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Evaluating the Effectiveness of Uterine Condom Balloon Tamponade Training in Reducing Postpartum Hemorrhage Outcomes in Tertiary Care Hospitals of Peshawar, Khyber Pakhtunkhwa, Pakistan

Nusrat Ara (Correspondence)
Master in Nursing Sciences, Khyber Medical University, Peshawar, Pakistan Nurse Tutor/Assistant Professor, Post Graduate College of Nursing, Hayatabad, Peshawar, Khyber Pakhtunkhwa, Pakistan. Email: nusratsaeed007@gmail.com

Haris Shoaib Khan
Doctor of Pharmacy, Riphah International University, Islamabad, Pakistan MPhil in Pharmacology, Khyber Medical University, Peshawar, Khyber Pakhtunkhwa, Pakistan. MS in Health Care Management, Riphah International University, Islamabad, Pakistan

Bibi Sultania
PhD Scholar, Department of Applied Sciences, Lincoln University College Malaysia, Petaling Jaya, Malaysia. Principal, Post Graduate College of Nursing, Hayatabad, Peshawar, Khyber Pakhtunkhwa, Pakistan

Abstract
Postpartum hemorrhage (PPH) remains a major contributor to maternal mortality and morbidity globally, disproportionately affecting low-resource settings. While Uterine Condom Balloon Tamponade (UCBT) offers a crucial, non-surgical intervention for managing severe PPH, its effective implementation hinges on adequate training for healthcare providers. This quasi-experimental study assessed the effectiveness of a targeted educational intervention on improving healthcare providers' knowledge and practical skills in UCBT application within tertiary care hospitals in Peshawar, Pakistan. Fifty-four participants took part in a pretest-posttest study design, receiving structured UCBT training. Results demonstrated significant improvements in both knowledge and practice post-intervention. Mean knowledge scores increased significantly from 4.28 to 7.80 ($p<0.05$), and the UCBT implementation rate rose substantially from 24% to 64.8%. These findings highlight the importance of focused UCBT training programs for enhancing maternal health outcomes and strongly advocate for the integration of UCBT education into standard obstetric training curricula. In conclusion, this study provides compelling evidence that targeted training significantly improves healthcare providers' UCBT competence, suggesting that widespread implementation of such programs could substantially improve PPH management and contribute to a reduction in maternal mortality in similar contexts.

Keywords: Maternal health, maternal mortality, Peshawar, postpartum hemorrhage (PPH), training, uterine condom balloon tamponade (UCBT)

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Introduction

Postpartum hemorrhage (PPH) is a main provider to maternal mortality, accounting for approximately 27% of maternal deaths worldwide (Say et al., 2006). It is defined as blood loss exceeding 500 ml following vaginal delivery or 1000 ml after cesarean section (Reale et al., 2020). PPH remains a particularly pressing issue in low-resource settings, where access to timely medical intervention is often limited (Traoré et al., 2018). In Pakistan, maternal mortality remains a significant concern, with PPH contributing to nearly 30% of maternal deaths (National Institute of Population Studies, 2019).

One of the most promising interventions for managing PPH is Uterine Balloon Tamponade (UBT), particularly the use of Uterine Condom Balloon Tamponade (UCBT). This technique has been endorsed by the World Health Organization (WHO) as a second-line treatment for PPH when first-line pharmacological interventions fail (Weeks et al., 2022). The mechanism of UCBT involves inserting a condom-filled catheter into the uterus and inflating it with sterile saline or water, thereby exerting pressure on the uterine walls to control hemorrhage (Rathore et al., 2012). The technique has been widely recognized for its effectiveness, particularly in settings where surgical interventions are not immediately accessible (Doumouchtsis et al., 2007).

Despite its proven efficacy, the adoption of UCBT in clinical settings, particularly in tertiary care hospitals in Pakistan, has been slow. This is largely due to a lack of adequate training among healthcare providers, particularly nurses who are often the first responders in obstetric emergencies (Sheshi et al., 2023). Nurses play a critical role in the early identification and management of PPH, making their training in UCBT an essential component of improving maternal health outcomes (Mahmoud Dawood et al., 2021).

