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Usability, acceptability and feasibility of simulation training in operative vaginal delivery using vacuum extraction in a rural setting in Tanzania – a mixed method study

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Abstract

Background

Vaginal assisted birth (VAB) is considered a safe mode of delivery but is hardly used in many developing countries. Training and implementation of VAB is a crucial step in reducing the need for second stage CS and to improve outcome for mother and child.

Methods

Cross-sectional mixed method study was conducted at a tertiary hospital in a rural part of Manyara region, Northern Tanzania. All 34 (100%) of the eligible HPCs consented in participating in the survey, and 13 HPCs participated in semi-structured interviews.

Results

All 34 HCPs present at the ward during the study period consented to participating in the survey. The survey showed a high satisfaction in the Safe Vacuum training, team training, clinical mentorship and clinical preparedness for vacuum extraction at the labor ward.

13 skilled birth attendants were interviewed, 4 medical doctors and 9 nurse/midwives.

Four themes were identified in the qualitative interviews: Initial Scepticism and Cultural Beliefs, Skill Acquisition and Clinical Competence, Navigating Language Barriers and Consent Challenges and Improved Maternal Health and Community Education.

Conclusions

This study showed that implementation of clinical use of VE through biweekly simulation on mannequin, team training and clinical mentorship is considered acceptable and feasible by HCPs working in a rural hospital in Tanzania. The study findings highlight the importance addressing misconceptions about the risks associated with VE among HCPs as well as on communication with the mother during training sessions.

Summary

This cross-sectional mixed method study shows that it is both acceptable and feasible to train health care personnel (HCPs) in the use of vaginal assisted birth using vacuum extraction in a rural setting in Tanzania. The study findings highlight the importance addressing misconceptions about the procedure among HCPs as well as on communication with the mother during training sessions.

Quick points

- Vaginal assisted birth by use of vacuum extraction is a crucial intervention during the second stage of labor.
- Despite the benefit and safety of the procedure it is seldom used in low-income settings.
- There is urgent need to train midwives and doctors in clinical use of vaginal assisted birth.
- This study shows that it is feasible and acceptable to implement a training program on vaginal assisted birth in a rural hospital in Tanzania.
- The study highlights the importance of communication training and addressing prevalent misconceptions about the procedure during implementation.

Background

Maternal and perinatal deaths are disproportionately affecting low-income and middle-income countries (LMICs) and are particularly high in Sub-Saharan Africa[1], [2],[3]. The risks associated with CS, including maternal mortality are 50 times higher after caesarean delivery in Africa compared to high-income countries[4]. The rise in non-medically indicated caesarean sections (CS) has also become a concern. By 2030, it's estimated that 29% of global deliveries will be done by CS, far exceeding the recommended 10–15% [5], [6], [7]. There is therefore an urgent need to reduce non-medically indicated CS in these settings[8].

Obstetrical care is a balancing act between adequate action vs. minimal intervention[9]. CS can be life-saving for both mother and child to address complications such as foetal distress, prolonged second stage of labor, maternal exhaustion or other medical contraindication for prolonged expulsive effort[10]. Conversely, CS increases the risk of maternal complications such as maternal haemorrhage, post-partum infections, venous thromboembolism and complications due to anaesthesia. There is also increased risk of uterine rupture and invasive placentation in consecutive pregnancies[11]. Due to factors such as a shortage of skilled health care personnel [12], lack of surgical capacity and major discrepancies in access to skilled care during birth these risks are particularly high in LMICs [1], [4], [13].

Vaginally assisted birth (VAB), either by forceps or vacuum extraction (VE), is considered a safe mode of delivery when the leading part of the foetal head has passed the ischiadic spine of the pelvis and when performed by skilled personnel. Although VE is routinely used in obstetrical practice in Europe, is has yet to be implemented as a standard procedure in most LMICs. Increasing the use VE have been identified as key in reducing the rates and associated risks of CS[13]. As mentioned, there are large discrepancies in many low-income countries when it comes to surgical capacity for acute delivery in the second stage. VE has been shown to have a shorter decision-to-delivery interval than CS and can thus increase the availability for acute delivery in these settings[14]. The use of VE can alleviate pressure on limited surgical capacity and thus increase access to medically necessary CS without delay. There is currently no consensus about how to best implement VAB/VE in LMICs [15].

