



Effect of the Iowa Model Evidence-Based Practice on Nurses' Knowledge Regarding Primary Postpartum Hemorrhage

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Abstract

Background: Primary postpartum hemorrhage (PPH) remains a significant cause of maternal morbidity and mortality worldwide. It is a critical emergency that requires immediate and competent nursing intervention. The Iowa Model Evidence-Based Practice (EBP) provides a structured framework for integrating current evidence into nursing education regarding primary PPH. **The aim of this study** was to evaluate the effect of the Iowa Model Evidence-Based Practice on nurses' knowledge regarding primary postpartum hemorrhage. **Research design:** A quasi-experimental design (one-group pre-test/post-test) was utilized in the study. **Setting:** The study was conducted in the labor and postpartum units at the Maternity Hospital, Zagazig University, Zagazig City, Sharkia Governorate, Egypt. **Subjects:** A convenience sample of 50 maternity nurses was enrolled in the study. **Tools of data collection:** Two tools were used: **Tool I:** A structured interview questionnaire. **Tool II:** Nurses' knowledge questionnaire regarding PPH and the Iowa Model EBP. **Results:** The present study showed that nurses' knowledge regarding primary PPH improved significantly following the Iowa Model EBP program. The proportion of nurses with a high level of knowledge increased from 0% pre-program to 72% post-program ($p < 0.001$). **Conclusion:** The study concluded that the educational program based on Iowa Model EBP significantly improved nurses' knowledge regarding primary PPH. **Recommendations:** It is recommended to implement regular educational programs based on the Iowa Model to update nurses' knowledge regarding primary PPH. In addition, hospitals should develop and provide standardized EBP guidelines in accordance with WHO and ACOG recommendations.

Keywords: Iowa Model Evidence-Based Practice, Nurses' Knowledge, and Primary Postpartum Hemorrhage (PPH)



Introduction

Postpartum hemorrhage (PPH) remains a major obstetric emergency and a leading cause of maternal morbidity and mortality worldwide (**Demissie, Kaura and Gebhardt, 2024**). PPH accounts for about 27% of maternal deaths globally, making primary PPH one of the most consequential causes of preventable maternal death (**Cresswell et al., 2024**). PPH is usually classified as primary or immediate when it occurs within 24 hours of birth, and secondary or delayed when it occurs after 24 hours up to 12 weeks postpartum (**Almutairi et al., 2024**).

Primary PPH is defined by the WHO as blood loss ≥ 500 mL after vaginal delivery or $\geq 1,000$ mL after cesarean section within 24 hours of birth (**Begum et al., 2024**). The American College of Obstetricians and Gynecologists (**ACOG, 2017**) alternatively defines primary PPH as cumulative blood loss $\geq 1,000$ mL or blood loss accompanied by signs or symptoms of hypovolemia within 24 hours postpartum, regardless of mode of delivery.

Primary PPH risk factors include anemia, previous PPH, cesarean birth, multiple pregnancies, placenta previa, sepsis, and lack of antenatal care, as well as prolonged labor, operative delivery, macrosomia, and antepartum hemorrhage (**Pettersen et al., 2024**). Additionally, new risk factors for primary PPH include COVID-19 infection and antidepressant use (**Yunas et al., 2024**).

The causes of primary PPH are classified into four main groups, known as the "four T's": Tone (accounting for 70% of cases), Trauma, Tissue retention, and causes related to Thrombin or clotting disorders (**Mohamed and Chandraharan, 2024**).

Prevention of primary PPH is achieved through active management of the third stage of labor, including prophylactic oxytocin, controlled cord traction, and uterine massage (**WHO, 2024**). Management of established PPH follows a stepwise, team-based approach based on the four T's—tone, trauma, tissue, and thrombin—starting with resuscitation, uterotonics, and tranexamic acid, and escalating to mechanical methods, surgical interventions, and peripartum hysterectomy if needed. Early recognition and a structured, multidisciplinary response are essential to reduce maternal morbidity and mortality associated with primary PPH (**Mohamed and Chandraharan, 2024; Begum et al., 2024**).