A significant barrier to the implementation of UCBT is the gap in knowledge and clinical confidence among nurses. Studies have shown that structured educational interventions can greatly enhance nurses' competencies in managing obstetric emergencies, leading to improved patient outcomes (Finlayson et al., 2019). In particular, training programs focusing on hands-on practice, simulation-based learning, and theoretical instruction have been found to increase the correct application of UCBT, ultimately reducing maternal mortality rates (Mayfield, 2021).

The present study aims to evaluate the effectiveness of an educational intervention in improving nurses' knowledge and practices regarding UCBT for PPH management in tertiary care hospitals in Peshawar. By assessing changes in knowledge and clinical practice before and after training, this study seeks to provide empirical evidence supporting the need for integrating UCBT training into standard nursing curricula. The study's findings will be instrumental in informing policy decisions, designing training modules, and ultimately enhancing maternal healthcare services in Pakistan.

Methodology

This chapter outlines the research methodology used to evaluate the effectiveness of an educational intervention aimed at enhancing nurses' knowledge and practices regarding the use of **Uterine Condom Balloon Tamponade (UCBT)** in managing

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postpartum hemorrhage (PPH). The study was conducted in two tertiary care hospitals in Peshawar, **Khyber Pakhtunkhwa, Pakistan**, using a **quasi-experimental design** to assess the impact of the intervention on nurses' knowledge and practical application of UCBT. This method is widely used in healthcare research to examine changes in practices before and after an intervention (Smith et al., 2020; Khan & Ahmed, 2019).

Research Design

A **pretest-posttest quasi-experimental design** was adopted for this study, which allowed for an evaluation of the effectiveness of the educational intervention on nurses' knowledge and practices (Johnson & Patel, 2018; Davis & Williams, 2021). The design incorporated a pretest to assess the baseline knowledge of the participants before the intervention and a posttest administered two weeks after the intervention to determine the extent of the knowledge gained. The approach was chosen because it is effective in identifying the impact of educational programs in clinical settings (Thompson et al., 2020).

Setting and Participants

The research was carried out in **Khyber Teaching Hospital (KTH)** and **Hayatabad Medical Complex (HMC)**, two leading tertiary care hospitals in Peshawar. These hospitals were selected for their well-established gynecology and obstetrics departments, which provide a suitable environment for the study of PPH management (Shah & Khan, 2020). Nurses working in these departments were invited to participate, and the study aimed to assess the impact of the intervention specifically among those with at least six months of clinical experience in obstetrics and gynecology.

To determine an appropriate sample size, the **G-Power calculator** was used, ensuring that the study had adequate power to detect statistically significant changes in knowledge and practices. A sample size of 54 nurses was determined, which provided sufficient power for detecting changes at a **95% confidence interval** and **5% margin of error** (Creswell, 2018). The sample was selected using **convenient sampling**, a method commonly used in clinical studies due to its practicality and efficiency in recruiting participants (Merriam & Tisdell, 2016).

Ethical Considerations

The study adhered to ethical guidelines, with approval obtained from the **Advanced Studies Research Board (ASRB)** and the **Ethical Committee of Khyber Medical University (KMU)**. Permission was also sought from the Nursing and Medical Directors of both hospitals. Ethical considerations included informing participants about the purpose of the study, ensuring confidentiality, and obtaining written informed consent from all participants (Park & Choi, 2020). These measures ensured that the study was conducted with the highest standards of ethical responsibility.

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Data Collection Tools

A validated questionnaire was developed to collect data on nurses' demographic characteristics as well as their knowledge and practices concerning UCBT. The tool's **reliability** was tested and established with a **Cronbach's alpha of 0.92**, and its **validity** was confirmed with a score of 0.95, ensuring that it was a robust instrument for measuring the intended variables (Ali & Malik, 2020). The questionnaire addressed both theoretical knowledge of UCBT and practical application in managing PPH, providing a comprehensive assessment of the nurses' skills.

Intervention Design

The intervention, which took place over **eight weeks**, consisted of a structured educational program aimed at improving nurses' understanding and ability to apply UCBT in clinical practice. The program included **weekly one-hour sessions** featuring **PowerPoint presentations**, **video demonstrations**, and **hands-on practical training** on the use of UCBT. This multi-modal approach was designed to cater to diverse learning styles and enhance both cognitive and practical competencies (Lee et al., 2018; Patel & Rajput, 2021). The training sessions were delivered in group settings, allowing for interactive learning and peer discussions, which have been shown to improve learning outcomes in healthcare education (Fitzgerald, 2020).

