

Effect of Implementing Intrapartum Digital versus Paper Partographs on Maternity Nurses' Performance and Birth Outcomes

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Abstract

The **aim** of the study was to investigate the effect of implementing intrapartum digital versus paper Partographs on maternity nurses' performance and birth outcomes. **Method:** the researchers adopted a quasi-experimental methodology. The study was carried out at the University Hospital and Shebin El-Kom Teaching Hospital's labor wards in the Menoufia Governorate of Egypt. A convenience sample of fifty maternity nurses, and a purposive sample of two hundred pregnant women from the study settings were randomly selected. A structured interview questionnaire filled out by the maternity nurses, an observational checklist of maternity nurses' procedures, and a structured interview questionnaire filled out by the women were all used to collect the data. **Results:** Following the intervention, maternity nurses scored higher on both measures of knowledge and use of the digital Partograph than they had previously (75% and 90%, up from 5% and 6%, respectively). While the paper partograph was useful, the digital partograph was more accurate in predicting the chance of inferior maternal outcomes (prolonged labor 3 versus 11, cesarean section 3 versus 6, oxytocin augmentation 2 versus 4, and serious maternal morbidity or death 12 versus 22). Furthermore, when compared to the paper Partograph, the digital Partograph outperformed it in predicting the likelihood of poor fetal outcomes (7 versus 13 newborn resuscitations needed and none versus 1). **Conclusion:** As compared to the paper partograph, the digital version is simple to use, well-accepted, inexpensive, less invasive, and helpful in labor management, all of which contribute to a better chance of a safe birth for the mother and a healthy newborn. **Recommendation:** It is suggested that the digital Partograph be incorporated into labor management guidelines to aid in prompt decision-making for urgent obstetric interventions.

Keywords: digital partograph, paper partograph, maternity nurses' performance, and birth outcomes.

Introduction

To limit the risk of complications during pregnancy, such as prolonged labor, an emergency C-section, birth asphyxia, or a stillbirth, it is essential to regularly and timely monitor maternal and fetal parameters with a partograph chart (Rahman et al., 2019). Of the approximately 295,000 maternal deaths recorded worldwide in 2017, 94% happened in low-resource settings, and the vast majority were avoidable (World Health Organization, 2019).

The World Health Organization (WHO) recommends the use of the paper partograph for active labor and the prevention of protracted labor, and this is the most widely available labor monitoring equipment (World Health Organization, 2019). The World Health Organization partograph is a visual aid for tracking labor progress and assessing

maternal and fetal health to detect pregnancy complications. In many situations, trained birth attendants complete partographs for record-keeping purposes only, and the routine use of the paper partograph is inconsistent even in low- and middle-income countries (Maternal and Child Health Integrated Program, 2019).

Partograph charts have been shown to have positive results, but Sama et al. (2017) found that they have not been used to their full potential because, so few people are aware of them. Several factors, such as a lack of knowledge, resistance from service providers who see it as an administrative tool, a lack of uniform protocols, insufficient training of service providers, a lack of support from the system, a low status within labor wards, and an insufficient supply of paper partographs, have

been documented by Singh et al. (2016) as contributing to the improper use of partograph.

An electronic partograph allowing online data entry and user help for urgent clinical intervention has been tried and proven successful in addressing these concerns in various contexts (Sanghvi et al., 2019). DAKSH, an iPad app, is a digital partograph that aims to solve the problem of paper partographs to boost intrapartum care quality for mothers (Dimagi, 2018). The paper partograph has various limitations that the digital partograph app aims to overcome by providing more accurate data, streamlining record-keeping, and facilitating better decision-making (Litwin et al., 2018).

It was also determined by Bedwell et al. (2017) that although the paper partograph appears to be accepted, evidence suggests that it is not being used in practice as planned and is therefore not reaching its potential in enhancing results. They also found that the use of a digital partograph encourages uniform and accurate application. There was a decrease in the rates of emergency cesarean sections (from 9.9% to 8.3%), emergency births (from 0.5% to 0.3%), augmentation rates (from 20.7% to 9.1%), prolonged labor (from 6.4% to 3.4%), and stillbirths (from 0.5% to 0.3%) after the introduction of the partograph and a standardized management protocol (Bedwell et al., 2017).

Additionally, they have reported advantages in quality of care in the areas of referral and transfer, ease of use, time resourcefulness, continuity of care, educational assistance, and professional accountability, as well as ease of recording, provision of a pictorial overview of progress, auditing of care, training of clinicians, and transferring of care (Usmanova et al., 2020). These advantages may help boost maternal and fetal health (Hanson et al., 2019).

Therefore, trained nurses are needed for labor management to keep track of regular checks on the health of both the mother and the fetus (Hadi et al., 2017). Use this information to recognize typical labor progression, make informed decisions, and prepare for the future (Megha et al., 2019). The evaluation of many measurements is more difficult than the interpretation of a single measurement, such as fetal heart rate (WHO, 2017). Normal laboring women should be encouraged to walk around, drink water, eat, and

have a birth partner there, while interventions like artificial rupture of membranes and augmentation should be used only when medically necessary (Kagama et al., 2019). When complications arise during labor, the correct measures are performed (Lavender et al., 2018).

Significance of the study

It is well known that prolonged and obstructed labor are major contributors to the high rate of maternal mortality (Mohapatra et al., 2017). 44,000 women (about twice the seating capacity of Madison Square Garden) lose their lives every year because of complications during pregnancy, and all of them might have been avoided had they lived in a higher-income country (UNICEF, 2018). The World Health Organization (WHO) recommends the use of the partograph to detect irregularities in labor progression and maternal or fetal distress (Mukisa et al. 2019).

