ABUAD Journal of Engineering Research and Development (AJERD)
ISSN (online): 2645-2685; ISSN (print): 2756-6811

Volume 8, Issue 1, 151-160

AI-Driven Assessment of Educational Interventions: Enhancing Midwives' Competence in using condom-catheter intrauterine balloon tamponade - Review

Oluwatoyin Olajumoke AKINYEMI[1], Gbemisola Bolanle OGBEYE[1], Oluwaseun Eniola ADEGBILERO-IWARI[1], Adeniran Sunday AFOLALU[2]

[1]*Faculty of Nursing, Afe Babalola University, Ado Ekiti, Ekiti State, Nigeria*
akinyemitoyin@pg.abuad.edu.ng/gbemisolaogbeye@gmail.com/adegbilero-iwari@abuad.edu.ng

[2]*Department of Mechanical Engineering, Afe Babalola University, Ado-Ekiti, Nigeria*
adeniran.afolalu@abuad.edu.ng

Corresponding Author: akinyemitoyin@pg.abuad.edu.ng, +234-8036153514
Date Submitted: 21/01/2025
Date Accepted: 08/03/2025
Date Published: 13/03/2025

Abstract*: Postpartum hemorrhage (PPH) is still a major cause of maternal death and morbidity globally, especially in areas with limited resources. This emphasizes the urgent need for strong training programs for healthcare professionals as well as efficient therapies. When first-line uterotonic medicines are ineffective, intrauterine balloon tamponade (IUBT) has become a useful, minimally invasive method for treating PPH. However, the ability of healthcare professionals, particularly midwives, to carry out IUBT accurately and effectively is crucial to its successful deployment. Conventional IUBT training approaches, such as lectures, demonstrations, and practical mannequin practice, frequently have drawbacks in terms of scalability, objectivity of evaluation, uniformity, and capacity to offer tailored feedback. These restrictions may make it more difficult to learn and retain critical skills, which may affect patient outcomes and safety. This study explores the revolutionary potential of artificial intelligence (AI)-driven evaluation methodologies to enhance midwives' competence with condom-catheter IUBT to address the shortcomings of conventional training methods.*

Keywords: *Postpartum Hemorrhage (PPH), Midwives' Competence), Condom-Catheter IUBT, Artificial Intelligence (AI), AI in Medical Education*

1. INTRODUCTION

While losing a woman during childbirth is always tragic, it is particularly painful in areas like Sub-Saharan Africa (SSA) with low human development indices. There, mothers abandon families who can be very dependent on their support for sustenance and financial well-being [1]. In lower-income countries, postpartum hemorrhage (PPH) is frequently the leading cause of maternal mortality; in higher-income countries, it remains one of the leading causes [2]. An estimated 500 mL or more of blood loss after vaginal delivery or more than 1000 mL after cesarean delivery is known as postpartum hemorrhage (PPH). Inappropriate placentation, genital tract cuts, residual placental materials, and uterine atony are the main causes of PPH [3].

The risk of maternal death from primary postpartum hemorrhage (PPH) within the first 24 hours after delivery is one in 100,000 deliveries in the UK [4], making it a significant contribution to maternal mortality worldwide. [1]. Both the incidence of PPH and maternal mortality (MM) were high. PPH was a significant cause of MM, particularly in nonmetropolitan women, and it was strongly associated with modifiable risk factors such uterine atony and prepartum anaemia [1]. Further genetic study is made possible by the association between PPH and a family history of PPH, which points to a hereditary haemorrhagic phenotype [5].

Massive postpartum hemorrhage is a leading cause of obstetric maternal death and morbidity worldwide, as indicates by the links between PPH and a family history of the condition. In order to maintain fertility and, more importantly, the survival of the foetus, an emergency condition needs to be treated right away. There is a history behind the use of uterine tamponade to stop bleeding. Cotton gauze was used for uterine packing in the past. However, there are several drawbacks, including the possibility of uterine infections or injury, a hereditary hemorrhagic phenotype, and the opportunity for additional genetic research [3].

Abnormal blood loss of 1000 mL or more in a single time period that affects the hemodynamics of the mother is referred to as severe postpartum hemorrhage. While the influence on maternal hemodynamics is given more weight in our resource-constrained nations, estimations of blood loss in Western nations are based on the use of measuring bags (Figure 1) [6].

Figure 1: Estimation of blood loss [16]

It usually happens 24 hours after giving birth, however it can happen up to 12 weeks later. Both small (500–100 ml) and high (>1000 ml) PPH are possible. Additionally, there are two categories for major PPH: moderate (1000–2000 ml) and severe (>2000 ml) [7].

Every year, almost 300,000 pregnant women worldwide pass away, with hemorrhage accounting for about 25% of these deaths. Additionally, it may cause the mother to experience serious, long-term health and mental health issues [1]. In the United States, PPH rates rose by 13% between 2010 and 2014, with 79% of cases being caused by uterine atony.8. Studies have looked at the manner of birth and induction of labor as possible reasons for the notable rise in PPH rates, in addition to the many patient factors that individually raise the risk for PPH [8]. Postpartum hemorrhage following vaginal delivery is associated with a family history of the condition: findings from the French prospective multicentre Haemorrhages and Thromboembolic Venous Disease of the Postpartum cohort study [5].

In a research involving over 154,000 newborns in primiparous mothers, 666 instances (0.4%) developed hemorrhagic problems.7 The following factors were significantly linked to hemorrhage: hypertensive diseases during pregnancy, induction of labor, prolonged labor, first or second stage of labor, morbidly adherent placenta, tract lacerations, use of forceps, placental retention, inability to progress during the second stage of labor, and macrosomia (> 4,000 g).[9]. Women giving birth must have access to easy, affordable, and efficient PPH management therapies if the Sustainable Development Goal (SDG 3) of lowering the maternal death ratio to 70 per 100,000 live births by 2030 is to be met, especially in areas with limited resources [10].

