dose magnesium sulfate	10 (25.6)	16 (41.0)	15.4	0.24

§ n = the number of *first and last exposure* simulations in which key clinical skill was completed

% = percent of *first and last exposure* simulations in which key clinical skill was completed

GEE logistical regression adjusted for time between simulations

‡ GEE linear regression adjusted for time between simulations

Time to the completion of key management steps by mentees in simulated PE/E cases is displayed in Table 3. Time from ‘BP measured to antihypertensive given’ decreased by 3.1 minutes ($p=0.06$), while time from ‘BP measured to magnesium sulfate given’ remained relatively constant ($p=0.69$).

Table 3. Time to completion of key management steps by nurse mentees in simulated preeclampsia and eclampsia cases

Time to completion of management steps	First simulation		Last simulation	Median time change in minutes	p-value
	N	Median time in minutes (IQR)			
BP measured to magnesium sulfate given	63	3.7 (2.2-4.5)	3.0 (1.8-6.4)	- 0.7	0.69
BP measured to antihypertensive given	47	5.8 (2.6 - 9.7)	2.6 (1.0 - 6.6)	-3.2	0.06

‡ GEE linear regression adjusted for duration (in days) between first and last simulations

Part 2: Perceived barriers and enablers to high quality PE/E care among nurse mentors

Mentor demographics

A total of 12 nurse mentors were enrolled. Their demographics are shown in Table 4. All had bachelor's degrees in nursing, 2 were GNMs, and 2 were pursuing master's degrees in nursing. Mentors came from geographically diverse states: Uttar Pradesh (3), Mumbai (2), Bombay (1), Kerala (2), Delhi (1), Tambalato (1), Chhattisgarh (1), West Bengal (1). Notably, no mentors were from Bihar.

Table 4. Characteristics of Nurse Mentor Participants, N = 12

Mentor Characteristics	N	
Age (median, range)	10	25.5 (22-28)
Bachelors in Nursing or Higher	12	18 (100%)
Years of Nursing Experience	12	1 (0-4)
Years of CARE Employment	10	1.5 (0.8 – 2)
<i>Prior Clinical Experience</i>		
Pediatrics/Neonatal ICU*		4 (33.3%)
ICU/Adult Wards*		3 (25.0%)
Clinical Instructor		2 (16.7%)
None		2 (16.7%)
Unknown		2 (16.7%)

*one nurse mentor had experience in both the adult and neonatal ICUs.

§ Median rating and interquartile range

Knowledge barriers

Despite tremendous improvement, mentors noted a few sources of confusion for mentees (Table 5). These included diagnostic criteria of severe preeclampsia (83%), calculation of the magnesium sulfate loading dose (66%), and seizure management (50%). Confusion regarding diagnostic criteria may be partially explained by the fact that during the AMANAT intervention, the diagnostic criteria for severe preeclampsia changed: at the

beginning of phase 1, a severe preeclampsia diagnosis required severe range hypertension (BP \geq 160/110) AND, proteinuria (\geq 3+ urine protein strip) AND one additional sign of end organ damage (headache, AMS, change in vision, epigastric pain). Halfway through phase 1, the criteria changed and included only one of the following: severe hypertension (BP \geq 110/160), proteinuria (\geq 3+ urine protein strip), sign of end organ damage. Three mentors said this was confusing for their mentees, and two mentors admitted that they were also confused by these changes.

They can do eclampsia and preeclampsia. But they're confusing like uh mild and severe....sometimes previously I also confuse what I will do. (Age 28)

The diagnostic confusion was likely exacerbated by the fact that mentees at times had trouble assessing the quality of a symptom. For example, they had trouble distinguishing between exhaustion headaches and the fierce headaches of preeclampsia, or labor pains versus the left upper-quadrant epigastric pain associated with preeclampsia-related liver pathology.

Epigastric [pain] they are not able to differentiate with labor pain. (Age Unknown)

Nine mentors said that calculating the loading dose of magnesium sulfate, where percentages are converted to grams, was very challenging for their mentees.