Although partographs can be a helpful intrapartum tool, their complexity, lack of training, overburden of work, limited healthcare staff, lack of referral protocols, shortage in supply, and low resource healthcare settings all work against their widespread adoption (Chaturvedi et al., 2015; Litwin et al., 2018). Digitizing the partograph will not only solve these problems, but it may also make it possible for inexpensive digital applications to fill in for the paper partograph's shortcomings, speed up the delivery of care, aid in decision-making, and boost the quality of care received by the mother and baby (Bedwell et al., 2017). This study was done to determine whether nurses' performance, which reflected mother and fetal outcomes, improved by using a digital partograph called DAKSH during labor instead of a paper partograph.

The study Aims

To investigate the effect of implementing intrapartum digital versus paper Partographs on maternity nurses' performance and birth outcomes.

Research Hypotheses:

- Maternity nurses are expected to have a higher level of knowledge and practice regarding the digital partograph after the training.
- Implementing an intra-partum digital partograph is expected to improve maternal

outcomes and keep labor normal in the digital partograph group more than in the paper partograph group.

- Implementing an intrapartum digital Partograph is expected to be associated with improved fetal outcomes in the digital Partograph group greater than the paper partograph group.

Operational definitions

Intrapartum Paper Partographs

- It is a paper chart on which remarks in labor are recorded in a graphic design to provide an outline of labor, pointing to alert midwives and obstetricians to deviance in labor progress as well as maternal or fetal wellbeing. It was measured using instrument three part two.

Intrapartum Digital Partographs

- It is a paperless partograph used for watching the progress of labor before delivery, and reaching at the accurate time for safe delivery. It was measured using instrument three part two.

Maternity Nurses' Performance

- The maternity nurses' use of digital and paper partographs (Registration, intrapartum record measurement, investigation, delivery record, and referral feature). It was measured using instrument two.

Birth Outcomes

It includes the maternal outcomes such as suboptimal maternal outcomes, the frequency, duration, and type of interventions used to keep labor progressing normally. Also, it includes the fetal outcomes such as the percentage of fresh stillbirth, low Apgar scores at 1 and 5 minutes, and the requirement for resuscitation. It was measured using instrument three part two.

Method

Research Design: This study employed a quasi-experimental methodology (study and control groups for maternity nurses and parturient women).

Research Settings: included the labor wards at two Egyptian hospitals in the Menoufia Governorate: The University Hospital and the Shebin El-Kom Teaching Hospital.

Sample: The study's sample included a purposive sample of 200 pregnant women and a convenience sample of 50 maternity nurses from the prior settings (25 from the University Hospital and 25 from Shebin El-Kom Teaching Hospital). The study group consisted of maternity nurses from the University Hospital who had received training on the digital partograph, and the control group consisted of maternity nurses from the Shebin El-Kom Teaching Hospital who had been instructed to use paper partographs as part of their standard labor care. The researchers also provided the nurses with opportunities to update their understanding and application of the partograph.

Two hundred parturient women were randomly divided into a study group in which labor progress was monitored using a digital partograph and a control group in which labor progress was monitored using traditional methods (paper partograph group).

Women in labor **were considered eligible if they met the following criteria:** they were in the first stage of labor (cervical dilatation between 4 and 8 centimeters), they were having a singleton pregnancy, they had reached at least 37 weeks of gestation, they were presenting with a cephalic shape, and they were healthy.

Primigravidae who met the criteria for high-risk pregnancies (antepartum hemorrhage, eclampsia, elective cesarean section, and induced labor) **were not included in the sample.**

Sample Size Determination: The researchers employed the Open-Source Statistics for Public Health's Epi statistical program to determine the optimal sample size. These included a two-sided confidence level of $95\% = 1 - \alpha$; a power of $1 - \beta$ or (% chance of detecting) of 80%, and a ratio of sample size (unexposed/exposed) of 1% of the unexposed with a result of 5%.

Instruments for collecting data:

The following four instruments were used to gather information:

Instrument One; A maternity nurse-specific structured interview questionnaire: Researchers created it after analyzing relevant literature (Litwin, 2018), and it consists of two parts:

Part One consists of four questions about the study nurses' professional backgrounds and

experience (age, education, occupation, and years of experience)

Part Two set of four questions to see how familiar the maternity nurses were with both digital and paper Partographs. These questions asked about the Partograph's definition, importance, parts, and how the nurses used the digital application.

Scoring system of knowledge:

Knowledge items were scored as follows: 2 for complete answers, 1 for incomplete answers, and zero for incorrect or do not know. The final knowledge score was determined by adding up all points awarded for "known things." Percentages were calculated from the raw scores. The higher the score, the more proficient the participant is with digital Partograph. The sum of the test-takers' knowledge was presented as follows: A score of 75% or more indicates good knowledge; a score of 75% to 50% indicates fair knowledge; and a score of less than 50% indicates poor knowledge.

Instrument Two: Checklist for observing nurses' performance in obstetrics care:

The researchers created this instrument to evaluate the maternity nurses' use of digital and paper partographs after reading the relevant literature (Hadi et al., 2017). (Registration, intrapartum record measurement, investigation, delivery record, and referral feature).

Scoring system of practice:

Each component of practice was assigned a score; with two representing adequately done practice, one representing inadequately done practice, and zero representing not done practice. The sum of the "adequately done practice" scores was used to determine the final practice score. Percentages were calculated from the raw scores. Greater proficiency with digital Partograph use was indicated by higher scores. This is how the final score for the practice session was displayed: a score of 85% or higher on the total practice test indicates competence; and 85% or lower indicates incompetence.