2. RESEARCH BACKGROUND

The disparity between LRSs and those with greater resources is still widening, despite a 43% decrease in the number of women dying during pregnancy and childbirth since 1990. In reality, compared to women in high-income countries (HICs), those in low- and middle-income countries (LMICs) have a roughly 33-fold increased risk of dying during pregnancy and childbirth due to complications [11].

Postpartum hemorrhage is one of the leading causes of mother death globally, accounting for 25% of maternal fatalities and 4% of all pregnancies (a percentage that has remained constant since 1992) [11].

Drugs are used to reverse the uterus's failure to contract after birth, which is the most prevalent cause of primary PPH. Retained placenta, cervical or vaginal rips, and blood clotting failure are further possibilities. In order to decrease uterine blood flow, mechanical and surgical techniques directly press against blood arteries. By blowing up a balloon inside the uterus, pressure can be applied from inside [1].

The chitosan-covered tamponade, which combines a compression tamponade with the physiological anti-hemorrhaging activity of chitosan, was first developed in the realm of military medicine to treat acute hemorrhage [12].

However, in situations where traditional pharmaceutical therapy fails, the use of an intrauterine balloon (including homemade approaches) to limit postpartum hemorrhages appears to be promising [9].

Predicting PPH at the individual level seems like a promising way to reduce the burden of PPH because it would allow caregivers to prevent PPH by providing each pregnant woman with individualized medical care, from close and active monitoring at delivery to the use of preventative drugs like tranexamic acid (TXA). Identifying and evaluating each pregnant woman's severe PPH clinical and biological risk factors before delivery may help prevent severe PPH [13].

Uterine massage, tranexamic acid, and uterotonics are the first-line therapy for PPH that most patients respond to well. Ten to twenty percent of these patients, meanwhile, eventually do not react well enough to these early treatments. This subset of refractory PPH cases accounts for the majority of morbidity and mortality associated with PPH [8].

An estimated blood loss of more than 500 mL within 24 hours of a vaginal birth or 1000 mL following a caesarean surgery, or any blood loss significant enough to jeopardize hemodynamic stability, is considered to violate the FIGO (International Federation of Gynaecology and Obstetrics) guideline [15]. The WHO released guidelines for the first-line management of PPH in 2012 and 2017. These guidelines are broken down into care bundles for initial response to PPH and response to refractory PPH (Table 1) [8].

According to the International Federation of Gynaecology and Obstetrics (FIGO) standards, uterotonic (such as oxytocin) and tranexamic acid are used as first-line treatments for postpartum hemorrhage. According to WHO and FIGO, uterine massage and intrauterine balloon tamponades are always excellent non-surgical alternatives for women who do not respond to such therapies or who are unable to get them [11].

Accurately measuring continuous blood loss and regularly evaluating patient risk factors, vital signs, and bleeding symptoms are essential for the early detection of PPH. It has been demonstrated that quantitative blood loss (QBL) offers several benefits over estimated blood loss (EBL), including a more precise evaluation of continuous blood loss during maternal hemorrhage [8]. The most common way to measure blood loss after childbirth is through visual evaluation. This approach, regrettably, frequently underestimates blood loss. Visual (clinical) assessment understates blood loss by 100–150 mL as compared to measured blood loss postpartum [1].

The first balloon system created specially to treat PPH was the Bakri tamponade, which showed impressive success rates. Newer systems have been described, and more research on IUBT has been published [4].
By applying pressure on the lower uterine segment in cases of placenta Previa, where an uncontracted lower uterine segment causes profuse bleeding, or surrounding the uterus in cases of atony, the Bakri balloon tamponade (BBT) has been used to reduce uterine bleeding [3].

One of the first techniques to limit uterine bleeding was uterine gauze packing (UGP), which is easy, rapid, and efficient for treating PPH. However, because of documented drawbacks such infection risk, uterine damage, and hidden bleeding, it has proven controversial [4]. The use of a condom-loaded Foley catheter in two low-income African settings resulted in higher rates of blood loss (extremely low confidence evidence). The results are validated by the Anger 2016 step-wedge cluster-randomized study.

Table 1: WHO PPH Care Bundle [8]

PPH Care Bundle	**Components**
First response PPH bundle	• Uterotonic drugs • Isotonic crytalloids • Tranexamic acid • Uterne massage • Notes: initial fluid resuscitation is performed with intravenous (IV) administration of uterotonics. If IV uterotonics are not available, fluid resuscitation should be started in paellel with sublingual mistoprotol or other parenteral uterotnics. If PPH is in the context of placenta retention, the placenta should be extracted, and a single dose of antibiotics should be administered during the application of this bundle
Response to refractory PPH bundle	• Compressive measure (aortic compression or bimanual uterine compression) • Intrauterine balloon tamponade • Non-pneumatic antishock garment • Notes: a continuing dose of uterotonics (eg oxytocin diluted in isotonic crytalloids) and a second dose of tranexamic acid should be administered during the application of this bundle

The reasons for the failures are unclear, but they suggest that the global roll-out of condom catheters alone will not improve mortality or morbidity from primary postpartum haemorrhage (PPH) in these contexts [1]. Intrauterine balloon tamponade (IUBT) is a currently acknowledged treatment for avoiding more invasive therapies to PPH [4]. The researchers compared usual care (misoprostol) and uterine balloon tamponade (condom-loaded Foley catheter) with usual care alone. All women were randomly assigned to receive either sublingual (600 ug) or rectal (1000 ug) misoprostol. The condom was inflated "by increments of 250 mL of solute" in the balloon tamponade group [1].

Uterine atony is the most common cause of PPH, accounting for more than 70% of cases. Using a uterotonic and massaging the uterus may help reduce bleeding. Uterine tamponade, B-Lynch or uterine artery embolization, uterine artery ligation, and even hysterectomy are typically the next steps a surgeon must do if this does not work [14].

