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Use of Artificial Intelligence for Personalized Postnatal Education on Episiotomy Care and the Effect on Knowledge, Perception, and Self-Care Practices

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Abstract- ***Episiotomy care is an important aspect of postnatal recoveries. However, several women have low knowledge and as well lack confidence in managing the self-care practices after childbirth. Therefore, the study evaluated the application of artificial intelligence for personalized postnatal education on episiotomy care and its impact on the mother's experience, perceptions and the self care practice. The outcome of the structured artificial intelligence-based education solutions was developed using the machine learning algorithms to deliver individualized and timely postnatal guidelines to the request of postnatal mothers that have gone through episiotomy. From the consulted literatures, data were collated using standard tools for analyses, assessment of knowledge, perceptions as well as self care practices before and after the interventions. The results revealed by such studies showed that there was significant improvement in the knowledge of participants, with more perceptions on episiotomy care as well as improvement in the care practices based on the artificial intelligence guidelines. The findings show that personalized artificial intelligence postnatal education is quite good in improving mothers' knowledge, thus leading to the reduction in misconception, fetal loss and promoting adequate self-care behaviour.***

Keywords: Artificial Intelligence. Personalized Care, Postnatal Education, Episiotomy, Practices

I. INTRODUCTION

Post-natal episiotomy care is an aspect of healthcare that maintains the care of the perineal area for the purpose of promoting healing. Some of the important actions include ice packs for the first 24 hours to reduce the swellings, warm sitz bath 4 times daily after 24 hours by using a perineal irrigation bottle (peri bottle). Episiotomy represents minor incision that is done during birth so as to increase the width of the vagina opening [4]. In most cases the tear could occur during childbirth on its own which involve muscle around the rectum or anus [5]. It requires stitches to mend and ensure healing during the time of recovery and discomfort in the process of healing. For some cases of episiotomy, women get healed without complications; however, this might take many weeks [6-8]. Also, sexual activity and any activities that may result in rupture of the stitches should be avoided for at least six weeks postpartum [9-10]. During this process, a lot of self care practices are done for the purpose of relieving pain [11]. Episiotomy is perceived necessary during breech presentation, shoulder dystocia, fetal macrosomia, etc [12-14]. Thus, it is recommended by healthcare professionals that deliberate surgical incision would help the vagina to stretch and open and prevent severe tear. It was mentioned that urinary incontinence and pelvic floor dysfunctions could be prevented [15]. This is because the pelvic floor has tissues and muscles which support the uterus and help to prevent urinary and bowel dysfunction [16]. There are two main types of episiotomy midline and the mediolateral. The median or midline episiotomy is a vertical incision that starts at the vaginal opening and extends towards the anus [17]. This has risk associated with the tearing to the anal sphincter or rectum; however, it represents an easier incision to perform [18]. The mediolateral episiotomy is described as an angle or diagonal incision. This incision starts at the vaginal opening and go beyond at an angle of 45 degrees. The possibility of extending the incision to the anal sphincter and rectum is less in this case. This type of incision has disadvantages which include complexity of repair, loss of blood and discomfort during recovery [3,19-22]. Episiotomy is in degrees just like the perineal care. There are four degrees of episiotomy which is a

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function of the layers involved in the tear [23-24]. The first degree is a small tear involving the vagina lining, second degree describes the tear that goes through the vagina lining down to the underlying vagina tissue [5]. Most of the episiotomies are usually second degree [25]. The third degree described the tear involving vagina lining and tissues which goes to the anal sphincter, while the fourth degree refers to tears that affect the lining of the vagina, vaginal tissues, anal sphincter and rectum [26]. It represents the type of tear with serious complications. It is important to establish that pain is less perceived during these processes due to the administration of anesthesia around the region of incision to numb the perineal region [27-28]. According to a study by Delicate et al. [29] majority of women in the UK suffer from perineal trauma which is a common result of vaginal birth. While so many injuries heal without complications such as infection, wound breakdown, and pain which can affect the maternal recovery, daily activities and the overall wellbeing; managing the postnatal wound has been inconsistent, with inadequate guidelines to carry out optimal care.