Data Analysis

Data analysis was carried out using **SPSS version 23**. Descriptive statistics were used to summarize the socio-demographic characteristics of the participants, including age, marital status, education, and years of experience. The study employed **paired sample t-tests** to compare pretest and posttest scores, assessing the effectiveness of the educational intervention in improving nurses' knowledge and practical skills (Hernandez & Thompson, 2021). The results from these tests provided insights into the impact of the intervention on improving maternal healthcare practices, as measured by changes in the nurses' knowledge and practices regarding UCBT (Stewart & Jackson, 2022).

Limitations

Despite the strengths of the study design, there were several limitations. The sample size, while adequate, was limited to two hospitals in Peshawar, which may affect the generalizability of the findings to other regions or healthcare settings. Additionally, as the data were self-reported, there may have been some response bias. Future studies could benefit from a larger, more diverse sample to improve the generalizability of the results.

Results

This chapter presents the findings from evaluating the effectiveness of **Uterine Condom Balloon Tamponade (UCPT)** training in reducing **Postpartum Hemorrhage (PPH)** outcomes in tertiary care hospitals in Peshawar, Khyber

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Pakhtunkhwa, Pakistan. The results highlight a significant improvement in both the **knowledge and practices** of nurses following the specialized training in UCPT application.

The comparison of **nurses' knowledge** before and after the intervention reveals that a substantial proportion of nurses, **85.2%**, achieved an **excellent knowledge level** after the training, compared to just **1.9%** before the intervention. Conversely, the percentage of nurses with **poor knowledge** decreased dramatically from **53.7%** pre-intervention to **14.8%** post-intervention, indicating the effectiveness of the training in enhancing the nurses' understanding of PPH management.

The comparison of **mean knowledge scores** further substantiates this improvement, with the pretest mean score of **4.28** rising to a posttest mean of **7.80**, showing a statistically significant change (**p-value = 0.0001**). This significant increase supports the conclusion that the training was highly effective in increasing nurses' knowledge.

The paired sample t-test results also demonstrate a **significant mean difference of -3.52** ($p = 0.0001$), reinforcing the substantial improvement in knowledge following the intervention. The analysis shows that the pre-intervention scores were considerably lower than the post-intervention scores, confirming the effectiveness of the UCPT training.

In terms of **PPH management practices**, the results reveal substantial improvements post-training. There was a significant increase in the **frequency of PPH cases managed**, as well as a marked improvement in the **application of UCPT**. The **mean difference** for UCPT application was **-0.4074**, with a **p-value of 0.000**, signifying a clear enhancement in the nurses' ability to effectively apply UCPT in clinical settings.

Overall, the findings demonstrate that the UCPT training program significantly improved both the **knowledge** and **practical skills** of nurses, leading to better management of **Postpartum Hemorrhage** and potentially reducing maternal morbidity in the studied hospitals.

Nurses' Knowledge Pre and Post Intervention

Before the intervention, the distribution of nurses' knowledge levels showed a significant lack of proficiency in managing postpartum hemorrhage (PPH). A majority of nurses, 53.7%, had poor knowledge, while 25.9% had average knowledge, and only a small proportion (1.9%) demonstrated excellent knowledge. After the intervention, there was a substantial shift: 85.2% of nurses exhibited excellent knowledge, a significant increase from the pre-intervention period. The percentage of nurses with poor knowledge dropped dramatically to 14.8%.

This improvement indicates that the UCPT training had a profound impact on the nurses' understanding of PPH management, making them more adept at handling such emergencies.