The inability of condoms to withstand insufflation volumes above 250 to 300 mL is one of their disadvantages, which can cause the device to malfunction. Moreover, its texture prevents the uterine cavity from being sufficiently compressed [9]. A different method of managing PPH, such BBT, should be investigated because of the short- and long-term effects of postpartum hysterectomy, which include blood loss, damage to other organs, poor wound healing, infection, and loss of fertility [3]. Condom catheter balloons are a low-tech, non-invasive, safe, effective, and simple option for treating postpartum hemorrhage [11]. Predelivery endogenous thrombin potential (ETP) levels were observed to be lower in women with severe PPH than in controls in the thrombin generation assay (TGA). TGA could be a valuable laboratory test for obstetricians to determine the individual PPH risk of pregnant women, in addition to the assessment of other risk factors for severe PPH, such as placental abnormalities [13].

In recent years, researchers have increasingly combined the use of the Bakri balloon with other compression techniques, such as the B-lynch method. The "sandwich" technique involves inserting the balloon into the uterus via the B-lynch operation and applying external pressure to restrict the mobility of the fundus, so boosting the effect of packing (Figure 2) [14].

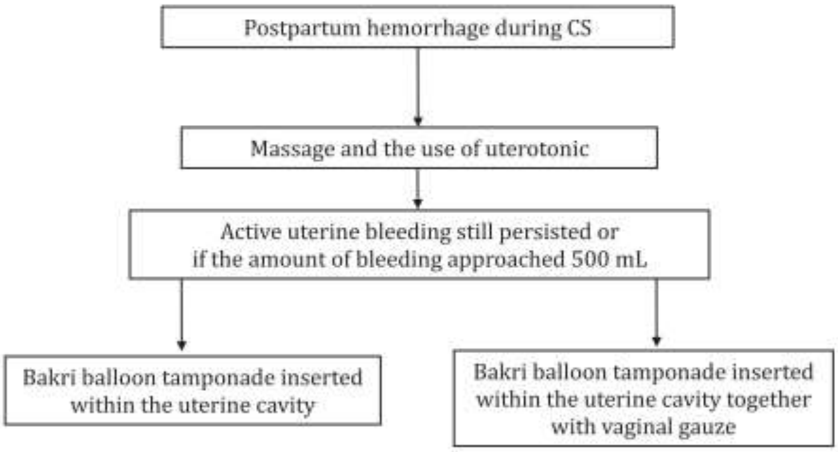

Figure 2: Protocol for uterine and vaginal tamponade [14].

Furthermore, several health providers reported avoiding employing the UBT due to worries about the risk of recurrent bleeding, a scarcity of blood products, or a lack of access to surgical operating rooms. To effectively promote the wider use of the UBT device and overcome such disturbances, it is critical to ensure a regular and stable supply [6].

Increased blood loss was associated with the use of the condom catheter for intrauterine tamponade at health centres in Benin and Mali (very low confidence evidence). The Ashraf 2018 study found that the condom catheter caused less postpartum fever than uterine packing with gauze (very low-certainty evidence), and the Kavak 2013 study found that patients treated with the Bakri balloon experienced lower mean blood losses during and after surgery compared to those treated with uterine square sutures [1].

Given that iron deficiency and other nutritional anemias are more common in SSA (≈50%–80%) [62] than in more developed countries (≈5%), the connection between anemia and PPH is significant and emphasizes the need for better iron substitution to lessen the issue [1].

3. LITERATURE REVIEW

The WHO recommendations now advocate using tranexamic acid (TXA) in PPH when uterotonic fail to stop bleeding, especially if the blood loss is suspected to be attributable to trauma [15]. Researchers released the first review of chitosan gauze's use in treating bleeding in injured troops in 2006. This study examined 68 examples of penetrating injury wounds with heavy bleeding caused by military blasts. According to the study, using chitosan-covered gauze resulted in either an improvement in haemostasis or a halt to bleeding in 97% (62/68) of cases [12].

Some of the features of uterine tamponade are low operating costs, ease of insertion into the cervix or through a hysterotomy surgical incision, low displacement rate, low training requirements, and sufficient conformability to the hemorrhagic area [9]. BBT works by raising intrauterine pressure above systemic artery pressure [3]. If a Bakri balloon is not accessible, a variety of comparable devices can be employed, such as Sengstaken-Blakemore tubes, condom catheters, and Foley catheters. The balloon can be positioned manually or with the help of ring forceps and a speculum. Accurate placement at the uterine fundus can be verified using simultaneous ultrasound guidance. For the lower uterine section to be adequately compressed, it is crucial to make sure the entire balloon is inside the uterus. Depending on the quantity of drainage, the Bakri balloon can be filled with up to 500 mL of saline until sufficient compression is reached, as shown by reduced bleeding. It can then be left in place for two to twenty-four hours [8].

Additionally, there have been some studies that have reported problems using the balloons. Certain failures, like uterine fibroids obstructing the balloon, injury to the balloon during the preparation of the Seng taken–Blakemore tube by cutting off the tip, and incapacity to put the balloon due to a B-Lynch suture, could be classified as placement complications [16]. A developing instrument in the obstetrical team's toolbox, the chitosan-covered tamponade can be employed as an adjuvant in the treatment of PPH, particularly in places with limited access to advanced surgical methods and other invasive treatments. Because it functions independently of the coagulation cascade, it might be especially helpful in PPH situations when the coagulation is already abnormal [12].

The Sengstaken-Blakemore tube is anatomically inappropriate for the uterine cavity and was intended for esophageal bleeding rather than postpartum hemorrhage [3]. Continuous assessment of acute blood loss anemia's clinical symptoms is also necessary for PPH management. The use of obstetric hemorrhage bundles has been suggested as a way to improve patient outcomes in response to severe PPH. Early bleeding resolution, lower transfusion rates, and a lessened necessity for invasive operations like uterine artery embolization and cesarean hysterectomy have all been brought about by systematic PPH programs [8].

