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The Effectiveness and Challenges of High-Fidelity Simulation Training in Maternal and Neonatal Critical Care

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ABSTRACT

Background
Potential risks occurring during pregnancy, childbirth, and postpartum can be mitigated by early recognition, preventive measures, and timely interventions carried out by experienced medical professionals within a supportive environment. Such approaches reduce maternal and neonatal complications and promote patient safety.

Methods
1. Development of maternal–neonatal critical care course modules.
2. Design of scenario-based simulation lesson plans.
3. Implementation of high-fidelity team-based simulation training.

Results
High-fidelity simulation training significantly improved participants' clinical confidence and enhanced interdisciplinary team collaboration. However, an inverse relationship between knowledge and confidence was observed.

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INTRODUCTION

Given the critical importance of maternal–neonatal safety, obstetric emergencies often require the involvement of multidisciplinary teams. In such high-risk scenarios, healthcare professionals' abilities in situation awareness, clinical decision-making, communication, and teamwork are constantly tested. This study applied high-fidelity clinical simulation as a team training approach to reinforce adherence to clinical guidelines, deepen learning through practice, and modify behaviors effectively.

Based on the aforementioned high-risk pregnancy scenarios, this research project introduces the concept of Team Resource Management (TRM) into the training of maternal and neonatal critical care teams. By incorporating high-fidelity simulation with realistic patient scenarios, the training aims to ensure that healthcare professionals enhance their knowledge, skills, and confidence through hands-on experience. The ultimate goal is to improve their ability to identify emergencies, execute appropriate clinical interventions, adhere to operational guidelines, and engage in effective team collaboration.

METHODS AND MATERIALS

1. Development of Course Modules

Six core modules were established, including: Identification of obstetric risk factors, Postpartum hemorrhage management, Emergency care prior to the arrival of a pediatrician, Neonatal advanced life support, Advanced airway management in obstetric patients, Application of team resource management. Teaching was conducted in small interactive workshops.

2. Two Scenario-Based Lesson Plans

- Emergency delivery and neonatal resuscitation in preterm birth
- Assessment of high-risk pregnancy with management of neonatal pneumothorax

3. High-Fidelity Team Simulation Training

Participants were maternal–neonatal critical care providers.

- Pre-training: Faculty prepared teaching materials, and participants familiarized themselves with the environment, equipment, and simulators.
- During training: Participants were assigned roles and engaged in 15-minute high-fidelity team-based simulations.
- Post-training: Instructors facilitated feedback and group discussions.

RESULTS

1. Four training sessions were conducted, with 48 participants (approximately half of the maternal–neonatal team).
2. Improved clinical confidence: Participants demonstrated significant gains in managing postpartum hemorrhage, neonatal resuscitation, and decision-making under pressure. Notably, nurses exhibited the greatest improvement.
3. Enhanced interdisciplinary collaboration: Pediatric intensive care staff excelled in leadership, communication, and teamwork, while obstetric staff required further strengthening in situation monitoring and communication. Both junior and senior staff outperformed mid-level participants, suggesting that experience and engagement influence team effectiveness.
4. Inverse correlation between knowledge and confidence: Simulation not only reinforced clinical skills but also heightened participants' awareness of the complexity of real-world practice and their personal limitations.

GRAPHS AND TABLES



Figure 1. High-Fidelity Scenario-Based Team Simulation Training



Figure 2. Obstetric and Pediatric Training Scenario

DISCUSSION

Improving efficiency and safety in maternal–neonatal teams requires a focus on teamwork, communication, and leadership development. Leadership competence and experience are more crucial than seniority alone. Simulation training has been shown to enhance emergency care delivery, patient safety, and team efficiency. Effective teams are more likely to declare emergencies promptly, conduct structured handovers, and employ closed-loop communication. Utilizing key communication tools and teamwork strategies is essential for optimizing the management of complex emergencies.

CONCLUSIONS

This study demonstrated that high-fidelity simulation training yields significant benefits in maternal and neonatal critical care. Future research should focus on linking simulation training outcomes to actual clinical performance through longitudinal follow-up, such as evaluating changes in response capability and error rates in real-world practice. Furthermore, studies may explore how simulation fosters the establishment of a strong safety culture within healthcare teams.

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