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Helping Mothers Survive, Bleeding After Birth: An Evaluation of Simulation-based training in a Tertiary Hospital of Eastern Nepal

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ABSTRACT

Introduction: Postpartum hemorrhage is the leading cause of maternal mortality worldwide, especially in resource-limited settings like Nepal. Simulation-based training is a proven educational approach that equips healthcare providers with the critical knowledge and skills necessary to manage postpartum hemorrhage effectively.

Objectives: The objective was to evaluate the effectiveness of simulation-based training on Helping Mothers Survive: Bleeding After Birth in strengthening healthcare providers' competencies in managing PPH and shock in a tertiary hospital in eastern Nepal.

Methodology: A simulation-based educational intervention was conducted in two phases: first phase took place on 26-27th June, 2023 and the second on 3-4th January, 2024, among 44 healthcare professionals. Helping Mothers Survive standardized assessment tools were used for Pre-test and Post-test knowledge on postpartum hemorrhage, and shock management and skill evaluations in Active Management of Third Stage of Labour, atony, bimanual compression, and condom tamponade, and shock management. Data were analyzed using paired t-tests in SPSS version 23, with $p < 0.05$ considered significant.

Results: Among 44 healthcare professionals the mean knowledge scores for postpartum hemorrhage and shock management improved significantly from 11.77 ± 1.89 to 14.0 ± 1.01 ($p < 0.001$) and 4.27 ± 1.32 to 7.38 ± 0.56 ($p < 0.001$) respectively. OSCE results showed that all participants passed Active Management of Third Stage of Labour L and shock management. Forty-two out of 44 participants (95.45%) successfully performed atony management, bimanual compression, and condom tamponade.

Conclusion: Simulation-based education significantly improved knowledge and skills among healthcare professionals working in maternity units. However, two participants who fell short highlight the need for frequent, ongoing training.

INTRODUCTION

Postpartum hemorrhage (PPH) is the leading cause of maternal mortality worldwide, with the highest burden in low-resource settings like Nepal. In Nepal, PPH accounts for 25% of preventable maternal deaths, often due to delays in recognizing and management.[1] Effective PPH care requires timely intervention and skilled healthcare providers, but gaps in training and clinical competency of

recognizing and managing PPH remain challenges.

Simulation-based training has emerged as an effective approach to enhance healthcare providers' knowledge, skills, and confidence in managing obstetric emergencies.[2,3] The Helping Mothers Survive: Bleeding After Birth (HMS-BAB) program is a structured, evidence-based training module designed to improve PPH management through hands-on practice and team-based learning.[4] By simulating real-life emergencies, this approach strengthens clinical decision-making and emergency response, improving maternal outcomes.

Evaluating the impact of such training offers valuable insights into its contribution to enhancing maternal healthcare services.

Therefore, this study evaluates the effectiveness of simulation-based training on Helping Mothers Survive: Bleeding After Birth in strengthening healthcare providers' competencies in managing PPH and shock in a tertiary hospital in eastern Nepal.

METHODOLOGY

A hands-on, simulation-based educational intervention was conducted in two phases at the simulation lab of Birat Medical College Teaching Hospital. The first phase took place on June 26-27, 2023, and the second on January 3-4, 2024. Ethical approval was obtained from the Institutional Review Committee (IRC-PA-344/2023) of the institute. Each phase included a two-day hands-on simulation training session: the first day focused on Helping Mothers Survive (HMS), while the second day covered Helping Babies Breathe (HBB). This training program aimed at improving maternal care in emergencies, with key components including PPH management, shock management, and prevention and preparedness through active management of the third stage of labor (AMTSL). Training sessions were conducted from 8 AM to 5 PM (for a duration of 8 hours) by certified HMS and HBB trainers.

A total of 44 healthcare professionals including both nursing and medical working in maternity and newborn units participated in the intervention, with 20 participants in the first phase and 24 in the second phase. The trainer-to-participant ratio was maintained at 1:5, with four trainers and two mentors in the first phase and five trainers with two mentors in the second. Standardized patients, MamaNatalie, and NeoNatalie mannequins were utilized for the simulations. Additionally, flip charts, video clips, and action plans provided within the HMS/HBB training framework served as supplementary educational resources.