Mentees, [with] ANM training, they don't know what is mg [milligram], so it's quite difficult. (Age 28)

Mentors also felt that mentees continued to have difficulty with management of eclamptic seizures. They attributed this to the low incidence of eclampsia and fear.

She's having seizure, they won't be able to do proper management because they will get panicked. (Age 22)

Table 5. Themes of barriers and representative quotations			
Theme	Subtheme	Frequency*	Representative quotation
Knowledge barriers	Diagnostic confusion	10 (83%)	<i>They can do eclampsia and preeclampsia. But they're confusing like uh mild and severe....sometimes previously I also confuse what I will do. (Age 28)</i>
	Difficulty calculating the loading dose	8 (67%)	<i>Mentees, [with] ANM training, they don't know what is mg [milligram], so it's quite difficult. (Age 28)</i>
	Seizure management	6 (50%)	<i>She's having seizure, they won't be able to do proper management because they will get panicked. (Age 22)</i>
Interpersonal barriers	Hierarchy	12 (100%)	<i>Yeah, they [nurses] are scared. If they tell something, also the doctor will say, that, "You know more than me, you're a doctor. You think that you are a doctor. You are not there to teach me. (Age 28)</i>
	Stressed provider/patient communication	9 (75%)	<i>Actually, the thing is, more than the staff nurses, the patients' attendants [relatives] are more nervous. And because of their nervousness—the Sisters [nurses] and doctors they get nervous on top of that...So it becomes a clash between them—And then the fight begins. (Age 28)</i>
Resource barriers	Human resource shortages	12 (100%)	<i>So 20, for 20 patients, only one sister [nurse] is there to check BP and take delivery. Often, it's very difficult... so identification, early identification is not possible. (Age 28)</i>
	Limited supplies	12 (100%)	<i>No in our facilities there were no magnesium sulfates. Or they will have magnesium sulfate, (laughs) but they were expired. Because nobody think uh magnesium sulfate is necessary uh to prevent eclampsia... Doctors don't have any sufficient knowledge. (Age 23)</i>
	Ambulance shortages	7 (58.3%)	<i>In Bihar like 80 percentage of ambulance is not working (laughs). It's the main problem. So after, after one hour, two hours, finally we got that vehicle. A private vehicle. (Age 28)</i>

Interpersonal Barriers

Mentors perceived the strict hierarchy between the nurses and the doctor (100%) and tense nurse-patient relationships (75%) to be important barriers to high-quality preeclampsia care. Several mentors described how mentees are reluctant or, in more extreme cases, refuse to question the medical decisions of the doctors because doctors expect that their orders will be followed without question.

Yeah, they [nurses] are scared. If they tell something, the doctor will say that, "You know more than me, you're a doctor. You think that you are a doctor. You are not there to teach me." (Age 28)

By law, nurses cannot administer a loading dose of IV magnesium sulfate without a doctor's permission. Nearly all mentors mentioned that this requirement decreased the frequency of IV magnesium sulfate administration (92%).

The majority of mentors reported that the aggressive behavior of patients' family members prevented nurses from providing evidence-based care (75%).

If anything happens, they're beating us. (Age 26)

Mentors were unsure of what led to this aggressive behavior, but they discussed fear, lack of education, previous medical mistreatment, and limited understanding of what was happening as important factors.

Actually, the thing is, more than the staff nurses, the patients' attendants [relatives] are more nervous. And because of their nervousness—the sisters [nurses] and doctors they get nervous on top of that...So it becomes a clash between them—And then the fight begins. (Age 28)

Resources barriers

All mentors agreed that human resource shortages (e.g., in the number of doctors and nurses) were a key barrier. One to two nurses covered the entire PHC including emergency care, vaccinations, and labor and delivery; doctors were frequently absent altogether.

“So 20, for 20 patients, only one sister [nurse] is there to check BP and take delivery. Often, it's very difficult... so identification, early identification is not possible.” (Age 28)

“Most of the times doctors are not available in the PHCs. They used to go for some meetings or some trainings... Or they go to their private clinics. They go to other clinics.” (Age 23)

Contributing factors to the widespread shortage of doctors in PHCs were perverse financial incentives and corruption. Many doctors had their own private clinics where they earned much more than in the public PHC facilities. This system encouraged many

doctors to spend nearly all of their time outside of the PHC and simply refer complicated cases by phone.