Evidence-based practice (EBP) is the application of the best scientific evidence in clinical decision-making by integrating clinical experience, incorporating patient

values and preferences into the practice of professional patient care (**Degu et al., 2022**). Additionally, evidence-based practice improves patient care quality and outcomes, reduces healthcare costs, and elevates healthcare standards (**Connor et al., 2023**).

The Iowa Model of EBP is one of the nursing frameworks used to translate evidence into practice. (**Iowa Model Collaborative et al., 2017**). Evidence-based care improves nurses' knowledge and standardizes practice (**Mohamed, Belal and El-Nagar, 2024**).

Nurses play a key role across all stages of primary PPH care. They prevent PPH through risk assessment and active management of the third stage of labor, detect it early via continuous monitoring of vital signs, uterine tone, and objective blood loss, and manage it by initiating emergency protocols, administering uterotonics and tranexamic acid, and preparing for surgical intervention. In addition, nurses provide psychological support and accurate documentation, making skilled nursing care essential to reducing PPH-related morbidity and mortality (**Yao et al., 2024; Escobar et al., 2022**).

Significance of the study

PPH is the leading cause of maternal mortality worldwide (**WHO, 2023**). The global burden is substantial, with PPH occurring in an estimated 27 million women annually—17 million after vaginal birth and 10 million during or after cesarean birth and results in approximately 43,000 deaths annually. Serious consequences among survivors include severe anemia, organ failure, hysterectomy, and psychological trauma (**Coomarasamy et al., 2024**). The incidence of primary PPH following vaginal delivery in Egypt was recently reported to be 8.1% at Kasr Al Ainy University Hospital, Cairo (**Genina et al., 2023**). Nurses' early detection and rapid intervention in cases of primary PPH throughout the third stage of labor are essential for minimizing maternal morbidity and mortality (**Yao et al., 2024**). Therefore, this study was carried out to evaluate the effect of the Iowa Model EBP on nurses' knowledge regarding primary postpartum hemorrhage.

Aim of the study

This study aimed to evaluate the effect of the Iowa Model Evidence-Based Practice on nurses' knowledge regarding primary postpartum hemorrhage.



Research Hypothesis:

- **H1:** Nurses’ level of knowledge regarding primary PPH will improve after implementing the Iowa Model EBP educational program.

Operational Definitions

***Iowa Model Evidence-Based Practice:** refers to a structured, step-by-step framework for integrating the best research evidence into clinical practice to guide decision-making in primary PPH management. It was implemented through a structured educational program (*Iowa Model Collaborative et al., 2017*).

***Nurses’ Knowledge regarding Primary Postpartum Hemorrhage:** It refers to nurses' theoretical understanding of primary PPH including definition, risk factors, causes, and early signs, as measured by a researcher-developed knowledge questionnaire based on current *ACOG (2017)* and *WHO (2023)* guidelines.

Methods

Research Design: A quasi-experimental research design with a **one-group pretest-posttest** was used to carry out this study.

Quasi-experimental designs examine the cause-and-effect relationship between two variables: the independent and dependent variables. In this study, the independent variable was the Iowa Model EBP educational program, and the dependent variable was nurses' knowledge regarding primary PPH.

Study setting

The study was conducted in labor and postpartum units at the Maternity Hospital, Zagazig University, Zagazig City, Sharkia Governorate, Egypt.

Study participants

A **convenience sample** of **(50)** nurses was enrolled from the above-mentioned setting.

Tools of Data Collection

To achieve the study objectives, two tools were used:

Tool I: Structured Interview Questionnaire

It was developed by the researchers after a thorough literature review. This questionnaire gathered data on the demographic characteristics of the studied nurses including age, residence, educational level, years of experience, participation in previous training programs regarding primary PPH, and

timing of the last training program.