Each phase began with trainers and mentors providing an overview of postpartum hemorrhage (PPH) and shock management, followed by a simulation demonstration. Participants then engaged in hands-on practice at their designated tables, guided by trainers using standardized patients and mannequins. The educational intervention followed the standard Helping Mothers Survive (HMS) framework.4 Informed written consent was obtained from relevant authorities before data collection.

To assess knowledge, a pre-test and post-test were conducted using standardized tools, covering 15 items on PPH management and 8 items on shock management (1 score per item).4 The pre-test and post-test mean scores were calculated, and a paired t-test was used to determine the statistical significance of knowledge improvement. Additionally, the Kruskal-Wallis test was employed to examine whether differences in knowledge scores were influenced by participants' educational levels. A p-value of <0.05 was considered statistically significant.

For skills assessment, the Objective Structured Clinical Examination (OSCE) checklist was used post-intervention. The checklist evaluated participants on Active Management of the Third Stage of Labor (AMTSL) (12 items), atony, bimanual compression, and condom tamponade (21 items), and shock management (13 items). Participants were deemed to have passed the OSCE if they scored at least 9/12 in AMTSL, 17/21 in atony, bimanual compression, and condom tamponade, and 10/13 in shock management. Frequency and percentage calculations were performed to determine the pass and fail rates of participants.

RESULTS

A total of 44 healthcare providers participated in the hands-on simulation-based education. The mean age of the study participants was 29 ± 7.35 years, with an age range of 21 to 48 years. The participants had varying levels of experience, ranging from less than six months to 25 years. The mean knowledge scores for PPH management improved significantly from 11.36 ± 2.136 (pretest) to 14.0 ± 1.02 (posttest) (p <0.001. Similarly, shock management scores improved from 4.27 ± 1.32 to 7.32 ± 0.56 (p <0.001, indicating a significant positive impact of the intervention, Table 1.

Table 1: Paired t-Test Results for PPH and shock Management (n=44)

Variable	Pre-Test Mean ± SD	Post-Test Mean ± SD	t-value	df	p-value
PPH managment	11.36 ± 2.136	14.00 ± 1.02	-7.986	43	<0.001*
Shock managment	4.27 ± 1.32	7.32 ± 0.56	-14.29	43	<0.001*

* Statistical significance (p value <0.05)

Table 2 assesses the association between educational qualification and knowledge of PPH and shock using the Kruskal-Wallis test. For PPH, the pre-test p-value (0.049) indicates a statistically significant difference in knowledge levels across education groups, specifically for those with an MSc. Nursing (mean rank 28.25) and MBBS (26.83) scoring highest. However, the post-test p-value (0.326) suggests no significant difference after training, implying uniform knowledge improvement. For shock, both pre-test (0.593) and post-test (0.636) p-values show no significant association, indicating similar baseline understanding and learning outcomes across groups.

Table 2: Association between educational qualification and pre- and post-test knowledge in simulation-based training

Educational Qualification	PPH Pre-test Knowledge	PPH Post-test knowledge	Shock Pre-test Knowledge	Shock Post-test knowledge
	Mean rank	Mean rank	Mean rank	Mean rank
Auxiliary Nurse Midwife (n=7)	9.43	19.50	17.14	19.50
PCL Nursing(n=21)	23.71	21.40	24.00	22.83
Bachelor of Nursing (BN) (n=7)	25.14	19.07	22.29	27.50
MSc. Nursing(n=6)	28.25	29.33	20.25	19.00
MBBS(n=3)	26.83	31.50	29.50	22.50
Chi square (H statistic)	9.561	4.646	2.795	2.550
P value	0.049*	0.326	0.593	0.636

*Kruskal Wallis Test was applied. Statistically significant at P value <0.05 .
PPH-Postpartum Hemorrhage

Table 3: Post-test intervention OSCE checklist on Active management of third stage of labour for study participants(n=44)**

	Checklist of skills	Yes Performed to standard n (%)
1.1	Following birth of the baby, checks for a second baby	44(100)
1.2	Tells the woman what medication is being given	43(97.73)
1.3	Gives uterotonic medication within 1 minute of birth of the baby (states dose, route, drug)	44(100)
1.4	Tell the patient why she is getting the medication	39(88.64)
1.5	Cuts the cord : observe for changing /taking off first pair of gloves and 2) cutting cord after uterotonic drug (1-3 minutes after birth)	37(84.09)
1.6	Applies counter pressure when performing controlled cord traction	44(100)
1.7	Performs controlled cord traction only when the patient is having a contraction	42(95.45)
1.8	Uses both hands to catch the placenta and gently turns the placenta while it is being delivered	42(95.45)
1.9	Checks uterine tone immediately following delivery of the placenta	43(97.73)
1.10	Inspects the placenta for completeness	39(88.64)
1.11	Checks for genital tears	38(86.36)
1.12	Checks the woman's bleeding	41(93.18)