Based on this, the study examined the current postnatal care provisions and the care procedures used by healthcare providers to tackle Childbirth Related Perineal Trauma (CRPT) in England as well as exploring their opinions on the enhancement of the care. The study method was guided using interpretive descriptive technique. Data was collated using a semi structured surveys with National Health Service (NHS) professionals providing care to women by following the childbirth related perineal trauma. The demographic data collated was analyzed using descriptive statistics with the interviewed data analyzed using the hybrid codebook thematic analyses. Also, the professionals in healthcare revealed that improvements in child birth related perineal trauma care could be from optimizations to maternal awareness and information; healthcare professional education and trainings. Thus, the study provided a unique information on postnatal care for women by using childbirth related perineal trauma in England, which revealed a complex and variable landscape within that region. Healthcare practitioners gave the need for standardization and targeted enhancements in care pathways to improve the outcomes for women.

Figure 1 depicts the care provision based on the childbirth related perineal trauma. It has several sections having disparities in the scope of delivery services around the National Health Service (NHS) regions. It was observed that the care pathways were utilized, professionals provided the healthcare; there was timeframe for contact with women as well as variation in care across all the service providers. It was mentioned that no complete pathway exists for women having childbirth related perineal trauma, thus, all women must receive the standard postnatal care that was delivered equally through the primary and community care route like community maternity services, general practices and health visitation. Such postnatal care is available universally to all women and their babies to support physical and mental health.

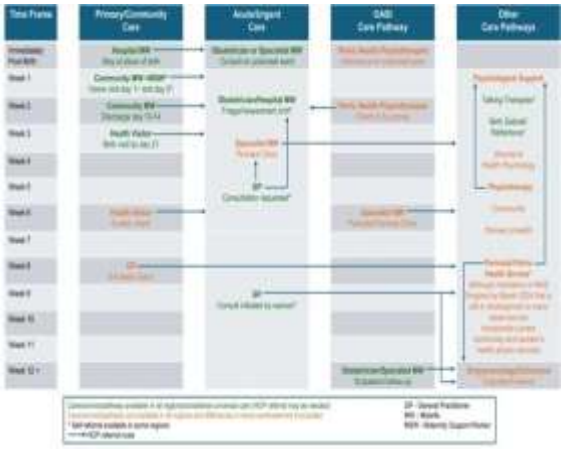

Figure 1: Reported postnatal Care for childbirth related perineal trauma [29]

Improvement to care and support women for better outcome is depicted by Figure 2. As observed, it could be from improvement to maternal awareness and information; healthcare professional education and trainings; standardized evidence related care pathway for universal postnatal care and specialists' childbirth related perineal trauma care.

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Figure 2: Improvement to care and support for women [29]

II. POSTNATAL EDUCATION ON EPISIOTOMY CARE

Episiotomy refers to a surgical procedure that is usually carried out during the childbirth that involve making of an incision to widen the opening of the vaginal region. Episiotomy repairs are based on the severity of the perineal laceration following the delivery of the infants. The continuity of non-locking sutures is frequently deployed to reduce pain and promote adequate healing [30].

Apart from its advantages, the routine use of episiotomy has been argued by several studies. For instance, it was mentioned that it may likely not reduce complications. Instead, it may possibly increase the possibility of anal incontinence and other complications, especially if the incision extends into an obstetric anal sphincter injury (OASI) [13, 15, 31]. This kind of activity in healthcare practice was developed to improve the competence of the learners that performs an episiotomy procedure, making it possible to evaluate the extent of the perineal laceration and the implementation of appropriate repair as well as inter-professional management solutions to enhance the patient outcome [16].