Most mentors felt that shortages of medications and urine protein strips were the most important physical resource barriers to high quality PE/E care. Half of mentors felt that lack of ambulances was a key problem. The combination of ambulance shortages, costly private vehicles, and long distances between PHCs and referral hospitals made it nearly impossible to effectively refer patients requiring a higher level of care. A few mentors mentioned lack of functional oxygen cylinders as a barrier. One mentor described how the lack of supplies in one PHC prevented mentees from adequately treating a woman with severe preeclampsia.

I was scared... Because now, mother, she is having bad headache. [Elevated] BP is there. No magnesium sulfate is there. No Nifedipine is there... After one hour, she got eclampsia. (Age unknown)

The mother described above was subsequently transferred to a private clinic, where she delivered vaginally without receiving any medications to treat her condition. She recovered, but her baby died of birth asphyxia.

Learning enablers

All mentors agreed that simulation training was an important enabler of high quality care (Table 5).

Simulation is very important. And by doing simulation they will learn, they will remember that for lifetime. Because in theory [didactics] they will write and they will after some days they will forgot. By doing simulation they are remembering—yeah once I had this case and I manage like that. (Age 22)

Almost all viewed mentoring during live cases as a helpful tool. Mentors felt that mentoring in live cases helped to develop mentees' confidence, enabling them to independently treat PE/E.

If they're managing one time, after that they, they don't even want support. (Age 26)

Mentors also thought that cognitive aids supported mentees' implementation of EBP. For example, case sheets (documentation paperwork implemented during AMANAT) and descriptive charts improved mentee clinical performance. Case sheets provided key history questions, normal vitals sign ranges, diagnostic criteria, management steps, and a referral sheet to be filled if a patient was being referred to a higher facility. Its impact was multifaceted. Mentors thought that case sheets encouraged mentees to take more complete histories (50%) and check vitals (25%), which assisted them with diagnoses.

Before mentoring no they were just writing their name, age, and LMP sometimes. They were not asking obstetric score and their previous history. After that we introduced case sheet in first week, so after that they started taking. (Age 22)

So in case sheet it was perfectly written the diagnosis for the preeclampsia. So was severe preeclampsia and eclampsia ... the symptoms were all described. So it was easier for them to pick it up that which, in which category the patient is coming. (Age 23)

Additionally, eleven mentors believed the referral sheet, which was embedded within the case sheet, improved communication between the PHCs and the referral centers.

It [documentation] has improved through the case sheet. Like they prepare when discharge paper and they have written whatever they've did, whatever the care they've given, or what happened. (Age 22)

Descriptive charts that described how to mix the magnesium sulfate loading dose (33%) were also considered to be helpful; mentors advocated for hanging them in the labor room, so that mentees would have a reference during high stress situations.

Table 6. Themes of enablers and representative quotations			
Theme	Subtheme	Frequency*	Representative quotation
Learning enablers	Simulations	12 (100%)	<i>Simulation is very important. And by doing simulation they will learn, they will remember that for lifetime. Because in theory [didactics] they will write and they will after some days they will forgot. By doing simulation they are remembering– yeah once I had this case and I manage like that. (Age22)</i>
	Mentoring during cases	11 (92%)	<i>If they're managing one time, after that they, they don't even want support. (Age 26)</i>
	Cognitive aids	6 (50%)	<i>So in case sheet it was perfectly written the diagnosis for the preeclampsia. So was severe preeclampsia and eclampsia ... the symptoms were all described. So it was easier for them to pick it up that which, in which category the patient is coming. (Age 23)</i>
Communication enablers	Clinical discussions	6 (50%)	<i>Communication has changed a lot. We show them [doctors] guidelines sometimes, and we do clinical discussion. The mentor who had that case will present the clinical picture. The doctor [and nurses] also will be there. So after the discussion, he also have the idea now, that yes, definitely this has to be given, and what is the benefit of it... because of this clinical discussion, the thing has little bit calmed down. (Age 28)</i>
	Professional communication techniques	3 (25%)	<i>Sometimes some mentees they [...] do the “Two-Challenge Rule.” [They say] We can't give the Lasix - we are not preventing the convulsions. And for the BP for the BP we have to give Nifedipine. (Age 25)</i>
Leadership enablers	Doctor buy-in	4 (33%)	<i>In PHC, medical officer will stay at home and in many emergencies they will call just call..., but now they are coming, they are seeing, and CARE block managers are also there, so mentees are having support now. (Age 22)</i>