Tool II: Nurses’ knowledge questionnaire regarding PPH and the Iowa Model EBP

It consisted of two parts:

Part (1): Nurses’ knowledge regarding PPH

It was developed by the researchers based on *ACOG (2017)* and *WHO (2023)* guidelines to assess nurses' knowledge regarding primary PPH. It included data such as; the type of PPH, definition, time of occurrence, risk factors, the most common cause, symptoms of uterine atony, complications, laboratory investigations, management, nursing interventions, signs and symptoms of hemorrhagic shock during primary PPH, and priorities of nursing care for primary PPH.

Part (2): Nurses’ knowledge regarding the Iowa Model EBP

It was developed by the researchers based on the Iowa Model EBP (*Iowa Model Collaborative et al, 2017*) to assess nurses' knowledge of the Iowa Model EBP. It included: the concept, the steps of the model, the benefits of EBP, the effective techniques for EBP education, the definition of the PICO structure, the components of clinical questions, the levels of evidence, and sources of EBP ranked from strongest to weakest.

The scoring system:

Knowledge questions were scored as follows: Correct and complete answers earned 1 point, and incorrect or "I don't know" answers earned 0 points.

The total scores were classified as:

High:	≥75%
Average:	50% - <75%
Poor:	<50%

Higher scores indicated a high level of knowledge of the Iowa Model EBP regarding primary PPH management, while lower scores indicated a low level of knowledge among the studied nurses.

Tools content validity and reliability

The content validity of the two tools was assessed by an expert panel of five professors in obstetrics and gynecological nursing. The panel evaluated the tools' clarity, relevance, applicability, comprehensiveness, and understanding. Based on their feedback, minor modifications were made.

Cronbach's Alpha
Knowledge tool
0.795



Field work

The study data were collected from **1st February to 30th June 2024**.

Data collection was carried **out three days per week**. The fieldwork for this study was implemented through four phases: assessment, planning, implementation, and evaluation. After obtaining official permission, a pilot study was conducted.

Phase I: Assessment phase

The sample was recruited from the study setting. The researcher contacted each nurse individually and obtained basic data through the interview. At the beginning of the interview, the purpose of the study, its duration, instructions for completing the questionnaire, and study activities were explained. The nurses were informed that their participation was voluntary and that they had the right to withdraw at any time. Oral consent was obtained from all nurses.

Each nurse received a structured interview questionnaire to assess demographic characteristics and nurses' knowledge of the Iowa Model EBP regarding primary PPH. To prevent potential bias, nurses were asked to complete the questionnaire individually. The average time for completion of the self-administered questionnaire was approximately 30 minutes.

Phase II: Planning Phase

The goal of this phase was to develop an educational program to improve nurses' knowledge regarding primary PPH. Based on the study aims, pretest results, and literature review, the materials for the theoretical sessions were developed.

Program Design

An extensive literature review informed the development of the program. An educational booklet was developed in both English and Arabic. The booklet covered the Iowa Model EBP, primary PPH, and nursing management of bleeding. It was reviewed by supervisors, validated by an expert committee, and designed to serve as a self-learning guide. The booklet was distributed to nurses at the beginning of the program. Additionally, various instructional strategies were prepared, including PowerPoint presentations, videos, posters, and group discussions to facilitate learning.

Phase III: Implementation Phase

The Iowa Model of EBP is a structured framework. It developed by the researchers based on (*Iowa*

Model Collaborative et al, 2017) through 7 steps as follows:



The sessions were conducted at the Maternity Hospital at Zagazig University in the labor, delivery and postpartum wards. Nurses were divided into **five groups** based on their availability and free time to facilitate attendance, with **10 nurses in each group**. The content was delivered **over 12 weeks in 3 theoretical sessions** per group, each lasting **30–45 minutes**. Sessions were conducted as lectures and group discussions, utilizing audiovisual aids such as PowerPoint presentations, videos, illustrations, and printed Arabic booklets. Simple language and recent teaching strategies were used, along with educational booklets and feedback sessions.