In most cases, there is severity of the perineal tears regardless of the episiotomy, which has raised a question about its effectiveness in the prevention of trauma. Some of the risk factors that resulted in increase of complications could be smoking, obesity, fourth degree laceration, operative vaginal deliveries as well as adherence to postpartum antibiotics. Thus, specialized clinical follow up is needed for a woman that is at increased risk of complications when it comes to perineal trauma. Endoanal ultrasound is usually recommended for suspected anal sphincter dysfunction. In the case of damages or confirmed OASI, secondary anal sphincter repair may be recommended [17]. To manage episiotomy as well as postpartum repair, it requires a collaboration of professionals developing solutions to improve patient centered care, outcomes, patient safety and performance of the team [18]. Therefore, midwives and physicians must be well skilled in performing these incisions and repairing the lacerations ensuring that strategies are deployed to prevent acute injuries as well as timely interventions. Nurses must be critical in the assessment of the level of lacerations, ensuring that immediate care and supports are provided via healing. Also, pharmacist must contribute through the management of pain relief and recommendation of the right medication regimen to prevent infections. Therefore, clear interprofessional communication is significant to coordinate the care effectively ensuring that each team member is informed about the condition of the patients and treatment plan. This great teamwork helps to advance a detail approach to care, thus, helping to address the physical and emotional need of the patient and improving the recovery and quality of life ultimately [20].

After episiotomy repair, dressing is applied. During the phase of post delivery, the patient is monitored for pain, infection, urinary continence and other possible complications. Patients are then health educated on how to observe sitz baths and clean the perineum. Any swelling observed, the nurse will help to apply ice packs which will help to reduce the pain [30]. The sutures used to close an episiotomy do not need removal and later reabsorb in the tissues within 6 to 8 weeks. Also, the patient must understand how to carry out Kegel exercise to aid the tightening up of the pelvic floor muscles.

In the study of Schmidt et al. [32], perineal trauma is connected both short term and long-term morbidity

with the inclusion of pain which is persistent, pelvic floor conditions, as well as depression. This affects the mother's capacity to care for her new baby. The experience of morbidity after perineal injury is a function of the nature of laceration incurred, the approach and materials used for repairing as well as the skill and knowledge of the birth attendants. After the delivery, systematic evaluation which includes visual inspection of vaginal, perineal and rectal examinations are recommended for accurate diagnosis of the perineal lacerations. The optimum management of the perineal trauma after the virginal birth includes accurate diagnosis, right approach and materials used to repair, experiences of the providers in the perineal laceration repair as well as the close monitoring.

In a study by [33] midwife home was described as a form of integrated home based on postnatal services for mothers that want early discharge after delivery which is between 6 to 24 hours. Thus, the study examined the midwife home by first giving the description of the characteristics of the mother and newborn pairs which was followed up by mental health to examine whether the service has the right target group. Secondly, it described the number and causes of the likelihood of re-admission for safety, the third part was the investigation of the midwife home following the right criteria that was established for the service, while the last aspect was to explore the service to facilitate the care continuity. Figure 4 depicts the flowchart of the recruitment process. The overall number of mothers to newborn pairs was determined using the hospital's monthly statistics of midwife home users. Similarly, the logistic data concerning the visit after multiple visits is shown in Figure 5. In a similar study by [34], it was mentioned that midwife led continuity care is linked with several health outcomes with women and babies but little is understood about the relationship between model of care and the rate of breastfeeding.

It was established that out of 383 women that consented to participate in the study, 77% completed the questionnaire during the second trimester of the pregnancy. When it got to the final time point which is four month postnatal, 55% of the women completed the questionnaire. At the time point, 14% of the women were not included for further participation as a result of the exclusion criteria that has been outlined. Based on the outcome of the study, the discourse about breastfeeding during the pregnancy was not addressed adequately to the expectation of the woman and this is evident for those that were taken care of under MLCC (midwife-led continuity of care). More women were observed to report dissatisfaction with the information provided about breastfeeding [35]. Thus, based on the significance of providing personalized care that meets the expectation of women, studies could focus on how midwives can support breastfeeding women both during the antenatal and postnatal periods [36].