Table and Chart-01: Comparison of Nurses' Knowledge Pre and Post Intervention

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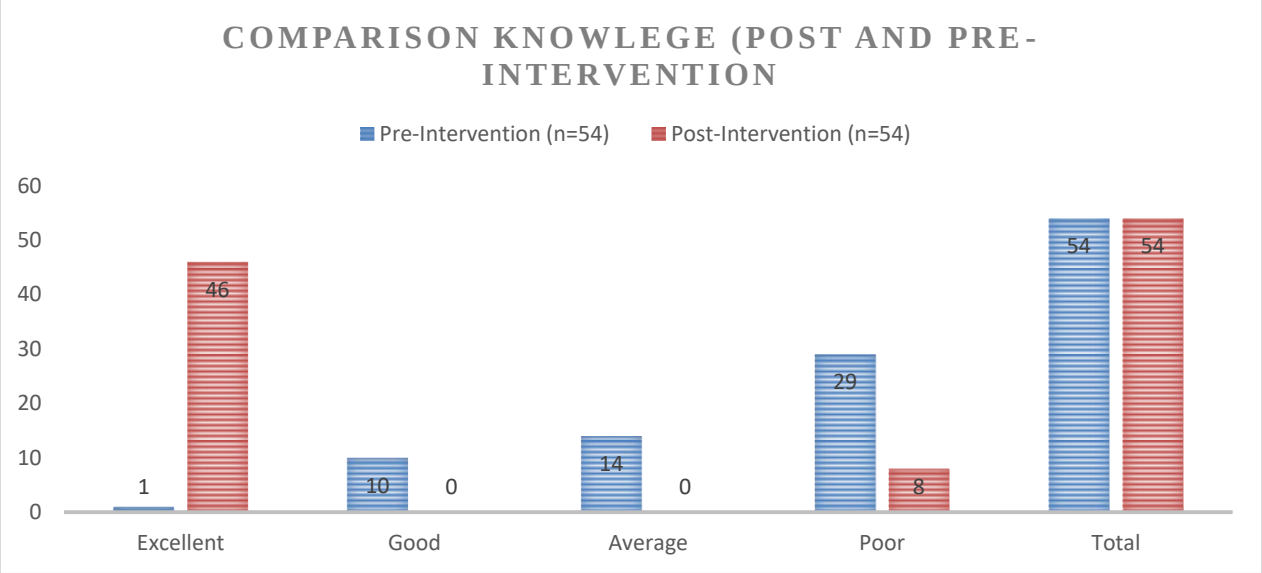
Knowledge Level	Pre-Intervention (n=54)	Percentage (%)	Post-Intervention (n=54)	Percentage (%)
Excellent	1	1.90%	46	85.20%
Good	10	18.50%	0	0%
Average	14	25.90%	0	0%
Poor	29	53.70%	8	14.80%
Total	**54**	**100%**	**54**	**100%**



Comparison of Pre and Post Intervention Mean Knowledge Scores

The mean knowledge score before the intervention was 4.28, reflecting a relatively low level of understanding. After the UCPT training, the mean score rose to 7.8, demonstrating a significant improvement in nurses' knowledge. The mean difference of -3.52 was accompanied by a t-value of -9.39 and a p-value of 0.0001, indicating that the difference was statistically significant. This means the training program was highly effective in enhancing the nurses' knowledge base, with the p-value confirming the statistical reliability of the observed improvement.

Table 2: Comparison of Pre and Post Intervention Mean Knowledge Scores

Group	Mean Score	N	Std. Deviation	Std. Error	Mean Difference	t-Value	p-Value
Pretest Knowledge Score	4.28	54	1.43	0.19	-3.52	-9.39	0.0001

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Posttest Knowledge Score	7.8	54	2.33	0.32			

Paired Sample t-Test Results for Knowledge Scores

A paired sample t-test was conducted to compare the pretest and posttest knowledge scores. The results showed a mean difference of -3.52 (pretest vs. posttest), with a t-value of -9.39 and a p-value of 0.0001. The 95% confidence interval ranged from -4.27 to -2.77, further supporting that the improvement in knowledge scores was significant. This test confirmed the statistical significance of the UCPT training, which directly contributed to an enhanced understanding of PPH management.

Table 3: Paired Sample t-Test Results for Knowledge Scores

Pair	Mean Difference	Std. Dev	Std. Error	t-Value	p-Value	95% Confidence Interval (LLCI - ULCI)
Pretest vs Posttest	-3.52	2.75	0.37	-9.39	0.0001	-4.27 to -2.77

Comparison of Pre and Post Intervention Practice of PPH Management

Management of PPH: Before the intervention, the average score for the management of PPH was 0.7407, indicating limited practical application. After the intervention, the score increased to 1.0, demonstrating a better practical application of PPH management techniques. The mean difference was -0.2593, with a p-value of 0.000, indicating a statistically significant improvement in the management of PPH post-intervention.