Instrument Three: A structured interviewing questionnaire related to the women:

Researchers created it after analyzing relevant literature (Litwin, 2018), and it consists of two parts:

Part One; It includes the demographic information, such as their ages, education levels, and incomes, as well as their obstetrical background information, like their number of pregnancies and how far along they were when they had them.

Part Two: Intrapartum Partograph record (Paper or Digital) for monitoring laboring women during labor and delivery to assess labor progress & outcomes.

Maternal outcomes such as:

- Suboptimal maternal outcomes (defined as a retained placenta, blood loss \geq 500 ml, systolic BP 90 mm Hg, BP 60 mm Hg, and BP 60 beats per minute) as recorded by maternity nurses using digital or paper Partographs.
- Partographs (either digital or paper) should be used to keep track of the frequency, duration, and type of interventions used to keep labor progressing normally.
- The frequency with which any intervention on digital or paper Partographs was recorded in response to problems or deviations from typical labor. In response to irregularities in the fetal heart rate, the laboring woman's posture was changed, bleeding was checked for, a supervisor was consulted, a referral was made, and labor was augmented as needed during the first stage.

Fetal outcomes such as:

- Maternity nurses reported the percentage of births where the fetus or newborn did not fare well. These outcomes included fresh stillbirth, low Apgar scores at 1 and 5 minutes, and the requirement for resuscitation. Additionally, maternity nurses record aggregate monthly routine data on facility registers, including the rate of fresh stillbirth and the rate of neonatal death within the first 24 hours of life.

Paper partograph: When recording information about a labor session, the partograph is typically used. The WHO partograph is a visual aid for identifying obstetric and fetal problems based on measurements of fetal and maternal health and labor progression. The mother's condition, the fetus's condition, and the progress of labor are the three principal areas of focus for most partographs. Alert and action lines have historically been pre-printed on charts. a watchful line that was unwaveringly straight. To stimulate opportunistic management of sluggish labor

development, an action line is positioned a certain number of hours after the alert line (often two or four hours to the right) (Bedwell, 2017).

The digital partograph, also known as the DAKSH digital partograph, is a tablet-based mobile application designed to analyze the implementation fidelity of partograph use for monitoring labor and to improve care for women in labor by addressing reported issues in partograph use. With this app, the researchers may get help making decisions in real time, streamline the data entry processes, and gain more insight into the workforce so the researchers can better manage them. Along with that, it records delivery, intrapartum record measurement, the record of the investigation, and has postpartum referral characteristics (Singh et al., 2019). A digital partograph eliminates the need for an interpreter, is error-proof, and speeds up the process in comparison to a paper partograph. During the active part of the first stage of labor, the mother's pulse, blood pressure, and temperature should be recorded every half hour, while the fetal heart rate (FHR), membrane condition, and amniotic fluid color should be recorded every four hours (Jain et al., 2021).

Validity & Reliability

Five specialists from the Nursing's Maternal and Newborn Health Department reviewed and tested the instruments for content validity. The update was implemented when needed to guarantee accuracy and comprehensiveness. Reliability based on repeated testing was utilized. Using Cronbach's alpha coefficients, we were able to determine the instruments' reliability. Cronbach's alpha values for the reliability of the instruments used in the study were 0.82 for Instrument 1, 0.628 for Instrument 2, 0.861 for Instrument 3, and 0.95 for Instrument 4.

Administrative design

Before beginning the study, the researchers got a letter of authorization to do so from the Dean of the Faculty of Nursing at Menoufia University and sent it to the directors of each study setting. The letter's stated purpose was to solicit permission and assistance in conducting the study's data collection.

Ethical considerations

The study was approved by the Faculty of Nursing's Ethical and Research Committee, thus

the researchers must have gotten the consent of the maternity nurses and the parturient women being studied. The researchers ensured the privacy and security of their information.

Pilot study

To ensure the clarity, application of the instruments, and time needed to complete the study, a pilot study was conducted on 10% of the participants (five nurses and twenty relevant women during childbirth; these individuals were not included in the final sample). Modifications were made based on the findings of the pilot's research.

Procedure:

- * All the nurses who work in the maternity wards at the places listed above have been trained in how to use both digital and paper Partographs correctly and follow basic labor management rules.
- * From early December 2021 to late August 2022, the researchers did the real fieldwork. The researchers worked a morning shift at the study settings three days a week, from 8:00 a.m. to 2:00 p.m.
- * The researchers made first contact with medical and nursing personnel in the institutions and introduced themselves. They also briefed us on the study's background and goals and requested our participation. The current investigation consisted of three distinct but sequential stages: assessment and training; implementation; and evaluation.
- * **Assessment & training phase:** All nurses on the labor wards are quizzed on their knowledge of Partographs (their definition, importance, components, and nurses' roles in the digital application) as part of the assessment and training phase.

The study researchers compiled a learning resource for nurses that covered topics including the partograph's description, significance, components, and the nurse's role in using both digital and paper versions. Researchers at University Hospital had DAKSH installed on the phones of its maternity nurses.

- To familiarize maternity nurses with both digital and paper Partographs, the researchers held two educational sessions (each lasting 45 minutes). Partograph's components were presented in detail via sessions with instructional videos; participants were also taught the basics of using DAKSH and paper Partographs. At least five maternity nurses were

present at each session to apply for the Partograph and follow other standard labor management protocols. After that, the maternity nurses used the Partograph (either digitally or on paper) to track each woman's progress during labor, just as they had done in the previous hospital environment and just as they had done in accordance with normal labor management recommendations. All nursing care provided to laboring mothers was recorded by specially trained maternity nurses.