III. ARTIFICIAL INTELLIGENCE FOR PERSONALIZED EPISIOTOMY CARE

Artificial intelligence is currently helping to transform personalized episiotomy care through adequate data driven predictions to know if a patient need incision, shifting away from subjective normal practice toward individualized care [37]. Machine learning models including support vector machine, linear regression and neural network are currently on the increase as they can be deployed into the analyses of intra-partum data like maternal age, parity as well as perineal evaluation for the prediction of risk of requiring episiotomy with accuracy [38].

In the study of Banaei et al. [39], it was mentioned that episiotomy is characterized by certain indicators and if identified adequately, can prevent women from suffering from lacerations that could result in significant complications such as anal incontinence. However, the risk factors associated with episiotomy has been the main center of argument within the medical field in the past decades. Thus, the machine deployed machine learning model to predict these factors that put women at risk of experiencing episiotomy using intra-partum data.

The methodology involved a retrospective design of the cohorts. Several factors like age, education category, place of residency, medical insurance, nationality, attendance at prenatal education programme, parity, gestational age, labor onset, doula presence during labor, maternal health condition such

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as anemia, diabetes, rupture in the membrane, abruption of placenta, meconium presence in amniotic fluid, growth of intrauterine retardation, fetal death due to intrauterine, body mass index and fetal distress were all extracted from the electronic health history of a medical centre in Iran. This data ranges from January 2022 to January 2023. Vaginal delivery of a single pregnancy was the criteria selected for inclusion. Furthermore, deliveries via mother's request, emergency caesarean section were excluded and the participants divided into two categories. These were those that had vaginal deliveries with episiotomy and those vaginal deliveries without episiotomy. Furthermore, the important variables as evaluated by their P-values were chosen as characteristics for the 8 machine learning models.

The outcome revealed that out of 1775 vaginal deliveries, about 35.4% needed an episiotomy. Each model was assigned area under curve (AUC). Linear regression was 0.85, deep learning was 0.82, support vector machine was 0.79, light gradient boosting had 0.79, logistic regression was 0.78, XGBoost classification had 0.77, random forest was 0.76, decision tree had 0.75 and permutation classification Knn was 0.70. Linear regression revealed a better performance in terms of diagnostics among the whole model having area under the ROC curve (AUC):0.85, accuracy being 0.80, precision was 0.74, recall was 0.86 and F1 score 0.79. Thus, the leading clinical factors that are associated with episiotomy according to their significance include parity, onset of labor, gestational age, body mass index and the doula support. Therefore, deploying clinical dataset and different machine learning models to determine the risk factors of episiotomy will give adequate result. Figure 3 shows the ROC curves of the machine learning models.

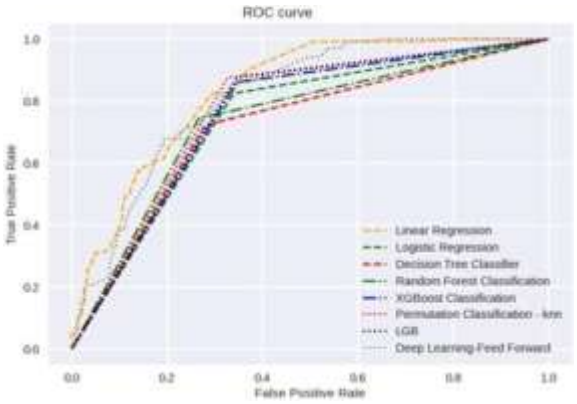

Figure 3: ROC Curves of Machine learning models [39]

Similarly, the outcome of the evaluation of the significance of the various factors in the linear regression model shows that parity, labor onset, gestational age, body mass index and the doula support represents the leading clinical predictors of episiotomy according to the order of importance.