Communication enablers

Mentors perceived that professional communication techniques facilitated effective communication between doctors and nurses. Clinical discussions provided a formal setting for nurses and doctors to discuss complicated cases and review guidelines. These interprofessional sessions fostered teamwork and increased institutional support for nurse mentees. Some mentors believed that this platform, by allowing mentees to demonstrate their proficiency, weakened the institutional hierarchy between doctors and nurses.

In addition, mentors described the “two-challenge rule” as a useful technique for respectfully challenging decisions made by superiors. One mentor described how the “Two-Challenge Rule” empowered mentees to question the improper treatment advice, only Lasix to treat severe preeclampsia, that a doctor ordered.

Sometimes some mentees they [...] do the “Two-Challenge Rule.” [They say] We can’t give the Lasix - we are not preventing the convulsions. And for the BP for the BP we have to give Nifedipine. (Age 25)

In this example, mentees demonstrate their knowledge that severe preeclampsia must be treated with an anticonvulsant, magnesium sulfate, and Nifedipine for the elevated blood pressure.

Leadership enablers

Mentors perceived that doctor buy-in was critical to the program's success. They described that doctor workshops helped doctors become better leaders, championing the program. Further, some mentors felt that these workshops allowed doctors to become comfortable prescribing IV magnesium sulfate.

In PHC, medical officer will stay at home and in many emergencies they will call just call..., but now they are coming, they are seeing, and CARE block managers are also there, so mentees are having support now. (Age 22)

Discussion

To reduce maternal deaths in Bihar, it is essential that primary health providers are able to effectively diagnose and manage PE/E. To our knowledge, no studies have reported the impact of simulation training on use of EBPs for PE/E by providers in low-resource settings. We found that mentees demonstrated improvement in several domains including history taking and clinical management. However, only one individual EBP improved significantly. The reason for this likely is multifactorial, encompassing both the need for additional training as well as resource and interpersonal barriers.

Mentees demonstrated improvement in history taking between simulation episodes. The median number of history questions asked improved by one ($p = 0.03$). In addition, the proportion of times mentees asked about epigastric pain improved significantly ($p = 0.03$). This improvement, while modest, represents a success of the training program. While simulation is thought to be an effective tool to improve history taking skills [43], it

has not been explored in the preeclampsia or low-resource literature where patients are acutely sick and providers are less skilled. The first step in successful management of PE/E is diagnosis, and asking about the signs and symptoms of a preeclampsia demonstrates that mentees internalized clinical indicators of severe preeclampsia and were able to apply this knowledge to a life-like clinical case.

However, mentees rarely asked about epigastric pain despite improvement (17.9%). The low-rate of questioning about epigastric pain may be attributed to the fact that to receive credit for this question, the mentee had to distinguish epigastric pain from labor pain. Mentors thought this was a challenging distinction for mentees. Future PRONTO trainings should emphasize the importance of these history questions and help learners better characterize the quality of symptoms.

Mentees did not improve in their ability to perform diagnostic tests or manage seizures. The low completion rates of urine protein assessment (28.2%) and oxygen given (34.6%) may be partially attributed to supply shortages [15, 44-46]. The common lack of availability of certain supplies likely contributes to providers not incorporating them into routine use.