TXA significantly reduced blood loss in this randomized controlled study (RCT) of women at high risk of PPH undergoing elective and unplanned caesarean deliveries (CDs) [15]. In 91.4% of instances with severe PPH that were unresponsive to conservative medical therapies, the study found that BBT was successful in preserving fertility and preventing hysterectomy [3]. With a 96% overall success rate, balloon tamponade was demonstrated to be very successful in treating PPH in the current trial population that was not responding to first-line therapy. Additionally, when the catheter was properly positioned and placed, balloon tamponade was very effective in preventing placental site hemorrhage (91%) and PPH caused by uterine atony (100%) [16].

Doctors, nurses, or trained lay users can employ the 3D-printed condom-based intrauterine balloon tamponade to temporarily stop or reduce postpartum bleeding in patients for whom uterotonics or another first line of treatment is ineffective (Figure 3). If no other option is available, the system can be utilized at the patient's house, in an ambulance, or in any healthcare facility [11].

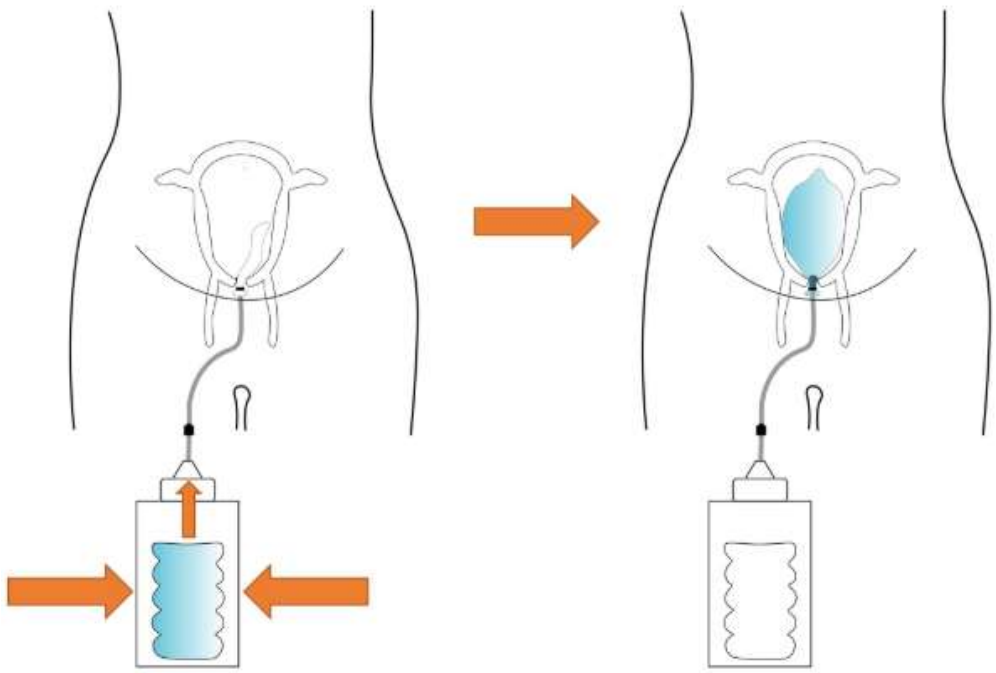

Figure 3: The proposed mechanism of the intrauterine balloon tamponade in treating postpartum haemorrhage [11].

There are over 1.9 million midwives in the world, making them a crucial professional group in the healthcare industry. There are many possible uses of AI in this field, as well as opportunities and risks related to them. Better decision-making is made possible by AI, which is also anticipated to improve patient outcomes and make the healthcare system more effective(Figure 4) [17]. AI has developed into a powerful tool in the medical industry that is revolutionizing patient care and leading to improved diagnosis, customized treatment plans, and more efficient healthcare delivery [18].

AI's revolutionary role in clinical practice emphasizes how data-driven insights and automation may streamline precision medicine and enhance patient care pathways [19]. In addition to conducting AI-related research in healthcare, midwives should be able to lead and take part in AI initiatives. Given the importance of AI in healthcare, midwives must obtain the proper training in order to properly integrate AI into their practice. Additionally, midwifery students must be prepared for their future professions [17].

AI-powered telemedicine and virtual assistants make healthcare more accessible and enable remote patient monitoring. Notwithstanding the advantages, issues including algorithmic bias, data confidentiality, a lack of legal frameworks, and ethical concerns must be resolved [18]. AI is no longer a minor aspect of daily life; rather, it has grown to be a significant factor in a number of areas, such as employment, healthcare, and education. This progress is linked to a public conversation about the potential and difficulties of artificial intelligence in numerous societies across the globe [20].

In order to prepare for their professional careers and take the lead in AI projects in healthcare, researchers have suggested incorporating AI into midwifery courses. These initiatives make reference to recent advancements in clinical research and healthcare AI. Midwives will be able to support evidence-based practice and policy by spearheading these projects [17]. Rapid advancements in artificial intelligence (AI) have made new uses possible in many industries, including healthcare[18]. How much generative AI can improve patient outcomes and how this might be measured are unknown. Lastly, it is necessary to investigate the potential of generative AI beyond enhancing administrative and clinical duties [21]. Machine learning (ML) has become a potent instrument for enhancing clinical judgment in recent years, especially in the area of obstetrics. ML algorithms can identify patterns and interactions between variables that are not immediately visible in conventional statistical models by examining huge datasets with many predictors. As a result, ML-based predictive models have been created that provide a more individualized approach to PPH risk assessment by outperforming traditional techniques in terms of accuracy and sensitivity [22]. The use of AI in healthcare, particularly in pharmacovigilance, is consistent with how electronic health information technology is developing [23].

By making it possible to create algorithms that may incorporate a variety of clinical and demographic data, machine learning provides a novel option that enhances early diagnosis and permits prompt interventions. Predicting obstetric problems using machine learning has yielded encouraging results, particularly for preeclampsia and intrauterine growth restriction [22]. Deep learning algorithms have demonstrated remarkable accuracy in recognizing anomalies and helping radiologists diagnose conditions like diabetic retinopathy or lung cancer. By learning from a vast collection of annotated medical images and identifying patterns that human observers would overlook, these computer programs might increase the speed and accuracy of diagnoses [18].