Month	Pre-test (Before primary PPH Program) Theoretical sessions	Post-test (After primary PPH Program)	No. of nurses
February 2024	30- 45 min. 12-12.45 pm	20-30 min. 1.30 pm	10 Nurses
March 2024	30- 45 min. 12-12.45 pm	20-30 min. 1.30 pm	10 Nurses
April 2024	30- 45 min. 12-12.45 pm	20-30 min. 1.30 pm	10 Nurses
May 2024	30- 45 min. 12-12.45 pm	20-30 min. 1.30 pm	10 Nurses
June 2024	30- 45 min. 12-12.45 pm	20-30 min. 1.30 pm	10 Nurses

The content was divided into 3 scheduled sessions, followed by a group discussion as follows:

1. **Initial Interview and Consent:** The initial interview with the nurses was performed. Invitations to take part in the study were distributed, oral consent was obtained, and each nurse received a booklet that was already prepared.
2. **Theoretical Sessions:**
 - **Session 1:** Covered knowledge about the definition, time of occurrence, risk factors, causes, and clinical features of primary PPH.
 - **Session 2:** Covered knowledge about laboratory investigations, complications, prevention, and management for primary PPH.
 - **Session 3:** Covered knowledge about the definition, effectiveness, advantages, levels of evidence, the PICO formula and Iowa Model EBP steps regarding primary PPH.

Every session started with an overview of the goals for the upcoming one, followed by comments and a re-demonstration of the previous one. Following each session, nurses had a chance to ask questions, receive information about the goals of the subsequent one, and participate in discussion time.

Phase IV: Evaluation Phase

To evaluate the effect of the Iowa Model EBP program in improving nurses' knowledge, post-tests were conducted to assess nurses' knowledge of the Iowa Model EBP regarding primary PPH after the program.

Pilot Study

Prior to data collection, a pilot study was carried out on 5 nurses representing 10% of the total sample to examine the clarity and feasibility of the study instruments. Necessary adjustments were made based on the pilot results. Nurses involved in the pilot phase were excluded from the main study sample.

Ethical Considerations and administration

Ethical approval to conduct the study was granted by the Postgraduate and Research Ethics Committee, Faculty of Nursing, Zagazig University (**Approval No: M.D.ZU.NUR/211/12/5/2024**). An official letter was also submitted to the administration of the Maternity Hospital at Zagazig University to obtain permission for data collection. Each nurse was informed about the purpose and nature of the study by the researcher. Oral consent was obtained from all participants. Participation was voluntary, and confidentiality of the collected information was maintained and used only for research purposes.

Limitations of the study

Limitations included reliance on self-reported questionnaires, the length of the study tools which required considerable time per nurse, and the need for a larger sample size in future studies to reduce bias.

Statistical design

Statistical analysis was performed using **IBM SPSS Statistics, Version 23.0 (IBM Corp., Armonk, NY, USA, 2015)**. The normality of data distribution was tested using the **Shapiro-Wilk test**. Continuous variables were expressed as mean $\pm$ SD. Categorical data were compared using the Chi-square test or **Fisher's Exact test** as appropriate. For paired categorical data, the **McNemar test** was used, while the Marginal Homogeneity test was used for paired ordinal data. Pearson's correlation coefficient was applied to assess the relationship between two parametric variables. Statistical significance was set at $p < 0.05$. A p -value ≥ 0.05 was considered non-significant (NS). All tests were two-sided.

Results

Regarding the demographic characteristics of the studied nurses, **Table 1** shows that 84% were <30 years old. Regarding educational level, 36% were health technical institute graduates, 34% held a bachelor's degree in nursing, and 30% were diploma holders. The majority resided in rural areas (68%) and had <5 years of experience (58%). Only 10% of the nurses reported prior participation in a training program on primary



PPH.