The total number of key management steps increased overtime. Notably, however, magnesium sulfate administration did not improve, which is unlike results following PE/E simulation trainings in high resource settings [28, 29]. Nonetheless, the rate of magnesium sulfate administration (76%) is much higher than that seen in the CLIP study,

which found that IV magnesium sulfate was never administered by nurses in PHCs [21]. Additionally, a written pre and post assessment administered by AMANAT demonstrated an increase from 10% to 50% in the number of nurse mentees who knew the correct dose of magnesium sulfate for eclampsia ($p < 0.001$, data not shown). The AMANAT assessments did not collect any additional PE/E baseline data. The AMANAT pre-test assessment data indicates that the initial simulation scenario by PRONTO likely overestimated mentees' baseline skills. This could have occurred during didactics and skill stations that occurred prior to simulation. The limited improvement between simulations may also be better understood by further exploring magnesium sulfate administration. While 71% of mentees administered 10 g IM, only 33% administered the IV dose. There are several likely reasons for this low completion rate. First, a few mentors perceived that some mentees continued to struggle with the loading dose calculation. This perception is consistent with the literature that has found the complexity of dosing is a barrier to magnesium sulfate administration [31]. Second, in Bihar PHCs, IV magnesium sulfate requires physician approval. Mentors believe that doctors rarely provide this approval. This may be causing mentees to not administer the IV dose in simulations. This hierarchical barrier is consistent with the literature in other low-resource settings; a Nigerian study found that strict guidelines preventing lower-tier health workers from administering magnesium sulfate significantly reduced its use [47].

Key seizure management steps also demonstrated no improvement between simulations. This may be because this skill was only assessed in eclamptic videos, and individual skills were only powered to see a clinical difference of 40%. Further, unlike the U.S.

study [28], no changes were seen in clinical efficiency. However, the time from blood pressure measured to antihypertensive given trended downwards ($p = 0.06$).

In order to understand and improve the simulation program, we examined the perceived barriers and enablers of PE/E care by interviewing the nurse mentors. We found that knowledge gaps, human and physical resource shortages, and interpersonal barriers all reduced the quality of PE/E care in Bihar. Previous studies have identified similar barriers including supply issues [9,22], human resources shortages [47], inefficient transport [16], and issues of hierarchy [48]. Our study affirms these findings and contextualizes them in Bihar. This study additionally highlights poor relationships between nurses and patients, including providers fearing retaliation for negative health outcomes, as an additional barrier to providing evidence-based, compassionate care.

Other studies have identified effective leadership [12], teamwork between doctors and nurses [30, 48], and targeted education and training approaches [48] as key facilitators to improved obstetric care in low-resource settings. Our findings corroborate these conclusions and detail promising intervention strategies, such as doctor workshops to effectively engage doctors, even when doctors are not the primary target of an intervention. We found that clinical discussions and communication techniques, such as the two-challenge rule, can improve communication between providers. This finding is consistent with results from high-resource settings [49, 50] and indicates that team-based interprofessional trainings can be successful in highly hierarchal cultures of southeast Asia [51]. Our study further demonstrated that simulations and live cases promoted PE/E

knowledge. This finding is consistent with adult learning theory that suggests that adults learn best by doing [52].

Limitations

This study has several limitations. Changes in the use of EBPs were evaluated through simulations, by comparing mentees' first and last participation in simulated PE/E cases.

As a result of this approach, different amounts of time elapsed between simulations.

However, changes in mentee performance were robust to adjustments for time.

Additionally, the format of PE/E teaching, which included didactic sessions, make it challenging to get a true assessment of baseline skills and knowledge of PE/E.

Simulations were performed after an initial educational review of PE/E to maximize learning during the experience. Prior educational exposures of the mentees included skills stations and rapid review, which prevents the first simulation from being a true assessment of baseline skills and knowledge of PE/E. Exposure to workshops/training of the mentees prior to the first simulation was not accounted for and therefore could not be controlled for. This may account for the relatively small changes seen between the two simulation videos.