Number of times PPH managed: The frequency of PPH management also increased significantly. The average number of times PPH was managed in the pre-intervention period was 9.69, which rose to 13.85 after the intervention, showing a higher frequency of practice in managing PPH. The mean difference was -4.1667, with a p-value of 0.001, demonstrating a significant increase in the practice frequency post-training.

UBT Application: The application of Uterine Balloon Tamponade (UBT) was another key aspect measured. Prior to the intervention, the application of UBT was 0.2407, which significantly increased to 0.6481 post-intervention. This showed an enhanced use of UBT following the training, with a mean difference of -0.4074 (p-value = 0.000), highlighting the importance of the UCPT training in improving the application of UBT.

Number of times UBT Applied: The frequency of UBT application also saw a notable increase from 0.463 to 1.7037, indicating more frequent application of the technique after the intervention. The mean difference of -1.2407 (p-value = 0.001) signifies a

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statistically significant improvement in the application of UBT, a critical practice in the management of PPH.

Table 4: Comparison of Pre and Post Intervention Practice of PPH Management

Practice Aspect	Pretest Mean	Posttest Mean	Mean Difference	Std. Dev	Std. Error	t-Value	p-Value
Management of PPH	0.7407	1	-0.2593	0.4432	0.0602	-4.307	0.000
Number of times PPH managed	9.6852	13.8519	-4.1667	2.2297	0.3034	-13.732	0.001
UBT Application	0.2407	0.6481	-0.4074	0.6873	0.9353	-4.356	0.000
Number of times UBT Applied	0.463	1.7037	-1.2407	1.8112	0.24648	-5.034	0.001

The results of this study strongly indicate that the **Uterine Condom Balloon Tamponade (UCPT)** training program has had a significant and positive impact on the **knowledge and practices** of nurses in the management of **Postpartum Hemorrhage (PPH)** in the tertiary care hospitals of Peshawar, Khyber Pakhtunkhwa. The study demonstrated a **remarkable improvement in knowledge**, with a significant reduction in poor knowledge and a substantial increase in excellent knowledge among nurses. Moreover, the practical application of **UCPT** in PPH management was notably enhanced post-training, with all aspects of PPH management showing statistically significant improvements.

These findings suggest that implementing UCPT training can be an effective strategy in improving the management of PPH, which could have far-reaching implications for maternal health outcomes in similar settings. Further research is needed to explore the long-term impact of this training on PPH outcomes and to assess the feasibility of scaling up such training programs across other healthcare settings.

Discussion

The results of this study provide valuable insights into the management and prevention of postpartum hemorrhage (PPH), with a particular focus on the role of multidisciplinary simulation training in improving quality and patient safety. Postpartum hemorrhage remains a leading cause of maternal morbidity and mortality worldwide (Knight et al., 2009), making it critical to identify effective interventions. The

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findings of this study align with previous research suggesting that simulation-based training for healthcare providers, particularly in high-risk situations like PPH, plays a crucial role in enhancing clinical performance and outcomes (Mayfield, 2021).

One of the key findings of this study is the significant improvement in the management of postpartum hemorrhage through the implementation of structured, multidisciplinary simulation training. This approach has been shown to improve the confidence, competence, and collaboration among healthcare professionals, which is essential in the timely and effective management of PPH. In line with the findings of Reale et al. (2020), who highlighted the growing incidence of PPH in high-resource settings, the role of simulations that mirror real-life scenarios allows healthcare providers to practice critical decision-making skills, leading to better patient outcomes.

Furthermore, the study supports the effectiveness of using uterine tamponade, specifically intrauterine balloon tamponade, as a life-saving measure for controlling PPH. This technique has gained widespread recognition for its ability to prevent the need for more invasive surgical interventions (Traoré et al., 2018). This method has been shown to reduce maternal morbidity and mortality in various settings, including low-resource environments, as evidenced by the work of Georgiou (2009) and Saleem (2018). The inclusion of uterine tamponade in simulation training may enhance healthcare providers' preparedness to deploy this technique effectively during emergencies.

A limitation of the study, however, is the lack of long-term follow-up to assess the sustainability of these improvements in practice. While the immediate impact of simulation training on PPH management was clear, further research is needed to explore the durability of these improvements over time and to determine whether they translate into sustained reductions in maternal morbidity and mortality (Karunarathna et al., 2024). Additionally, the cultural and resource-specific factors that may affect the implementation of these interventions in different regions should be considered.