** multiple response

The post-test intervention OSCE results for active management of the third stage of labor (AMTSL), management of atony, bimanual compression, condom tamponade, and management of shock indicate a generally high level of competency among participants, with some gaps in critical areas. Participants showed high adherence to essential steps like checking for a second baby 44(100%), giving uterotonic medication within 1 minute of delivery 44(100%), applying control cord traction using counter pressure 44(100%), and checking uterine tone immediately following delivery of the placenta 43(97.73%), table 3.

Table 4: Post-test intervention OSCE checklist on management of atony, bimanual compression and condom tamponade for study participants(n=44)**

Checklist of skills	Yes Performed to standard n(%)
Massage the uterus	43(97.73)
Checks the woman's bleeding	44(100)
Gives a second dose of medication telling what dose, route and why (mark correct if 10 IU Oxytocin IM OR 800mcg misoprostol orally or sublingual)	43(97.73)
Re-checks the uterus and bleeding	39(88.64)
Checks bladder or catheterizes bladder	39(88.64)
Inspects the placenta for any missing pieces	40(90.91)
Shouts for help! (here or earlier)	38(86.36)
Starts IV infusion with oxytocin 20 IU in 1 L at 60 dpm, or directs another to do this. Takes or direct others to take pulse and BP	42(95.45)
Collects blood for 1) hemoglobin, and 2) bedside clotting test (or directs another to do this). If the learner says they would collect blood, ask what tests they would perform.	41(93.18)
Give tranexamic acid 1gm IV(diluted in 10 ml of diluent and given over 10 minutes).	40(90.91)
Washes hands or uses hand rub, puts on long gloves or improvises with two pairs of gloves	40(90.91)
Provides bi-manual compression (after 20-30 seconds)	44(100)
Direct another to bring uterine balloon tamponade and IV set and bag or syringe	44(100)
Gives ampicillin 2 grams IV	41(93.18)

Using aseptic technique, places the high end of the condom into the uterine cavity with forceps and ensures the entire condom is above the os.	43(97.73)
States connect the outlet of the foleys' catheter to the IV set connected to the infusion bag and rapidly inflate the condom with saline to about 300-500 ml.	43(97.73)
Folds over the end of the catheter and ties firmly	42(95.45)
Monitor the woman(for vital signs, uterine tone, bleeding, and urinary output every 15 minutes for the first 2 hours after placenta is out, and every 30 minutes until 6 hours postpartum)	40(90.91)
Leave the UBT in place for 12 – 24 hours if bleeding controlled and the woman is stable"	41(93.18)
Maintain, continue IV infusion with 20 IU oxytocin in 1 L at 60 dpm.	42(95.45)
Demonstrate the correct technique of removing UBT and arrangement of timely referral in case of failed UBT to control bleeding (UBT remains in place for 12 – 24 hours if bleeding is controlled and the client is stable. At this time deflate UBT by letting out 100 mL of saline every hour. Re-inflate to previous level if bleeding reoccurs.)	43(97.73)
Provided respectful care and good communication, told you as the woman what was to happen and why	43(97.73)

** Multiple response

Participants showed a high competency in performing uterine massage 43(97.7%), bimanual compression 44(100%) and placing uterine balloon tamponade 43(97.73%) in the uterine cavity. Lower adherence was observed in rechecking uterine tone and bladder assessment 39(88.6%) each, which are critical in managing postpartum hemorrhage post intervention, table 4.