In addition, the interviewers were members of the PRONTO research team, which may have facilitated social desirability bias. To increase content validity, a local Hindi interviewer was present at all interviews, and participants were ensured their responses were completely confidential in nature

Conclusion

The implementation of EBPs among nurses working in low-resource PHCs in Bihar were sustained or improved over the course of the eight-month intervention. No EBPs decreased and mentees demonstrated improvement in history taking and management. Further, we anticipate a larger effect if there was more accurate assessment of baseline data. Nevertheless, while enablers including learning tools, communication techniques, and effective leadership can contribute to these positive changes, several barriers including diagnostic confusion, hierarchy, and stressed patient-provider communication made the successful implementation of these skills and translation into clinical settings challenging. Further, we anticipate that these barriers will have an even larger impact on mentees use of EBPs in clinical settings because, despite efforts to maintain fidelity, simulations are idealized situations. Given these many challenges, we hypothesize that to have a meaningful impact, the training cannot occur in isolation [54]. Instead, simulation training must be embedded within a multipronged approach that addresses systemic issues such as supply and human resource availability, feedback loops, clear responsibility delineation for all providers, mitigation of violence against providers, processes to address patient complaints, among others.

Our finding of multilevel barriers is consistent with results from the WHO Safe Childbirth Checklist Program in India [54], one the largest women's health program ever implemented. This study found that the checklist led to increased use of EBPs at 2 and 12 months. However, they found no significant improvement in maternal or perinatal outcomes or severe maternal complications within 7 days of delivery between control and

intervention groups. Of note, there was no difference in seizure rates or magnesium sulfate use between control and intervention facilities. The authors concluded that contextual barriers including persistent skills gaps in complication management, access to supply and medications, and systems level accountability decreased the impact of the program. Looking forward, they called for programs to use systemic approaches that are adaptive and contextually precise.

The next iteration of PRONTO educational interventions will take into account several of these findings by addressing contextual barriers in Bihar. For example, it will make two simulation modifications to mitigate hierarchical and patient-provider relationship barriers. The next iteration of training will include interprofessional trainings with doctors and nurses. This will provide a protected situation for them to work together, and reflect critically on their teamwork, and develop professional communication skills. Second, the curriculum will include a simulation with an ‘aggressive’ family member. Following this simulation, mentors will encourage mentees to reflect on successful communication skills to reduce conflict and discuss methods of providing empathic care to ‘difficult’ patients. Finally, we will continue to foster strong in country partnerships with local partners and government. We acknowledge that only in concert with a multisystem intervention will a complication management training help promote maternal survival throughout the rural districts of Bihar.

Appendix

1. Mentor Semi-Structured Interview Guide

Preeclampsia & Eclampsia Management Quality

Objectives:

1. How did mentors perceive the treatment of pre-eclampsia and eclampsia at the beginning of training in facilities?
2. How do mentors perceive mentees treatment of pre-eclampsia and eclampsia following mentor training?
3. What do mentors perceive as barriers to high quality preeclampsia treatment?
4. What are the successes, limitations, and next steps of pre-eclampsia/eclampsia simulation training?

Study ID:

Interview Date:

Ice breaker

I want to take some time today to talk to you about management of pre-eclampsia and eclampsia. First, I would like to learn a little bit about your background.

1. How long have you worked as a nurse after finishing your education?
2. How long have you worked as a nurse mentor with CARE?
3. What was your favorite part about being a nurse-mentor?
4. Did you see a lot of pre-eclamptic and eclamptic mothers in the BEmONC facilities you worked in?
 - a. How many per month?
 - b. Can you tell me about one particular pre-eclamptic or eclamptic patient that you remember? Starting from when she walked into the clinic, can you tell me what happened during this case?

Define treatment of pre-eclampsia and eclampsia at the beginning of training

1. Think about the nurse mentees that you worked with at the primary health centers. Think about when you first arrived at the facilities, before you started teaching anything. Imagine a woman with 30-weeks gestation presents to clinic with severe headaches and blurry vision. Will you please describe what would have been done for her?
 - a. Who and how many people would have taken care of her?
 - b. How will they diagnose her condition?
 - i. What questions would the nurses have asked?
 - ii. What Physical exam will be done?
 - c. Medical management?
 - d. What would have happened if she had had a seizure?