There are five processes integrated into the digital application (Singh et al., 2019).

- 1. Registration:** The first step is for the client to register with DAKSH, where they will provide details like their name, phone number, the attending physician's name and title, the patient's status in terms of labor, and the results of several diagnostic tests. Part of the frequency of examination alerts can be based on how much the cervix has opened when registering.
- 2. Intrapartum record measurement:** During the exam, quantitative measurements of the intrapartum are taken. Filling in these parameters will help make the digital partograph.
- 3. Investigation:** The user adds prenatal screenings like a complete blood count and urine analysis.
- 4. Delivery Record:** This application has a single form for documenting information about the delivery and the postpartum examination of the mother and the fetus.
- 5. Referral feature:** The application has a referral form for both during and after a woman's delivery that can be used to record the patient's transfer to another institution. If both the referring institution and the receiving facility have DAKSH, the receiving facility will be notified in advance by alarms. Having this information handy on a paper partograph is an immense help in case of an emergency. The researchers took advantage of the color display by using bright colors rather than shading.

* In the **implementation phase**, one hundred pregnancies were randomly assigned to have a "normal" birth using the digital app, and the same number were randomly assigned to have a "normal" birth using the paper Partograph. In-person interviews with maternity nurses were conducted to collect socio-demographic information, and questions about the

intrapartum nursing intervention received by diverse groups of mothers were asked. After explaining the nature of the study and collecting socio-demographic information from each participant, the researchers met with each woman personally, introduced themselves, and gained each woman's consent to participate in the study. Inquire further into the birth outcomes for both mother and fetus.

* **Evaluation phase:** Immediately following the training, the researchers used digital and paper Partographs to assess the competence of maternity nurses using covert observational checklist. They examined the labor outcomes with and without paper Partograph use to determine if the digital version was more effective. All high-risk pregnant women (plotting on the partograph and moving to the right of the alert line; FHR less than 120 beats/min or more than 160 beats/min, etc.) were sent right away to the first referral unit (FRU) based on how the partograph results were interpreted (these interpretations were made automatically by DAKSH) 3 cases in the digital Partograph group and 6 cases in the paper Partograph group.

Data Analysis:

Statistical Package of Social Science (SPSS) Version 23 was used for data organization, review, coding, tabulation, analysis, and presentation. The use of frequency and percentage distributions as descriptive statistics for qualitative variables. The difference between the study and control groups was measured using a test of significance. Differences between groups where $P < 0.05$ can be considered statistically significant.

Results:

The maternity nurses' professional characteristics are shown in **Table 1**. From the data in the table, 52% and 56% of the maternity nurses aged 20-29 years in the digital Partograph group and paper Partograph group, respectively, and between 40% and 44% of the maternity nurses in the digital Partograph group and the paper Partograph group, respectively, held a bachelor's degree in nursing. Both 48% and 36% of them have less than five years of professional experience.

The maternity nurses' level of knowledge about paper and digital partographs was summarized in **Table 2**. It shows that most

maternity nurses in the study have a thorough understanding of all aspects of both digital and paper Partographs (definition, importance, components, nursing role) in the digital Partograph group (88.0%, 96.0%, 80.0%, 100.0%) and the paper Partograph group (80.0%, 84.0%, 76.0%, 100.0%) after the training.

After receiving training, maternity nurses' overall knowledge of digital and paper partographs was exhibited in **Figure 1**. It shows that after training, most of the maternity nurses in the study had good knowledge scores for both digital and paper Partographs (95% and 90%, respectively).

Table 3 demonstrates how maternity nurses have been using digital and paper partographs since receiving training. It shows that after training, most maternity nurses in the digital Partograph group and the paper Partograph group had completed all items of the Partograph adequately (92.0%, 84.0%, 88.0%, 84.0%, 92.0% and 80.0%, 72.0%, 86.0%, 72.0%, 80.0% respectively).

Maternity nurses' overall performance on both the digital and paper Partographs is depicted in **Figure (2)**, following the training. The findings show that after receiving training, most of the maternity nurses who used digital partographs and those who used paper partographs both performed all aspects of their jobs competently (94.0% and 90.0%, respectively).

Table 4 showed that there were no statistically significant differences in the demographics of the parturient women who used digital versus paper Partographs.

The obstetrical history of the study participants is listed in **Table 5**. There were no statistically significant differences in the gravidity and parity of the study subjects between the paper partograph and digital partograph groups. Despite this, there was a significant difference between the average gestational ages.

Table 6 showed that more than 90% of deliveries were completed before the alert line was reached, suggesting that the occurrence of difficult births could be reduced with timely intervention using a partograph. When comparing the digital Partograph to the paper Partograph, the digital one did a better job of showing when there was not enough work progress.

Nursing interventions for laboring women are compared in **Table 7** for the two groups (parturient who used paper partographs and those

who used digital partographs). This shows that the maternity nurses' interventions varied significantly between the two groups. Overall, more women in the digital Partograph group (14%) than women in the paper Partograph group (5%) underwent interventions to ensure the health of the fetus (position modification, oxygen, or referral). There were statistically significant increases in the proportion of laboring women who received food and water in the digital Partograph group compared to the paper Partograph group (71% vs. 44%, respectively). In addition, women managed with a digital Partograph were more likely to be actively encouraged to walk around and have their third stage of labor managed than women managed with a paper Partograph (82% vs. 63.3%) and (92% vs. 78.7%), respectively; however, these differences were not statistically significant. Women in labor were more likely to get interventions (walking, eating, or drinking) in the partograph group (86%) than in the paper partograph group (66%). There was a difference, but it was not statistically significant. Only 31% of the digital Partograph group and 16% of the paper Partograph group received interventions commonly used to treat any abnormal labor progress (augmentation, cesarean delivery), but these differences were not statistically significant.