Table 5: Post-test intervention of OSCE on management of Shock (n=44)**

Checklist of skills	Yes, Performed to standard n (%)
Shouts for help	43(97.73)
Ensure the airway is open and you are breathing.	42(95.45)
Gives oxygen at 6-8 lit/min.	44(100)
Check uterine tone.	43(97.73)
Massage the uterus or direct another to do this and continue to assess tone throughout.	44(100)
Check blood pressure and pulse or direct another to do this.	44(100)
Give oxytocin 10 IU IM or direct another to do this.	44(100)
Start IV infusion or direct another to do this.	44(100)
While beginning IV, collect blood for 1) Hemoglobin, 2) cross-matching, and 3) bedside clotting test or direct another to do this.	43(97.73)
Infuses correct IV fluids (1 l of normal saline or Ringer's lactate with 20 IU of oxytocin added) or directs others to do this.	44(100)
Infuses at the correct rate (1lp 15-20 minutes).	44(100)
Inserts a urinary catheter or directs another to do this.	44(100)
Conclude by informing that blood loss is decreasing. (Checking vital signs, blood loss and tone every 15 minutes. Reassess after 30 minutes for signs of improvement (pulse <90 beats/minute or less, SBP 100 mmhg or higher, urine output >30ml/hr, and less confusion or anxiety)	43(97.73)

** multiple response

The post intervention of OSCE on shock management showed a high compliance in crucial lifesaving skills, including oxygen administration 44(100%), starting IV fluids (100%), and continuous uterine assessment 44(100%). Minor deficiencies were observed in shouting for help 43(97.7%) and collecting necessary blood samples for evaluation, table 5.

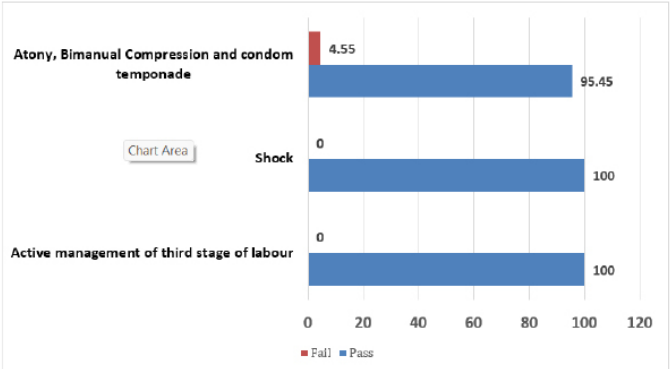

Figure 1: Post-test intervention of OSCE on AMTSL, Shock Atony, Bimanual compression and Condom tamponade (n=44)

Post test intervention OSCE results showed that all participants passed AMTSL and shock management. For atony, bimanual compression, and condom tamponade, two participants (4.55%) scored below the pass mark (13 each), while the remaining succeeded, figure 1.

DISCUSSION

The implementation of a hands-on, simulation-based educational intervention in our study yielded significant improvements in healthcare providers' knowledge and skills in managing postpartum hemorrhage (PPH) and shock. Knowledge scores significantly increased from 11.36 ± 1.89 to 14.0 ± 1.02 post-training ($p < 0.001$), while shock management scores improved from 4.27 ± 1.32 to 7.32 ± 0.56. Participants demonstrated strong competency in critical procedures such as uterine massage, bi-manual compression, and administration of uterotonic drugs. However, some areas, including patient communication, placenta inspection, and reassessment of bleeding, required further improvement.

Our findings align with previous studies that have demonstrated the effectiveness of simulation-based education in obstetric

care. For instance, a nurse-mentoring program in Bihar, India, incorporating simulation training, significantly improved healthcare providers' ability to diagnose and manage PPH and intrapartum asphyxia, although diagnostic accuracy remained below global standards.[5] Similarly, a quasi-experimental study in Tanzania found that scenario-based, multi-professional simulation training improved clinical performance and reduced maternal morbidity, reinforcing the value of simulation in resource-limited settings.[6] Comparable findings have been documented in other studies demonstrating the effectiveness of simulation in enhancing both theoretical knowledge and clinical competency in managing obstetric emergencies.[7,8,9] A study conducted in Saudi Arabia showed that simulation-based training significantly improved nurses' knowledge and performance in managing primary postpartum hemorrhage. The knowledge gains observed immediately post-training remained significant even one month later, while practical skills were also sustained over time, reinforcing the long-term benefits of simulation-based learning.[10] A systematic review highlighted that simulation enhances self-confidence in clinical practice, enabling nurses to perform more effectively in real-life situations.[11] An integrative review demonstrated that repeated simulation training positively impacts self-confidence, critical thinking, and competence—all essential for effective emergency management.[12] Our findings reflect these results, as 44 participants successfully passed the OSCE evaluation, indicating that simulation-based training can significantly boost confidence and preparedness in handling urgent obstetric cases. These results also align with a scoping review by JuHee Lee et al., which concluded that high-fidelity simulation-based training strengthens core clinical competencies.[13] The structured curriculum from the "Helping Mothers Survive"(HMS) program was instrumental in this improvement, ensuring participants followed evidence-based protocols for PPH management. The high adherence to critical procedural steps further validates the role of simulation training in bridging the gap between theory and practice, ultimately enhancing maternal and neonatal outcomes.