Engaging learning experiences, fostering human-to-human healing interactions, and offering some successful health and wellness therapies, including therapeutic counseling, are some of the current applications in education and practice. These applications—such as immersion, virtual reality, perspective switching, avatars, and simulation suits—are accomplishing this in novel and distinctive ways that are made feasible by AI [24].

Without endangering actual patients, medical students can communicate with these virtual patients, diagnose them, and suggest treatment strategies. In a low-stakes environment, this enables pupils to make mistakes and grow from them [21]. Additionally, augmented reality and other technologies can be combined with training robots to create simulations that are completely integrated with the current educational framework [25]. The incorporation of AI instruction into medical school curricula and post-graduate clinical training programs has been sluggish. Medical education accreditation rules generally exclude AI capabilities, and the majority of medical students today lack comprehension of the fundamental technological ideas behind AI [26].

Given the scarcity of skilled workers in the healthcare industry, the employment of training robots in medical education enables the quick training of a greater number of staff members. The entire educational process is streamlined by training robots, which also cut down on the amount of time required to get ready for work in a rigorous clinical setting [25]. AI technology may detect people who are at high risk for conditions like diabetes or heart disease by encoding a mix of environmental factors, genetic information, and subject characteristics. This enables tailored preventive actions. Large datasets can be analyzed by AI systems to find trends and forecast the course of diseases [18].

According to predictions, artificial intelligence (AI) will transform healthcare in the ensuing decades. As a result, new jobs and care models for medical professionals will emerge. As a result, healthcare workers' educational requirements and competencies will need to be modified [17]. Training robots can assist in the analysis of training participants' progress because of sophisticated artificial intelligence algorithms. This allows them to tailor task difficulty to each participant's needs, making the educational process more efficient and individualized [25].

AI has many benefits for the healthcare industry. Personalized patient care, improved medical decision-making, improved diagnostic method and speed, and expedited administrative procedures are some of the main advantages noted [18].

Additionally, AI facilitates the creation of novel diagnostic techniques that promptly detect infections, which is essential in the battle against epidemics [25]. To find patterns linked to diseases, generative models can be trained on enormous datasets of medical records and images (such as MRIs and CT scans). For example, image reconstruction, synthesis, segmentation, registration, and classification have all been accomplished with GANs [21]. AI can identify minute alterations in tissues, improving diagnosis precision and lowering the possibility of mistakes. According to MedTech, AI's capacity to compare fresh photos with extensive databases enables the development of precise comparative models and disease predictions that are more accurate than those made using conventional techniques [25].

In many healthcare applications, artificial intelligence (AI) technologies—most notably machine learning (ML) and deep learning algorithms—have proven to be highly effective [19]. Unprecedented potential arise from the combination of cutting-edge technologies like artificial intelligence (AI) and the internet of medical things (IoMT). IoMT is revolutionizing healthcare data management and decision-making with a network of linked medical devices and apps that gather, send, and analyze health data. These tools have the power to transform how decisions are made and enhance patient outcomes [27].

There is a guarantee that digital technology offers more effective ways to set up healthcare and public services [17].
In addition to providing health information and guidance, artificial intelligence (AI) technologies are being used to develop or improve empathetic awareness, empathetic response and relational behavior, communication skills, health coaching, therapeutic interventions, moral development learning, clinical knowledge and clinical assessment, healthcare quality assessment, therapeutic bond and therapeutic alliance, and more. The results support a reinterpretation of compassion as a six-element human-AI intelligent care system [24]. With its capacity to build a solid model based on more predictors and incorporate nonlinear correlations and interactions between variables into assessments, machine learning provides an edge over existing risk assessment techniques [2].

Empathic awareness, relational behavior and empathetic response, communication skills, health coaching, therapeutic interventions, moral development learning, clinical knowledge and clinical assessment, healthcare quality assessment, therapeutic bond and therapeutic alliance, and many others are being enhanced by AI technologies in order to guide and provide information on health [24]. IoMT stands for the collection of connected devices and applications deployed to collect, transmit, and analyze health data. Wearable health monitors, remote sensors, and smart medical equipment have greatly improved healthcare data analytics through the provision of real-time and continuous streams [27]. Therefore, the themes related to AI should find representation in midwifery courses in a way to enable the contribution and leadership of midwives in the related healthcare projects [17]. Yet, it is not necessarily easy to bring generative AI into clinical medicine. In fact, this requires very intensive and detailed preparation and execution: from assessment of healthcare professional and patient needs, the choice of appropriate AI technology, its integration into the current healthcare systems, and the training of personnel in their effective use [21].

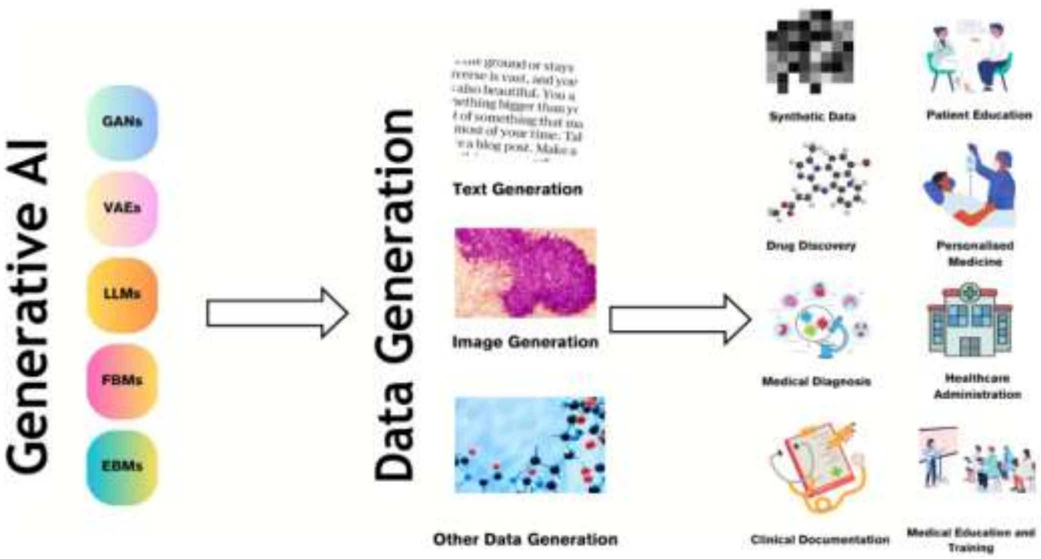

Figure 4: Use cases of generative AI in healthcare. Generative AI models like generative adversarial networks (GANs) and large language models (LLMs) [21].