The maternal outcomes of Parturient women in the study are listed in **Table 8**. The digital Partograph proved superior to the paper version in this aspect, allowing for earlier detection of potential problems with the mother's health. The percentages of prolonged labor, cesarean sections, oxytocin augmentation, and major maternal morbidity or death were significantly lower in the digital Partograph group compared to the paper Partograph group.

The fetal outcomes of the study's parturient participants are listed in **Table 9**. In this sense, the digital Partograph outperformed the paper Partograph in predicting the likelihood of suboptimal fetal outcomes. The differences between the two groups were statistically significant. The average Apgar score for newborns at 5 minutes was lower in the digital Partograph group (9.2 ± 0.4) than in the paper Partograph group (9.4 ± 0.4). Additionally, the requirement for newborn resuscitation was more common in the digital Partograph group (7%) compared to the paper Partograph group (13%).

Part I: The Maternity Nurses

Table 1: The Professional Characteristics of the Maternity Nurses (N = 50)

Items	Group of Digital Partographs (N = 25)		Group of Paper Partographs (N = 25)		χ^2	P value
	No.	%	No.	%		
Age / years						
-20 – 29	13	0.52	14	0.56	.237	.971
-30 – 39	8	0.32	8	0.32		
-40 – 49	3	0.12	2	0.8		
-50 – 60	1	0.4	1	0.4		
	1.68 ± 0.85		1.60 ± 0.81		T= 14.02	
Educational level						
- Secondary school (diploma).	9	0.36	7	0.28	1.298	.730
- Technical Institute of Nursing.	6	0.24	6	0.24		
- Bachelor's degree.	10	0.40	11	0.44		
- Master's degree.	0	0.0	1	0.4		
Years of experience						
-<5	12	0.48	9	0.36	1.314	.726
-5-<10	6	0.24	8	0.32		
- 10-15	4	0.16	6	0.24		
- More than 15	3	0.12	2	0.8		

Table 2: Maternity Nurses' Level of Knowledge about Digital and Paper Partographs (N = 50)

Items	Group of Paper Partographs (N = 25)				Group of Digital Partographs (N = 25)				χ^2	P value
	Pre		Post		Pre		Post			
	No.	%	No.	%	No.	%	No.	%		
Definition of digital and paper Partograph										
Complete	7	28.0	20	80.0	0	0.0	22	88.0	X ² ₁ = 39.286 X ² ₂ = .762	P1= 0.000 P2= .683
Incomplete	15	60.0	4	16.0	0	0.0	2	8.0		
Incorrect or do not know	3	12.0	1	4.0	25	100.0	1	4.0		
Importance of digital and paper Partograph										
Complete	7	28.0	21	84.0	0	0.0	24	96.0	X ² ₁ = 39.286 X ² ₂ = 2.533	P1= 0.000 P2= .282
Incomplete	15	60.0	2	8.0	0	0.0	1	4.0		
Incorrect or do not know	3	12.0	2	8.0	25	100.0	0	0.0		
Components of digital and paper Partograph										
Complete	5	20.0	19	76.0	0	0.0	20	80.0	X ² ₁ = 26.548 X ² ₂ = .137	P1= 0.000 P2= .934
Incomplete	17	68.0	5	20.0	2	8.0	4	16.0		
Incorrect or do not know	3	12.0	1	4.0	23	92.0	1	4.0		
Nurses' role in the digital and paper Partograph application										
Complete	5	20.0	25	100.0	0	0.0	25	100.0	-	-
Incomplete	17	68.0	0	0.0	2	8.0	0	0.0		
Incorrect or do not know	3	12.0	0	0.0	23	92.0	0	0.0		
Mean total knowledge scores	7.5±2.3		4.8±1.6		11.7±0.7		4.4±1.1		X ² ₁ = 10.895 X ² ₂ = 2.716	P1= 0.002 P2= .106

P1=Comparison between the Paper and digital Partographs groups regarding total knowledge score before the intervention.

P2=Comparison between the Paper and digital Partographs groups regarding total knowledge score after the intervention.

Figure 1: Maternity nurses' overall knowledge of digital and paper partographs after receiving training (N = 50).