Simulation training has also proven effective in high-resource settings. A study in the United States found that team-based simulation training significantly improved PPH response times among experienced labor and delivery teams.[14] Another U.S. study highlighted the feasibility and effectiveness of virtual simulation training in hospitals with low-to-moderate delivery volumes, demonstrating its capacity to enhance knowledge acquisition and retention.[15]

The World Health Organization (WHO) recommends uterine balloon tamponade (UBT) as a second-line intervention for severe postpartum hemorrhage when initial medical treatments fail. This non-surgical technique provides a crucial alternative to surgical interventions, particularly in resource-limited settings.[16] Despite the overall success of simulation training, our study identified a small proportion of participants (4.54%) who did not meet the passing criteria for skills such as bi-manual compression and condom tamponade. This finding highlights the challenges in ensuring long-term skill retention and underscores the need for continuous learning opportunities. Additionally, gaps in patient communication and reassessment of bleeding suggest that future training should emphasize these aspects through repeated practice and periodic refresher courses.

The results of the pre- and post-test knowledge assessments and OSCE evaluations indicate that simulation-based training significantly enhances knowledge and practical skills in obstetric shock management. A study in China involving midwives found that simulation-based training not only provided a positive learning experience but also fostered improved teamwork, which is crucial for managing obstetric emergencies.[17] Similarly, research in India reported that simulation-based interventions enhanced nurses' labor management skills, thereby helping prevent PPH, a leading cause of obstetric shock. [18] In the United States, the Obstetric Crisis Team Training Program (OBCTT) employed simulation-based crisis team training for multidisciplinary obstetric providers, leading to improvements in knowledge, confidence, and competency in emergency obstetric care.[19]

Nepal has increasingly embraced simulation-based training for obstetric emergencies, particularly for PPH and shock management. The Simulation-Based Mentorship Program, implemented by One Heart Worldwide (OHW), trains midwife nurses as Skilled Birth Attendants in rural districts, strengthening clinical competencies and preparedness.[20] Our study reinforces the importance of integrating simulation training into regular healthcare providers' education, particularly in regions with high maternal mortality rates due to PPH. These type of hands on training will eventually decrease Maternal mortality ratio and also helps in the achievement of SDGs.

CONCLUSION

The study demonstrated that hands-on, simulation-based training significantly improved healthcare providers' knowledge and skills in postpartum hemorrhage and shock management. Participants showed high competency in critical procedures such as uterine massage, bi-manual compression, and uterotonic administration. However, persistent gaps in patient communication, placenta inspection, and bleeding reassessment indicate areas for further improvement. Additionally, the underperformance of two participants suggests a need for personalized follow-up and frequent refresher training to ensure skill retention. These findings highlight the effectiveness of structured simulation training and underscore the need for continuous skill reinforcement to maintain long-term clinical competence.

RECOMMENDATION

Simulation-based educational interventions are effective in improving nursing and medical healthcare professionals competencies in PPH and shock management across various settings. To maximize their impact, the program Helping Mothers Survive: Bleeding After Birth should be part of continuous professional development, complemented by regular formative assessments and support systems to ensure sustained clinical excellence. Future studies should include a larger, more diverse sample and a control group to enhance the validity of findings.

Longitudinal follow-up is necessary to assess knowledge retention and real-world skill application.

LIMITATION

While this hands-on, simulation-based educational intervention has notable strengths, our study also has several limitations. The small sample size and single-center design restrict the broader applicability of the findings. Additionally, the assessment measured only immediate post-intervention knowledge and skills, without follow-up to assess long-term retention or real-world application. The lack of a control group further complicates attributing improvements solely to the intervention. Moreover, challenges such as logistical constraints, costs, and accessibility in resource-limited settings present additional limitations.

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CONFLICT OF INTEREST: None

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