The integration of machine learning and natural language processing can also make healthcare systems more adaptable and user-friendly for older persons (Figure 5) [17].
It can be used to generate individualized educational content depending on a patient's specific condition, symptoms, or inq uiries [21].

The analyzed publications underline the potential of artificial intelligence in midwifery. These include improving care quality and safety, optimizing decision-making processes, simplifying administrative procedures, and increasing precision and productivity. As a result, midwives have more time to provide patient care. Furthermore, enhanced patient outcomes and predictions are discussed, as well as a more efficient healthcare system in general [17].
Advanced artificial intelligence algorithms employed in robots allow for the modeling of diverse medical scenarios, changing the level of complexity of assignments to the particular needs of learners, making the teaching process more successful [25].

A generative AI model may be trained to go through this material, identify essential points, and produce a succinct summary. This summary may highlight key facts including diagnosis, prescribed drugs, and recommended therapies [21]. By sorting and analyzing massive amounts of research, clinical, and patient data, AI systems in healthcare can recognize patterns to boost knowledge generation and decision-making [17].

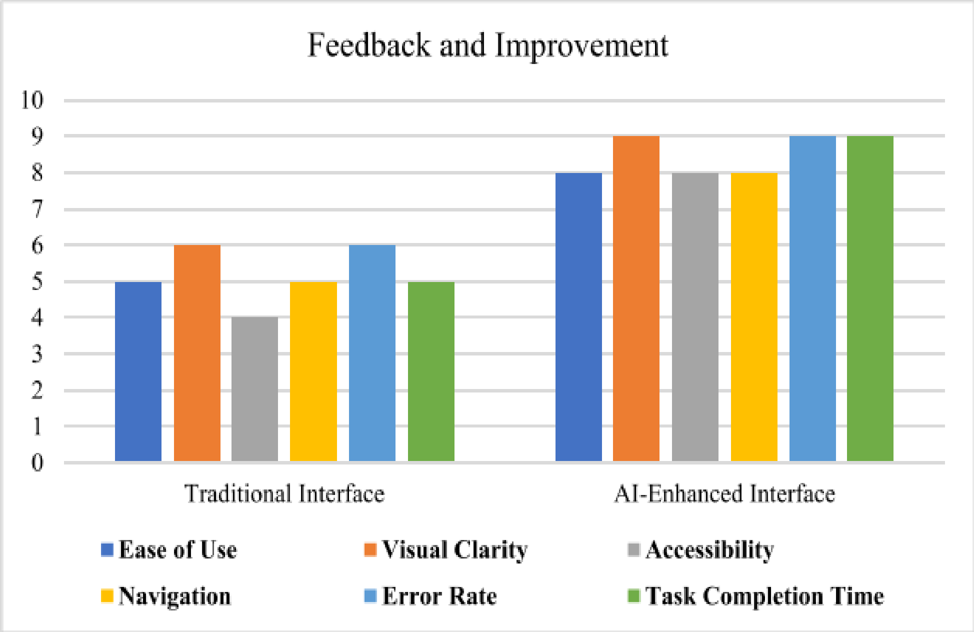

Figure 5: Feedback and improvement of AI [17].

4. CONCLUSION

Postpartum hemorrhage (PPH) is still a primary cause of maternal mortality worldwide, necessitating effective and accessible therapies, particularly in resource-limited settings. When uterotonics fail, intrauterine balloon tamponade (IUBT) has emerged as an important nonsurgical approach for treating PPH. However, maintaining midwives' competency in executing this operation is critical. Traditional training approaches, while helpful, frequently have limits in standardization, objectivity, and scalability. This review investigated the potential of artificial intelligence (AI) to revolutionize the assessment of educational programs meant to improve midwives' IUBT skills. While the examined literature thoroughly covers the burden of PPH, the effectiveness of IUBT, and the broader applications of AI in healthcare and midwifery, there is a crucial void in the specific use of AI for assessing IUBT training. The concept of AI in medical education, which includes simulations, virtual patients, and training robots, emphasizes the ability of AI to deliver interesting and tailored learning experiences. However, the connection to objective performance assessment during IUBT training requires additional focus. In this situation, AI-driven evaluation has a lot of potential advantages. Computer vision-powered automated video analysis could measure variables including insertion time, inflation pressure, and protocol adherence to objectively assess midwives' IUBT method. Real-time feedback during training might be made possible by integrating AI with virtual or augmented reality simulations. This would enable midwives to practice in a secure setting and get prompt performance feedback. Personalized learning routes could be made possible by machine learning algorithms that examine performance data to pinpoint areas in which specific midwives need more training.

The reviewed literature highlights the advantages of AI in healthcare, including enhanced diagnosis accuracy, customized treatment plans, and efficient resource utilization. These advantages extend to the classroom, where AI can provide uniform, scalable, and objective assessment. Furthermore, AI's ability to analyze large datasets can identify patterns and predict which students could struggle with the IUBT process, enabling more targeted interventions and preventing potential problems in real-world scenarios. AI holds great promise, but there are a number of issues that need to be resolved. Clear performance criteria and sizable expert performance datasets are necessary for the creation and validation of reliable AI algorithms for IUBT evaluation. Careful attention must be paid to ethical issues pertaining to algorithmic bias, data privacy, and security. Furthermore, careful planning, sufficient instructor training, and resolving any potential resistance to new technologies are necessary for the successful integration of AI-driven evaluation into current midwifery courses. It is also necessary to take into account the expense of putting these systems into place, particularly in environments with limited resources. Future research should focus on developing and evaluating AI-powered assessment tools for IUBT training. Studies should evaluate the effectiveness of these tools in increasing midwives' competence, as well as their impact on patient outcomes. Investigating the integration of AI with other technologies, such as wearable sensors and mobile applications, could help improve the training and assessment process.