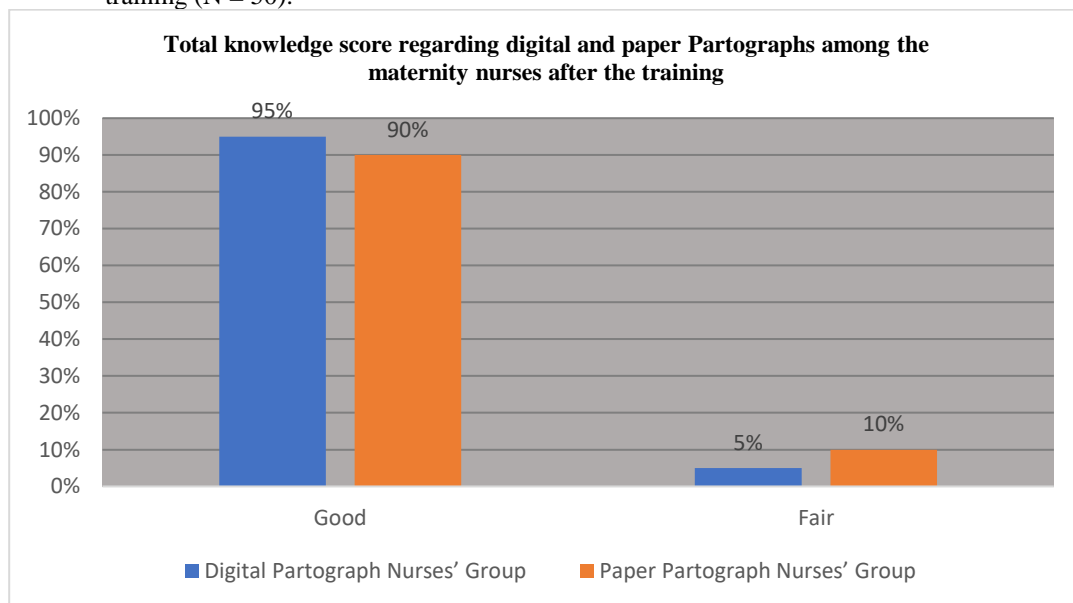
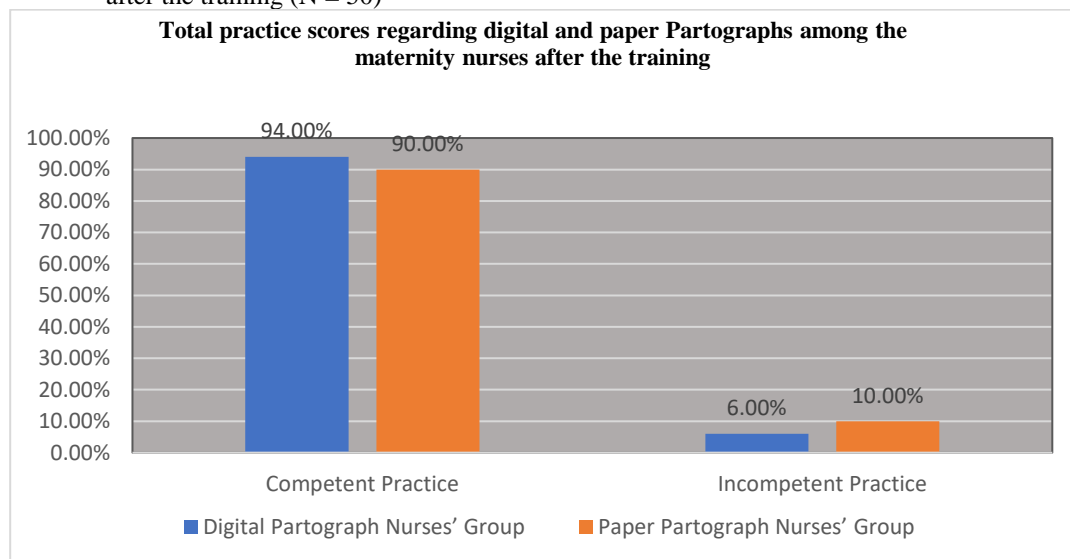


Table 3: Maternity Nurses' Practice Regarding the Application of Digital and Paper Partographs After Training

Items	Group of Digital Partographs (N= 100)				Group of Paper Partographs (N=100)				χ ²	P value
	Pre		Post		Pre		Post			
	No.	%	No.	%	No.	%	No.	%		
Registration										
Adequate done	2	8.0	23	92.0	7	28.0	20	80.0	X ² ₁ = 7.759 X ² ₂ = 1.647	P ₁ = 0.021 P ₂ = .199
Inadequate done	22	88.0	2	8.0	13	52.0	5	20.0		
Not done	1	4.0	0	0.0	5	20.0	0	0.0		
Intrapartum record measurement										
Adequate done	2	8.0	21	84.0	8	32.0	18	72.0	X ² ₁ = 7.714 X ² ₂ = 1.219	P ₁ = 0.021 P ₂ = .269
Inadequate done	22	88.0	4	16.0	13	62.0	7	28.0		
Not done	1	4.0	0	0.0	4	16.0	0	0.0		
Investigation										
Adequate done	3	12.0	22	88.0	7	28.0	19	86.0	X ² ₁ = 3.325 X ² ₂ = 1.380	P ₁ = .190 P ₂ = .240
Inadequate done	20	80.0	3	12.0	14	56.0	6	24.0		
Not done	2	8.0	0	0.0	4	16.0	0	0.0		
Delivery record										
Adequate done	0	0.0	21	84.0	5	20.0	18	72.0	X ² ₁ = 26.513 X ² ₂ = 1.049	P ₁ = .000 P ₂ = .306
Inadequate done	2	8.0	4	16.0	15	60.0	7	28.0		
Not done	23	92.0	0	0.0	5	20.0	0	0.0		
Referral feature										
Adequate done	0	0.0	23	92.0	5	20.0	20	80.0	X ² ₁ = 1.495 X ² ₂ = 1.495	P ₁ = .221 P ₂ = .221
Inadequate done	2	8.0	2	8.0	15	60.0	5	20.0		
Not done	23	92.0	0	0.0	5	20.0	0	0.0		

Figure 2: Total practice scores regarding digital and paper partographs among the maternity nurses after the training (N = 50)**Part II: The parturient women and birth outcomes:****Table 4:** The socio-demographic characteristics of the parturient women (N = 200)

Items	Group of Digital Partographs (N= 100)		Group of Paper Partographs (N=100)		χ^2	P value
	No.	%	No.	%		
Age / years						
-20 – 25years	40	40	34	34	1.58	4.21
-25 – 30 years	28	28	36	36		
-30 – 35 years	20	20	24	24		
-35 – 40 years	10	10	6	6		
-40 – 45 years	2	2	0	0		
Educational level						
- Read and write	16	16	20	20	1.059	.589
-Secondary school.	54	54	46	46		
- University.	30	30	34	34		
Income						
-Enough	47	47	26	26	8.68	.003
-Not enough	53	53	74	74		