Hu et al. [40] carried out a predictive model for evaluating medio-lateral episiotomy and this help to identify warnings using open-source R software. Physiological data of about 1191 parturient that delivered in a hospital in China was collated between January 2022 and December 2022. This was divided into training dataset and test set in a ratio 8:2. The factors which affect the mediolateral episiotomy were evaluated based on the judgment methods of expert. Furthermore about 6 machine learning models which include logistic regression, support vector machines, KNN, random forest, light gradient boosting and XGBoosting were developed.

Furthermore, the performance of the model was determined using accuracy, precision, recall, F1 values as well as AUC measures. In addition to this, a confusion matrix was deployed to assess the performance across the categories. Interpretability was provided by Shapley Additive explanation. The verification process was basically on the collected data and intelligent online evaluation solution for mediolateral episiotomy was established. SHapley Additive exPlanation (SHAP) provided interpretability. The clinical external verification process focused on data collected from January to March 2023, and an intelligent online evaluation

system for mediolateral episiotomy was developed. In the same vein, the variable distributions were integrated into the support vector machine prediction model. It was observed that perineal elasticity, number of pregnancies, body mass index and that of perineal edema were seen as the top five predictors of the episiotomy risk.

Furthermore, Figure 4 shows the risk factors identified. These were established to be the influencing risk factors of mediolateral episiotomy. Based on the plot, perineal elasticity represents the highest predictor of risk. The poor perineal elasticity is traceable to an increase in the risk of episiotomy [41]. Also, the number of pregnancies, body mass index as well as perineal edema contributed to the important predictors. This underscores that the patient health record and that of perineal conditions play a potential role in the model's risk prediction. Also, the age of the patient contributed significantly to the episiotomy risk [42].

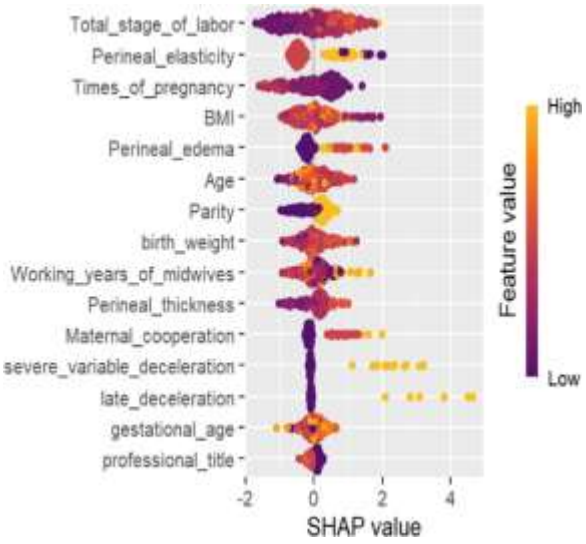

Figure 4: Dependency of features and the interactive effect [40]

More so, the outcome of the external evaluation based on the data and expert assessment revealed that out of 32 cases which had mediolateral episiotomy, 125 cases did not participate, the result of verification revealed that there was 74% accuracy for those that undergo mediolateral episiotomy and 93% for those that did not undergo episiotomy [43-45].

IV. CONCLUSION

Findings from the reviewed literature show that using artificial intelligence for personalized postnatal education on episiotomy care has a potential and significance on the mother's knowledge, perceptions and self care practice. Artificial intelligence driven educational solutions have provided adequately, individualized and ease of access information, helping postnatal mothers to understand episiotomy care, recognition of warning sign and the adoption of adequate self care behaviors. Understanding episiotomy care underscored that personalized artificial intelligence support will help to reduce misconception, anxiety and the fear that are usually experienced during the period of postnatal, thus, improving confidence and engagements during recovery. In conclusion, artificial intelligence integration in postnatal education provides a great potential solution to improving maternal health outcome. Through the use of adequate learning experiences that will handle the needs of individuals and preferences, artificial intelligence will complement the conventional nursing education and fill the gaps in postnatal care. Thus, the study provides insight on the potentials of artificial intelligence driven to strengthen mothers, enhance self care management as well as supporting healthcare professionals in consistent delivery of evidence related education.

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