Table 2 reveals highly statistically significant differences in nurses' knowledge of the Iowa Model for EBP regarding primary PPH post-program ($P < 0.0001$). Correct responses related to the definition of EBP and methods of accessing patient values improved from 44% and 58% pre-program to 78% and 96% post-program, respectively. There was also a statistically significant improvement in knowledge across all Iowa Model EBP steps post-program ($P < 0.05$). The greatest improvements were observed in Step 3: Form a Team, which increased from 18% to 94%, and Step 4: Gather Evidence, which increased from 72% to 94%. Furthermore, knowledge about the PICO formula definition improved from 52% pre-program to 94% post-program. All PICO components showed significant improvement post-program ($P < 0.0001$), especially patient/population and outcome, which reached 92% and 90%, respectively. Regarding levels of evidence, the percentage of nurses who correctly identified systematic reviews and meta-analyses as the

highest level of evidence, and expert opinion as the lowest, increased from 52% and 42% pre-program to 80% and 84% post-program, respectively.

Table 3 presents a considerable improvement in the knowledge level regarding primary PPH among the studied nurses at pre- and post-program, with a highly statistically significant difference ($P \leq 0.0001$). At pre-program, 62% and 48% of the nurses had poor knowledge scores regarding primary PPH and the Iowa Model EBP, respectively. Meanwhile, at post-program, the proportion with high knowledge scores improved to 70% and 82%, respectively.

Figure 1 illustrates a significant improvement in total knowledge levels regarding primary PPH among the studied nurses following the program. Prior to the program, 0%, 40%, and 60% of nurses had high, average, and poor knowledge levels, respectively. Following the program, these proportions changed to 72%, 22%, and 6%, respectively. There was a statistically significant difference between pre- and post-program knowledge levels ($p < 0.0001$).

Table (1): Distribution of the studied nurses according to their demographic characteristics (n=50):

Variables	χ^2	P
○ Age per years		
• <30	42	84.0
• ≥ 30	8	16.0
○ Residence		
• Rural	34	68.0
• Urban	16	32.0
○ Educational level		
• Bachelor of nursing	17	34.0
• Health technical institute	18	36.0
• Nursing diploma	15	30.0
○ Years of experience		
• < 5 years	29	58.0
• 5- $\leq$ 10 years	14	28.0
• >10 years	7	14.0
○ Participation in previous training program about primary PPH		
• Yes	5	10.0
• No	45	90.0
○ Duration of training program (n.5):		
• <1 year	1	2.0
• ≥ 1 year	4	8.0



Table (2): Distribution of the studied nurses according to their knowledge of Iowa model EBP program regarding primary PPH (n=50):

knowledge of Iowa model EBP regarding primary PPH	Pre-Program				Post-Program				P-value
	Correct		Incorrect		Correct		Incorrect		
	No.	%	No.	%	No.	%	No.	%	
○ Definition of evidence-based practice	22	44.0	28	56.0	39	78.0	11	22.0	0.0001*
○ How might you access patient values as part of your evidence-based practice	29	58.0	21	42.0	48	96.0	2	4.0	0.0001*
○ The steps involved in generating evidence based clinical practice regarding PPH									
1. Step 1: Identify Trigger or problem	20	40.0	30	60.0	45	90.0	5	10.0	0.0001*
○ Definition of PICO Formula	26	52.0	24	48.0	47	94.0	3	6.0	0.0001*
2. Step 2: State the Question (PICO)/ components of clinical questions									
• Patient /Population	26	52.0	24	48.0	46	92.0	4	8.0	0.0001*
• Intervention /Exposure	26	52.0	24	48.0	43	86.0	7	14.0	0.0001*
• Comparison	31	62.0	19	38.0	43	86.0	7	14.0	0.009*
• Outcome	20	40.0	30	60.0	45	90.0	5	10.0	0.0001*
3. Step 3: Form a Team	9	18.0	41	82.0	47	94.0	3	6.0	0.0001*
4. Step 4: Gather Evidence	36	72.0	14	28.0	47	94.0	3	6.0	0.007*
5. Step 5: Critique Evidence	28	56.0	22	44.0	46	92.0	4	8.0	0.0001*
6. Step 6: Design and Pilot	21	42.0	29	58.0	43	86.0	7	14.0	0.0001*
7. Step 7: Evaluate Outcomes	21	42.0	29	58.0	46	92.0	4	8.0	0.0001*
○ Advantage of EPB	26	52.0	24	48.0	37	74.0	13	26.0	0.009*
○ The levels of EBP									
• Systematic reviews and meta-analyses are located at the top of the evidence hierarchy	26	52.0	24	48.0	40	80.0	10	20.0	0.001*
• Case-control study	21	42.0	29	58.0	36	72.0	14	28.0	0.0001*
• Case series and case report	16	32.0	34	68.0	46	92.0	4	8.0	0.0001*
• Expert opinion is the lowest level of evidence	21	42.0	29	58.0	42	84.0	8	16.0	0.0001*