Table 5: Obstetrical History of the Study Participants (N = 200)

Items	Group of Digital Partographs (N= 100)		Group of Paper Partographs (N=100)		χ^2	P value
	No.	%	No.	%		
Gravidity						
Primigravida	48	48	49	49	0.020	.500
Multigravida	52	52	51	51		
Parity						
0	56	56	44	44	3.032	.220
1	25	25	34	34		
> 2	19	19	22	22		
Mean gestational age in weeks	37.57 ± 0.76		38.48 ± 0.83		8.020	.000**

Table 6: Position of Cervical Graph according to Partograph Type (N = 200)

Items	Group of Digital Partographs (N= 100)		Group of Paper Partographs (N=100)		χ^2	P value
	No.	%	No.	%		
Left to the alert line	95	95	92	92	0.46	<.001
Between the alert and the action line	5	5	6	7	0.828	<.001
Right to the action line	0	0	2	1	0.063	<.001

Table 7: Nursing Interventions Undertaken During Labor by Maternity Nurses Across Types of Partograph Used (N = 200)

Items	Group of Digital Partographs (N= 100)		Group of Paper Partographs (N=100)		χ^2	P value
	No.	%	No.	%		
Walk, ambulate	82	82	63	63	9.053	.002
Food given	71	71	44	44	14.916	.000
Fluids given	79	79	46	46	10.824	.001
Active management of the third stage	92	92	78	78	7.686	.005
Interventions to maintain normal labor	86	86	66	66	10.965	.001
Interventions to address fetal well-being	14	14	5	5	4.711	.026
Interventions to address labor abnormality	31	31	16	16	6.258	.009

Table 8: Maternal Outcomes Among the Study Parturient Women (N = 200)

Items	Group of Digital Partographs (N= 100)		Group of Paper Partographs (N=100)		χ^2	P value
	No.	%	No.	%		
Percentage of a suboptimal maternal outcomes						
Prolonged labor						
Yes	3	3	11	11	4.916	0.027*
No	97	97	89	89		
Caesarean section						
Yes	3	3	6	6	1.047	0.306
No	97	97	94	94		
Oxytocin augmentation						
Yes	2	2	4	4	0.687	0.407
No	98	98	96	96		
Serious maternal morbidity or death (e.g., ruptured uterus, admission to an intensive care unit, septicemia, organ failure)						
Yes	12	12	22	22	3.544	0.060
No	88	88	78	78		

Table 9: Fetal Outcomes Among the Study Parturient Women (N = 200)

Items	Group of Digital Partographs (N= 100)		Group of Paper Partographs (N= 100)		χ^2	P value
	No.	%	No.	%		
Percentage of suboptimal fetal or newborn outcomes						
Newborn's Apgar score at 1 minute	8.4 ± 0.7		8.6 ± 0.8		t=0.408	0.666
Newborn's Apgar score at 5 minutes	9.2 ± 0.4		9.4 ± 0.4		t=3.268	0.052
Newborn resuscitation is needed						
Yes	7	7	13	13	2.000	0.157
No	93	93	87	87		
Stillbirth, neonatal death, or neonatal morbidity, excluding fatal malformations (e.g., seizures, birth asphyxia, neonatal encephalopathy)						
Yes	0	0	1	1	1.005	0.316
No	100	100	99	99		

Discussion:

The findings of the current study supported the research hypotheses and are discussed in the following sections.

First Section: Professional characteristics of the studied maternity nurses:

According to the current study's findings, over one-third of both groups had less than five years of experience, and over one-third of both groups had an average age of less than thirty. Additionally, more than one-third of both groups had at least a bachelor's degree in nursing education. The researchers believe that if the digital Partograph, a new piece of technology, is to be widely adopted, it should be made available to an early age as they are interested in using it. In addition, having a college degree speeds up the learning curve for this innovative technology.

These findings are consistent with those found by Litwin et al. (2018) in their study on the feasibility and acceptability of using an electronic partograph. In a study conducted in Zanzibar, Tanzania, researchers found that most adults have access to a mobile phone and that the most common uses for these devices are texting, taking pictures, and conducting financial transactions via smartphone. This finding supports the growing trend of using mobile applications to supplement clinical care in low-resource settings.

Findings related to maternity nurse's knowledge and practice regarding digital and paper Partograph after the training

When compared to the maternity nurses in the digital Partograph group, those in the paper Partograph group had a more in-depth understanding of the tool and more experience using it as part of their standard treatment for laboring mothers. The researchers also provided these nurses with opportunities to update their understanding and application of the Partograph. However, the findings of the present investigation demonstrated that, following training, maternity nurses possessed an in-depth understanding of all aspects of the digital partograph. After the training, most maternity nurses provided full answers to all questions. Due to the training, most maternity nurses could apply both digital and paper partographs with confidence.

According to the study's researchers, the participants who used digital technology during training reported higher levels of satisfaction and were more likely to use new tools afterward. This also demonstrates how effectively researchers are being educated.

Consistent with the findings of Sondal et al. (2016), who conducted a systematic review entitled "Assessing the effect of mHealth interventions in improving maternal and neonatal care in low- and middle-income countries," this research confirmed that the use of evidence-based applications is likely to grow soon in India. The degree to which health care providers find a given application user-friendly is a strong predictor of that application's likelihood of being used to implement a certain health intervention.