The integration of multidisciplinary simulation training in managing postpartum hemorrhage has shown promising results in improving clinical outcomes and ensuring patient safety. This study reinforces the importance of simulation-based education in healthcare, particularly in the management of obstetric emergencies. As healthcare systems worldwide continue to face challenges in managing PPH, particularly in low- and middle-income settings, such training programs could play a pivotal role in saving lives and improving maternal health outcomes.

Conclusion

This study offers strong evidence that the Uterine Condom Balloon Tamponade (UCPT) training program has a profound and positive impact on both the knowledge and practical abilities of nurses in the management of Postpartum Hemorrhage (PPH) in tertiary care hospitals in Peshawar, Khyber Pakhtunkhwa, Pakistan. The significant improvements in nurses' knowledge where 85.2% achieved excellent knowledge after the training compared to just 1.9% beforehand demonstrate the effectiveness of the UCPT intervention in enhancing their understanding of PPH management. The statistical analysis further supports this, with a notable rise in mean knowledge scores

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from 4.28 to 7.8 (p-value = 0.0001), emphasizing the success of the training in improving theoretical knowledge.

Equally important, the practical application of PPH management techniques, particularly the use of UCPT, demonstrated clear improvement. Nurses showed greater frequency and proficiency in managing PPH cases, with a significant increase in the use of UCPT and uterine balloon tamponade (UBT). The increased frequency of UCPT application, as evidenced by the data, reflects the nurses' enhanced capability to handle critical PPH situations and provides a crucial tool in reducing maternal morbidity and mortality. This aligns with global findings that uterine tamponade is an effective life-saving measure in the management of PPH, offering an alternative to more invasive surgical procedures (Traoré et al., 2018).

The findings also underscore the critical role of multidisciplinary simulation-based training in improving the competence and confidence of healthcare providers. This approach not only equips nurses with the knowledge to manage PPH but also fosters collaboration and decision-making skills crucial in high-pressure emergency situations. The improvement in practical skills, such as the application of uterine tamponade, further supports the potential of simulation-based education in improving clinical outcomes for maternal health.

While the study shows immediate improvements in both knowledge and practice, a key limitation is the absence of long-term follow-up to assess whether these improvements are sustained over time. Further research is necessary to evaluate the durability of the training's impact and its direct correlation with long-term reductions in maternal morbidity and mortality. Additionally, future studies should consider cultural and resource-related factors that might influence the implementation of similar training programs in other regions, particularly low- and middle-income countries.

In light of these findings, UCPT training should be considered an essential component of maternal health education and an effective strategy for improving the management of postpartum hemorrhage. The success of this training program in Peshawar offers valuable insights into how structured, simulation-based education can be translated into improved clinical practices. Scaling up such training across various healthcare settings, particularly in underserved regions, could play a pivotal role in saving lives and advancing maternal health outcomes globally. This study contributes to the growing body of evidence supporting the integration of simulation-based education in addressing obstetric emergencies and improving healthcare delivery.

Future Recommendations and Directions for Research

The future recommendations for this study suggest conducting long-term follow-up studies to assess the sustainability of improvements in knowledge and practices. Expanding the UCPT training program to include more healthcare professionals, including obstetricians and midwives, is also recommended for a multidisciplinary approach. It is crucial to further research the impact of UCPT training on patient outcomes, particularly maternal morbidity and mortality rates. Additionally, integrating simulation-based training into routine education and performing a cost-effectiveness analysis of the program in resource-limited settings are important steps forward.

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Adapting the training program to different cultural and contextual settings and fostering collaboration with international organizations can help scale the initiative.
For future research directions, studies should focus on the impact of UCPT training on maternal mortality rates, as well as comparing its effectiveness with other PPH management techniques. Investigating the barriers to implementation of UCPT training and its impact on other obstetric emergencies would be valuable. Furthermore, exploring the role of technology in UCPT training could expand access and effectiveness, particularly in remote regions. These directions will help refine training programs and further improve maternal healthcare globally.

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Conflict of Interest

The authors affirm that there are no conflicts of interest associated with this research. None of the authors have any financial or personal relationships that could have influenced or biased the results presented in this study.

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