McNemar test, $p < 0.05$: significant

Table (3): Distribution of the studied nurses according to their knowledge' dimensions level regarding primary PPH at pre& post program (n=50):

Knowledge’ dimensions	Nurses’ Knowledge				P-value
	Pre-Program		Post-Program		
	No.	%	No.	%	
○ Knowledge of nurses regarding primary PPH level					
• High	1	2.0	35	70.0	0.0001*
• Average	18	36.0	14	28.0	
• Poor	31	62.0	1	2.0	
• Mean±SD • Median (range)	27.6±7.8 25(16-43)		42.1±6.39 44(26-49)		
○ Nurses’ knowledge of Iowa model EBP regarding primary PPH level					
• High	1	2.0	41	82.0	0.0001*
• Average	25	50.0	6	12.0	
• Poor	24	48.0	3	6.0	
• Mean±SD • Median (range)	9.02±2.69 9(4-17)		15.12±2.99 16(4-18)		

$p < 0.05$ = significant * marginal homogeneity Test,

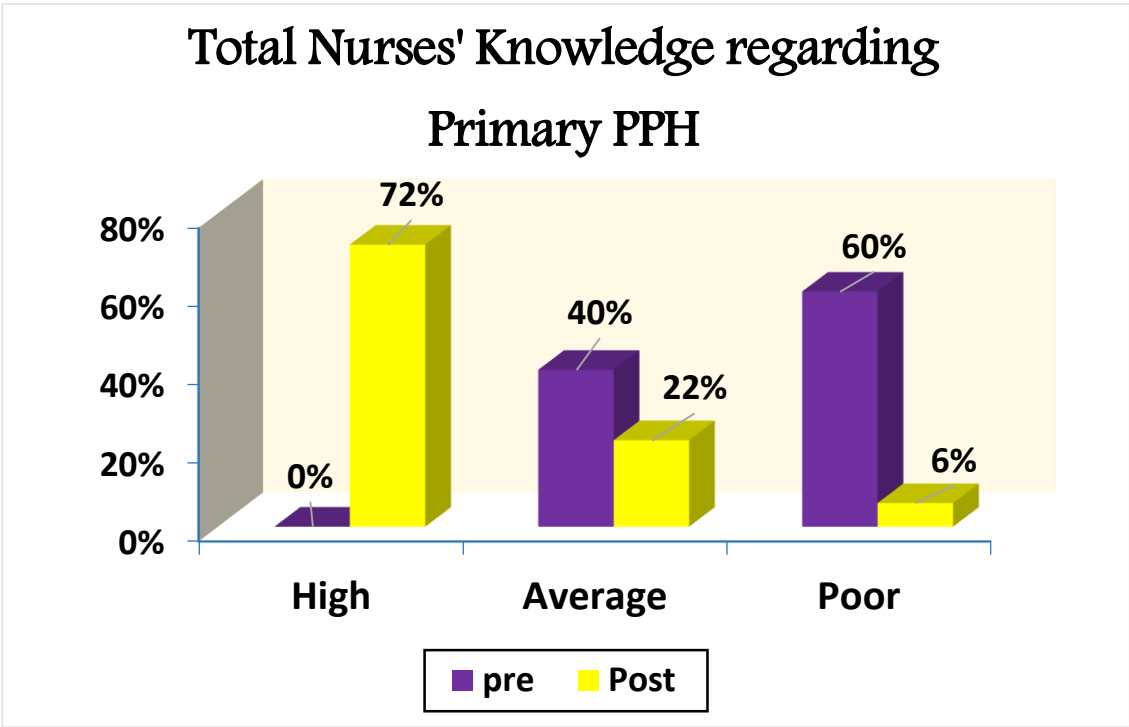


Figure (1): Distribution of the studied nurses according to their total knowledge level regarding primary PPH at pre- & post-program (n=50)