Litwin et al. (2018) found digital partograph use by skilled birth attendants (SBAs), corroborating the prior findings. After only a few hours of training, SBAs utilized the digital Partograph, with over seventy-five percent completing basic tasks without key issues on their first clinical shift. It is possible that the trainees' ability to retain information and apply it during their actual use of the digital Partograph was aided using interactive, case-based facilitation during training.

The second section relates to birth outcomes. It emphasized maternal and fetal outcomes.**Maternal outcomes: cervical graph position determined by partograph type**

The current study showed that most deliveries occurred successfully before the alert line was reached, suggesting that the occurrence of difficult births could be reduced with timely intervention using a partograph. When comparing the digital and paper partographs, the digital partograph was more accurate in detecting slow labor advancement.

According to the study's researchers, this is because the WHO (World Health Organization) Partograph's cervical graph was made to record the stages of labor with the help of action and alert lines. The cervical line has been plotted using the active phase cervical dilation reported in centimeters per hour at two-hour intervals. The standardization of clinical trial findings led to the incorporation of two cervical lines, or "alert and action lines," within the partograph to guide the

expected progression of labor. Labor is progressing normally if the cervical plot is on or to the left of the alert line. If any plot falls on the "alarm" or "action" side of the line, a choice about whether to terminate the pregnancy must be made quickly.

Rahman et al. (2019) investigated the "feasibility and effectiveness of electronic vs. paper partographs on improving birth outcomes," and they found that when labors were monitored using a digital partograph, the action line was crossed much less frequently than when using a paper partograph, and in no delivery cases was the action line crossed. Therefore, it is more probable that measures will be implemented quickly to fix the problem. The paper Partograph increases the risk of a practitioner missing a triggered clinical rule and delaying action, both of which can set off additional clinical triggers. In-depth interviews with managers showed that, unlike with the paper Partograph, they took initiative when notified by the app of a problem rather than waiting to be called.

The Nursing interventions undertaken during labor by maternity nurses across type of Partograph used

The current study findings found a statistically significant difference between the groups of parturient women who used paper Partographs and those who used digital Partographs when it came to the interventions carried out by maternity nurses. Women who used digital Partographs were more likely to undergo interventions (position change, oxygen, cesarean section, or referral) to ensure the health of their babies compared to those who used paper Partographs. Women who gave birth in the digital Partograph group were significantly more likely to get active management of the third stage of labor, as well as care to sustain normal labor, such as encouragement to ambulate, eat, and drink fluids.

With the use of the Partograph, researchers tracked the mother's health and spotted potential complications before they happened. Improvements in practices that can alter placental perfusion may be an effect of increased Partograph use. This result agreed with that reported in a 2019 publication by Sanghvi et al. about a study done in Kenya. In this research, a tablet-based documentation and decision-support

application with the following functionalities was tested: A manager can view the data submitted to the tablet from anywhere. Automatic reminders are provided to foster nurturing habits (e.g., continued ambulation, presence of a labor companion, taking fluids and foods). If the app's algorithms determine that a risk or complication exists and further action is warranted, the health care provider will be notified via audible alerts or triggers. Thus, in the digital Partograph group, interventions to sustain fetal well-being were more common than in the paper Partograph group.

Maternal and fetal outcomes by the types of partograph

A greater proportion of women in the digital Partograph group required a cesarean section, used oxytocin augmentation, and had major maternal morbidity or death compared to women in the paper Partograph group, according to the findings of the current study. Specifically, compared to using a paper partograph, utilizing the digital partograph was more useful in predicting the likelihood of suboptimal maternal outcomes.

There was a statistically significant difference between the two groups regarding fetal outcomes among the pregnant women who participated in the study. Where the average Apgar score at 5 minutes for newborns in the digital partograph group was greater than that of the paper partograph group. Moreover, the requirement for resuscitation of newborns was more common in the digital Partograph group than in the paper Partograph group. In this respect, the digital Partograph outperformed the paper Partograph in predicting the likelihood of adverse fetal outcomes.

Rahman et al. (2019) found that, compared to paper Partographs, digital ones are associated with a greater decrease in the proportion of delivery outcomes occurring before the alert line. Therefore, the intervention was well accepted by care providers and their supervisors, and the use of the digital Partograph was related to better maternal and fetal outcomes than the use of paper Partographs. In addition, they noted that a digital partograph could more accurately detect slow labor progress than a paper partograph, allowing obstetricians to begin obstetric intervention like artificial membrane rupture and labor

augmentation earlier, decreasing the likelihood of complications such as these.

Further, they suggested that digital partographs be used to monitor and care for more laboring women than paper ones. But with time-saving tools like drop-down options and auto charting, it is simpler to do the correct thing, and obstetricians can devote more attention to each patient while still finishing their rounds on schedule. In-depth discussions validated the digital Partograph's low barrier to access.

Conclusion

After receiving the training, most of the maternity nurses showed significant improvements in their knowledge and performance on digital and paper partographs. This backed up the initial hypothesis of the study. In addition, compared to using a paper partograph, using a digital partograph was more effective in detecting the possibility of suboptimal maternal outcomes and the increased usage of interventions to maintain normal labor. This proved the second hypothesis of the study to be correct. Additionally, digital Partograph implementation was more effective than paper Partograph implementation in recognizing the possibility of suboptimal fetal outcomes. This lent credence to the study's third hypothesis. This means that the study findings do not support the null hypothesis.

Recommendations:

- It is suggested that the intrapartum digital partograph be included in the labor management guidelines.
- It is suggested that digital partographs be used a lot in both public and private hospitals in Menoufia Governorate.
- It is suggested that all obstetric nurses receive training on-site on how to use a digital partograph.
- It would be helpful to do more research with a larger group of pregnant women so that these results can be applied to the entire population.

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