- e. Would she be referred? What would that look like?
 - i. Type of Transport, communication with patient and family and communication with referral centre?
2. discussing nurse mentee skill in pre-eclampsia and eclampsia treatment. There are two sides to this worksheet. The first discusses mentee performance at the beginning of the training. The back side discusses nurse mentee skills at the end of the training. First, please think about the nurse mentees that you worked with at health facilities **when you first arrived at the facilities, before you started teaching anything**. I am going to ask you to rate the quality of your mentees' pre-eclampsia and eclampsia skills. I would like you to rate the quality of the skills on a scale of 1 to 5 with 1 meaning strongly disagree and 5 meaning strongly agree. *Consider asking the mentor to give an example for each topic discussed.*
 - a. Which section or sections did you rate the highest? Tell me more.
 - b. Which skill did you rate the highest? Please explain.

Define treatment of pre-eclampsia and eclampsia following training

1. Now think about after you completed mentoring at each facility (this means after didactics, activities, and simulation). At this time what would treatment have been like for the same woman who presents with headache and blurry vision? Will you please describe what would have been done for her?
 - c. What questions would the nurses ask?
 - d. Physical exam?
 - e. Medical management?
 - f. Referral?
 - g. What would have happened if she had had a seizure?
 - h. Would she be referred? What would that look like?
3. Again, I would like to return to the back side of the worksheet where you rated mentees on a scale of 1-5. Now please rate the mentees at the end of simulation training.
 - a. Which sections do you think improved the most? Tell me more about that?
 - b. Which parts of pre-eclampsia remain challenging for nurse mentees?

Define barriers to quality pre-eclamptic/eclamptic diagnosis and management:

1. In facilities where you mentor, what things prevent good diagnosis and management of pre-eclampsia/eclampsia from happening?
 - a. Is the ability to diagnose pre-eclampsia a problem?
 - b. Is the confidence of the providers a problem? Tell me more.
 - c. The number of available doctors and nurses?
 - d. Is the availability of medications a problem? Of equipment?
 - e. Is communication a problem? Between providers? Between provider and patients?
 - f. Is the referral process a problem? Tell me more.

Definite successes and limitations of the simulation program:

Now I would like to talk specifically about the pre-eclampsia curriculum. You have taught Pre-eclampsia diagnosis and management through various methods such as discussion, videos, practical and simulation training.

1. Which teaching methods did you find most helpful? Why?
2. Which teaching methods did you find least helpful? Why?
3. What did mentees learn in pre-eclampsia simulations that they did not learn in other parts of the pre-eclampsia training?
4. What did they learn better in the other methods of teaching?
5. What issues of pre-eclampsia diagnosis and management did you commonly address in the debrief?
 - a. Were there any particularly challenging concepts for mentees?
 - b. What were the reactions of the mentees when you addressed these?
6. Are there any particularly challenging concepts for you as a mentor?
 - a. How confident do you feel in managing and monitoring a pre-eclamptic patient?
 - b. Which management questions do you find most challenging?
7. Do you think simulations are helpful in teaching mentees to diagnose pre-eclampsia?
 - a. Do they already know the diagnosis before the beginning of the simulation?
8. In your opinion, are the pre-eclampsia and eclampsia cases similar to real cases?
 - a. Do you perceive that the mentees have the same challenges in simulations that they have with real patients?
9. Are eclamptic simulations that incorporate seizures good practice for the nurse mentees?
 - a. Do mentees feel overwhelmed?
 - b. Does it affect the comfort level they have with administering mg? antihypertensives?
10. Now I would like to ask you to think creatively about how to improve the current training curriculum.
 - a. What pre-eclampsia diagnosis and management skills are not taught well using the current teaching methods?
 - b. How could we teach these skills better?
 - c. Do you think enough time is devoted in the curriculum to pre-eclampsia?

This is the end of the interview. Thank you so much for your time and help. I am very grateful for all the information and ideas you have shared. Do you have any questions for me?

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