Discussion

Primary PPH remains a leading cause of maternal death worldwide, especially in low-resource settings (WHO, 2023). Management of primary PPH follows a stepwise protocol including early recognition, uterine massage, uterotonics, fluid resuscitation, tranexamic acid administration, and escalation to surgical or radiological intervention if bleeding persists (Chandrahara, 2024). Nurses play a key role in prevention through active management of the third stage of labor, ongoing monitoring of vital signs and blood loss, prompt escalation, and patient education (Mihretie et al., 2023). The current study aimed to evaluate the effect of the Iowa Model Evidence-Based Practice on nurses' knowledge regarding primary postpartum hemorrhage at the Maternity Hospital, Zagazig University, specifically in the labor, delivery, and postpartum wards. The study successfully achieved its aim and answered the research hypothesis. The results of the current study revealed that the majority of the studied nurses were <30 years old, and more than two-thirds were from rural areas. This finding could be attributed to the high physical demands of maternity wards and the preference for younger nurses in such settings. This result is consistent with El Sharkawy et al. (2020) at Ain Shams Hospital, Egypt, who reported that three-quarters of nurses were aged 20–<30 years.

Similarly, Elhakm and Elbana (2018) in Benha, Egypt, found that 61.5% of nurses were <30 years old with a mean age of 29.6 ± 7.62 years. Regarding residence, 88% of nurses were from rural areas (Hashem, El-Kholy, and Abo-Hatab, 2022), which is supported by Posey, Howell, and Gibson-Young (2024) who reported 68% from rural areas. In contrast, Mohamed, Hasab Allah, and Abdallah (2024) found that 70% were from urban areas. Regarding educational level, more than one-third of nurses were health technical institute graduates, followed by those with a bachelor's degree. This finding is consistent with Sallam et al. (2024) in Suez Canal, Egypt, who reported that 36% were technical institute graduates. It also aligns with Shahin, Desoky, and Salim (2021) in Egypt, where 50.0% had a technical institute degree followed by 26% with a bachelor's degree. Conversely, Almutairi et al. (2024) reported that 59.3% held a bachelor's degree. As regards years of experience, more than half of the nurses had <5 years of experience, and only one-tenth had previously attended a training program on primary PPH. This may be attributed to most nurses being recent graduates, along with limited program availability, financial barriers, and heavy workload. These findings are consistent with Shahin, Desoky, and Salim (2021), who



reported that 86% had not attended training. In contrast, **Abdelwahed and Farahat (2022)** indicated that more than one-third of the studied nurses had 1–<5 years of experience.

The current study demonstrated highly statistically significant improvements in nurses' knowledge of the Iowa Model for EBP related to primary PPH following the program ($p < 0.001$). Correct responses increased substantially for the EBP definition and for accessing patient values. All Iowa Model steps improved significantly ($p < 0.05$), with the greatest gains in Step 3: Form a Team and Step 4: Gather Evidence. Knowledge of the PICO framework and all its components also increased significantly ($p < 0.001$), with most nurses correctly identifying Population and Outcome. Regarding levels of evidence, most correctly identified systematic reviews and meta-analyses as the highest level and expert opinion as the lowest.

These findings align with **Mehammed-Ameen and Abdulla (2024)**, who stated that multifaceted EBP education improves nurses' knowledge, especially when it includes EBP steps and PICO/PICOT formulation. In the same vein, **Santos et al. (2022)** and **Yeh et al. (2024)** emphasized that effective EBP programs include structured teaching on PICOT, levels of evidence, and literature searching, which likely explains the gains in PICO definition, evidence hierarchy, and the "Gather Evidence" step. The improvement in "Form a Team" is expected given the Iowa Model's emphasis on team-based change and system-level implementation.