In conclusion, while the reviewed literature provides a solid foundation for understanding PPH, IUBT, and AI in healthcare, additional study is required to fully realize the promise of AI-driven assessment in improving midwives' competency in using IUBT. By tackling existing difficulties and doing targeted research, we may harness the power of AI to improve training quality, standardize evaluation, and ultimately help to lowering maternal death rates linked with PPH.

AI-powered platforms provide several major benefits. First, they allow for individualized suggestions based on an individual's dietary habits, health issues, genetic predispositions, and lifestyle preferences. By evaluating user data using advanced algorithms, these platforms may deliver individualized advise that is consistent with WHO dietary standards for certain populations and health problems. This level of customisation is critical for increasing adherence and making significant nutritional improvements. Second, AI boosts engagement with interactive elements like gamification, virtual coaches (chatbots), and personalized feedback. These aspects make learning about nutrition more pleasurable and engaging, boosting the chances of long-term habit change. Third, AI simplifies data analysis and progress tracking, allowing users to track their dietary intake, identify areas for improvement, and receive data-driven feedback on their progress. This feedback loop is critical for reinforcing positive improvements and remaining motivated. Finally, AI can customize instructional content and delivery methods to meet individual learning styles and preferences, resulting in a more effective and interesting learning experience.

The alignment of these platforms with WHO standards is crucial to their potential impact. AI-powered systems that incorporate WHO recommendations for balanced diets, particular nutrient intakes, and healthy dietary patterns can reinforce evidence-based habits and help to meet global nutrition targets. Platforms, for example, can be set to prioritize WHO guidelines for lowering sugar intake, boosting fruit and vegetable consumption, and supporting breastfeeding, ensuring that users receive advise that is aligned with global health goals. However, integrating AI into nutrition instruction raises a number of obstacles. Data privacy and security are critical considerations since these platforms collect and analyse sensitive personal information. Robust data protection mechanisms and transparent data usage regulations are required to retain user trust and ensure ethical data management.

Another concern is the possibility of algorithmic bias, which can result in unequal or unfair outcomes for specific populations. AI algorithms must be carefully designed and validated in order to reduce bias and promote fair access to good nutrition education. Accessibility is also an important factor because these platforms rely on technology and digital literacy. It is imperative to endeavour to close the digital gap and guarantee that these resources are available to all groups, irrespective of their financial situation or level of technological expertise. Furthermore, to guarantee the precision and efficacy of these platforms, strict validation and evidence-based content are necessary. A number of fascinating advancements are anticipated in the future. Real-time data collection and even more individualized feedback may be made possible by the combination of AI with wearable technology and other sensor technologies. Deep learning and natural language processing are two examples of advanced AI approaches that can further expand these platforms' capabilities, enabling more complex user data analysis and more organic and interesting interactions. instruction. To overcome the current obstacles and completely utilize AI in nutrition education, more study and development are required.

In conclusion, AI-powered platforms have enormous potential to revolutionize nutrition education and encourage better eating practices globally. These platforms can help people make better food choices and enhance their general health by providing individualized, interactive, and data-driven experiences that are in line with WHO recommendations. To guarantee the moral and just application of these technologies, it is imperative to address the issues of data privacy, algorithmic bias, and accessibility. AI has the potential to significantly contribute to reaching global nutrition targets and enhancing public health globally with further study, development, and cautious application.

REFERENCES

[1] Glenzer, M. M. Correia, M., Nhantumbo, V. Barnes, R.F, & von Drygalski, A. (2023). Postpartum hemorrhage in Sub-Saharan Africa—a prospective study in metropolitan Mozambique," *J. Thromb. Haemost.*, . 3463–3476, 2023, doi: 10.1016/j.jtha.2023.09.002.

[2] Ahmadzia, H. K.. *Sophia*, A, Cordes, Hani, F., Joaquin, A & Calderon (2025). Machine Learning Models for Prediction of Maternal Hemorrhage and Transfusion : Model Development Study Corresponding Author :2024;18(3):365, doi: 10.2196/52059.

[3] Alkiş, I. Karaman, E., Han, A., Ark,H. C., & Büyükkaya, B. (2015). The fertility sparing management of postpartum hemorrhage: A series of 47 cases of Bakri balloon tamponade," *Taiwan. J. Obstet. Gynecol.*, 54(3), 232-235, doi: 10.1016/j.tjog.2014.03.009.

[4] Abul, A. Al-naseem, A. Althuwaini, A. Al-muhanna, A & Clement, N., S. (2023). Safety and efficacy of intrauterine balloon tamponade vs uterine gauze packing in managing postpartum hemorrhage: A systematic review and meta-analysis.5:3(1):100135, doi: 10.1016/j.xagr.2022.100135.

[5] De Moreuil, C. Anouilh, F. Tremouilhac, C. Jacquot, 0. Salnelle, G. Bellec, V, Touffet, N. Cornec, C. Muller, M. Dupre, P., F, Bellot, C. Morcel, K. J. Jollif, D., L. Drugmanne, G. Gelebrat, E. Lucier, S. Nowak, E. Bihan, L. Couturaud, F, Tromeur, C. Moigne, E., L. Pan-Petesch (2023) *(2023).* Family history of postpartum hemorrhage is a risk factor for postpartum hemorrhage after vaginal delivery: results from the French prospective multicenter Haemorrhages and Thromboembolic Venous Disease of the Postpartum cohort study, 101062, doi: 10.1016/j.ajogmf.2023.101062.