Differences in findings across studies may reflect variations in intervention intensity, mentoring, follow-up duration, and organizational support, particularly where limited database access and workplace barriers hinder sustained EBP use (**Shahat and Abd Allah, 2019; Yeh et al., 2024**). Overall, the multifaceted PPH-focused training appears effective in addressing knowledge gaps. However, sustaining these gains likely requires ongoing repetition, mentorship, and an organizational culture that supports EBP in daily practice (**Mehammed-Ameen and Abdulla, 2024**).

Regarding knowledge dimensions, the present results revealed a marked improvement in nurses' knowledge regarding primary PPH and the Iowa Model of EBP following the program ($P \leq 0.001$). Prior to the program, more than half of the nurses had poor knowledge of primary PPH, and nearly half had poor knowledge of the Iowa Model. After the program, the majority achieved high knowledge levels in both dimensions. These improvements likely reflect those nurses and midwives

are first-line responders to PPH, making targeted training clinically relevant. These findings are in agreement with **Sapri et al. (2022)**, who reported that educational interventions improve nurses' EBP knowledge.

Overall, the significant improvement in nurses' knowledge of primary PPH and the Iowa Model following the intervention is strongly supported by recent literature. In Egypt, similar gains were reported after WHO guideline implementation in Port Said (**Hassen, 2024**), video simulation in Menoufia (**Elbahlowan, Salam, and Ashour, 2022**), and competency-based training in Zagazig (**Shahin, Desoky, and Salim, 2021**).

Internationally, comparable results were observed following case-based education in Iran (**Mohamadirizi et al., 2024**), clinical interventions in Pakistan (**Khadim et al., 2022**), and mobile learning in Rwanda (**Nishimwe et al., 2021**). Regarding the EBP component, the Iowa Model is widely used for nursing education, training, research fellowships, and translation of evidence into practice (**Speroni, McLaughlin, and Friesen, 2020; Chays-Amania, Schwingrouber, and Colson, 2024**).

Regarding total knowledge, the current study revealed a significant improvement in the total nurses' knowledge level. Prior to the program, most nurses demonstrated poor knowledge regarding primary PPH. However, post-program results showed a high knowledge level. This improvement could be attributed to nurses' motivation to learn, their willingness to update clinical knowledge, and the provision of a written booklet as an ongoing reference.

This is consistent with **Abdelbaky (2024)**, who reported an increase in good knowledge from 37.5% pre-intervention to 82.5% post-intervention. Similarly, **El Sharkawy et al. (2020)** in Egypt found that good knowledge increased from 54.3% pre-intervention to 80.0% post-Iowa Model EBP intervention ($p \leq 0.001$). The findings suggest that the Iowa Model EBP program is an effective approach for improving nurses' knowledge regarding primary PPH.

Conclusion

The present study achieved its aim, and the research hypothesis was supported. Nurses' knowledge regarding primary PPH improved significantly following the implementation of the Iowa Model EBP. The proportion of nurses with high knowledge increased from 0% pre-program to 72% post-program. This improvement was evidenced by a



statistically significant difference between pretest and posttest scores ($p < 0.0001$).

Recommendations

Based on the present study findings, the following recommendations are suggested:

- Implement regular in-service educational programs based on the Iowa Model EBP to enhance nurses' knowledge regarding primary PPH.
- Develop and provide evidence-based educational materials and clinical guidelines aligned with WHO and ACOG recommendations.
- Conduct periodic workshops and knowledge

assessments to ensure updating of nurses' knowledge.

- Conduct further studies with larger samples in diverse settings to examine the long-term impact of the Iowa Model EBP on nurses' knowledge and maternal outcomes.

Authors' contributions

A.E.M. Helal: Conceptualization, Methodology, Data Collection, Data Analysis, Writing - Original Draft. **F.T.F. Ali:** Proposed the research idea. **H.A. Emarah, M.M. Abdelmonem and F.T.F. Ali:** Conceptualization, Methodology, Supervision, Writing - Review & Editing. **All authors** have read and agreed to the published version of the manuscript.

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