[6] Dehi, M. B. Guie, P. Apollinaire, H. Aka, E. Kouakou, K.., V. Ahoupke, B. Kone, S. Rochon, S. Boni, S. & Burke, T. (2023). Implementing uterine balloon tamponade (UBT) device for immediate postpartum hemorrhage management : Leveraging resource allocation and highlighting noteworthy experiences, 175-180, doi: 10.1016/j.gocm.2023.08.004.
[7] Rai, S. Poudel, S. Adhikari, S., P. Subedi, K. Upadhyaya, P. C. & Shah, P . (2023). Impact of Skill Development Training in the Management of Postpartum Hemorrhage, doi: 10.36348/sijog.2024.v07i12.008.
[8] Liu, L. Y. Nathan, L. J. Sheen, J. & Goffman, D. (2023). Review of Current Insights and Therapeutic Approaches for the Treatment of Refractory Postpartum Hemorrhage, 1:15:905-926, doi: 10.2147/IJWH.S366675.
[9] Dalmedico, M. M. & Barbosa, F. M. (2022). Intrauterine balloon tamponade for postpartum hemorrhage," *WOMEN´S Heal.* 35, doi: 10.1590/fm.2022.35617.
[10] Id, K. F. Vogel, J. P. Althabe, F. Widmer, M. & Oladapo, O. T. (2019). Healthcare providers experiences of using uterine balloon tamponade (UBT) devices for the treatment of post-partum haemorrhage : A meta-synthesis of qualitative studies. 18-16(3), 3e0248656, doi: 10.1371/journal.pone.0248656.
[11] Id, D. P. Hyland, S. Maccaro, A. Iadanza, E. & Pecchia, L. (2024). A 3D-printed condom intrauterine balloon tamponade : Design , prototyping , and technical validation, doi: 10.1371/journal.pone.0303844.
[12] Henrich, W. Dückelmann, A. Braun, T. & Hinkson, L. (2024.). Uterine packing with chitosan-covered tamponade to treat postpartum hemorrhage, 230(3S):S1061-S1065, doi: 10.1016/j.ajog.2022.11.1297.
[13] de Moreuil, C. Dargaud, Y. Nougler, C. Dupre, P., F. Tremouilhac, C. Le Joliff, D. Rosec, S. Lucier, S. Pabinger, I . Ay C. Couturaud. F. Pan-Petersch, B. (2023). Women with severe postpartum hemorrhage have a decreased endogenous thrombin potential before delivery:21(11), 3099-3108, doi: 10.1016/j.jtha.2023.07.021.
[14] Guo, Y. Hua, R. Blan, S. Xie, X., Ma, J. Cal, Y. Scooranna, S., R. & Cheng, W. *(2018).* Intrauterine Bakri Balloon and Vaginal Tamponade Combined with Abdominal Compression for the Management of postpartum hemorrhage, doi: 10.1016/j.jogc.2017.08.035.
[15] Neumann, B., G. Metgud, M., C. Hoffman, M.,K. & Patil, K. (2024). Tranexamic acid to reduce blood loss in women at high risk of postpartum hemorrhage undergoing cesarean delivery — a randomized controlled trial, 22-4(1):100316, doi: 10.1016/j.xagr.2024.100316.
[16] Kandeel, M. Sanad, Z. Ellakwa, H. El Halaby, A. Rezk, M. & Saif, I.(2016). Management of postpartum hemorrhage with intrauterine balloon tamponade using a condom catheter in an Egyptian setting, 3, 272-275, doi: 10.1016/j.ijgo.2016.06.018.
[17] Kranz, A. & Abele, H. (2024). The Impact of Artificial Intelligence (AI) on Midwifery Education : A Scoping Review, doi: 10.3390/healthcare12111082.
[18] Chhabra, C. Hamdard, J. & Kaur, H. (2023). LEVERAGING ARTIFICIAL INTELLIGENCE IN HEALTHCARE: A TRANSFORMATIVE APPROACH, 28-43.
[19] Mohsin M., K, Shah, N. Shaikh, N. Thabet, A. Alrabayah, T. & Belkhair, S. (2025). Towards secure and trusted AI in healthcare: A systematic review of emerging innovations and ethical challenges, 195:105780, doi: 10.1016/j.ijmedinf.2024.105780.
[20] Gnambs, T. Stein, J. Appel, M. Griese, F. & Zinn, S. (2024). Computers in Human Behavior : Artificial Humans An economical measure of attitudes towards artificial intelligence in work , healthcare , and education (ATTARI-WHE) doi: 10.1016/j.chbah.2024.100106.
[21] Reddy, S. (2024). Generative AI in healthcare : an implementation science informed translational path on application ,integration and governance 19(27), doi: 10.1186/s13012-024-01357-9.
[22] Carolina, S. Anamaria, H. Ingrid-Andrada, V. Harabor, V. & Alina-Mihaela C. (2024). Predicting Intra- and Postpartum Hemorrhage through Artificial Intelligence. 3060(10):1604, doi:.org/10.3390+medicina60101604
[23] Agarwal, A. Singh, G.. & Mittal, S. (2025). Beyond boundaries: charting the frontier of healthcare with big data and ai advancements in pharmacovigilance, doi: 10.1016/j.hsr.2025.100214.
[24] Morrow, E. Zidaru, T. Ross, F.Mason, C. Patel, K., D. Ream, M. & Stockley, R. (2023). Artificial intelligence technologies and compassion in healthcare : A systematic scoping review, 13(1), doi: 10.3389/fpsyg.2022.971044.
[25] Nguyen, H. (2025). Analysis of the Potential of Artificial Intelligence in Medicine.4(4):204-212.
[26] Schubert, T. Oosterlinck,T. Stevens, R. D. Maxwell, P. H. & Van Der Schaar, M. (2024). AI education for clinicians," *eClinicalMedicine*, doi: 10.1016/j.eclinm.102968.
[27] Rawas, S. Tafran, C. Alsaeed, D. & Al-ghreimil, N. (2024). "Transforming Healthcare : AI-NLP Fusion Framework for Precision Decision-Making and Personalized Care Optimization in the Era of IoMT.81(3),4575-4601, doi: 10.32604/cmc.2024.055307.