Despite experiencing some of the highest maternal and newborn mortality rates in the world, Tanzania has made significant progress in improving maternal and neonatal health care over the last decade.

Institutional births have increased to 81.7% in 2020[16]. Approximately 10% of deliveries in the country are done by CS but with significant discrepancies between rural and urban areas. 54% of deliveries are done by CS at the highest referral hospital in Tanzania, but only 0.8% deliveries are done by VE at the same institution[17]. Here, almost 14% of women give birth vaginally while waiting for a CS[18]. Unstructured and inconsistent training in VE, economic incentives and fear of blame in case of adverse outcome after VE, were shown to be factors discouraging increased use of VE[17].

The Safer Births Bundle of Care (SBBC) have shown that through simulation training with clinical mentorship, continuous quality improvements, team-training and a focus on sustainability and scalability, one can achieve major improvements in outcome for both mother and child[19]. Low-dose, high-frequency simulation training has also been shown to increase competency, skill acquisition and maintaining proficiency in a new intervention in clinical practise[20], [21].

Based on the framework from SBBC, the Safe Vacuum training was initiated in 2022 at a rural hospital in Tanzania to implement VE. This mixed method study aims to assess the acceptability and feasibility of this initiative and explore the experience of health care personnel (HCPs) involved.

Methods

Study design

This cross-sectional mixed-method study assessed VE training's feasibility and acceptability among HCPs. Surveys were conducted from May to August 2023, and interviews between October 2023 and January 2024.

Setting

The study was conducted at a tertiary referral hospital located in the northern part of Tanzania. The labor ward consists of 6 beds, served by 18 midwives, 1 specialist in gynaecology and 2 assistant doctors. In addition, there are intern nurses and doctors present at the ward. There are approximately 3500 deliveries annually, with 20% performed by CS.

Participants

All HCPs working at the labor ward during the study period were eligible to participate in the survey and interviews. Participation in the survey and interviews was voluntary, and written consent was obtained for the survey, and verbal consent was obtained for the interviews (Supplementary files: “Questionnaire vacuum with consent”). The research adhered to the principles for protection of privacy and voluntary participation chartered in the Declaration of Helsinki. A consent for publication was not obtained as it was not applicable for this study.

Ethics approval and consent to participate

All participants provided written informed consent before participating in the study. A consent to publish was not applicable for this study as the information provided by participants was un-identifiable for the researcher.

Ethical approval

Ethical approval of the study has been obtained from National Institute of Medical Research (NIMR) in Tanzania Ref NIMR/HQ/R.8a/Vol.IX/5019

and the Norwegian Regional Ethical Committee REK West Ref 229725.

Funding Statement

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Intervention package

A survey conducted by the local HCPs identified a need for more knowledge and training in VE. In response, a training program was developed for the use of VE using Jhpiego (Safe Vacuum) [22], following the SBBC framework for improvements in clinical practise[23]. The training program was based on educational tools developed by Helping Mothers and Babies Survive, particularly the training module “Prolonged and Obstructed Labor” [24]. The initial training was combined with a training module in management of prolonged and obstructed labor[25] and vaginal palpation to assess station and descent of the foetal head. The training used a metal cup and manual pump. In addition to initial training, participants practiced VE on mannequins and attended biweekly team training sessions. The research team developed Standard Operating Procedure (SOP) (appendix 1) as well as a checklist (appendix 2) for the use of vacuum extraction in cooperation with management for the labour ward.

Data collection

To assess the acceptability and feasibility of the Safe Vacuum training and the clinical use of VE, a quantitative survey and qualitative semi-structured interviews were conducted. The questionnaire included demographic questions (role, experience), skill (prior training, number of simulations attended, and number of VE performed or participated in) and questions regarding Safe Vacuum, team training, clinical mentorship and clinical preparedness for vacuum at the ward. Over a period of 2 months during the summer of 2023, data collectors provided the questionnaire to HCPs.

Semi- structured interviews with skilled birth attendants working in the labor ward were carried out using an interview guide (appendix 3). Interviews were carried out in Kiswahili by a trained qualitative research assistant and lasted between 35-45 minutes. The interviews were recorded and transcribed verbatim and translated to English before analysis.

Acceptability and feasibility

HCPs answered 20 statements on acceptability and feasibility of the training and implementation of VE using a Likert scale of 1-5. 1 represents strongly disagree, and 5 represents strongly agree [26]. The questionnaire was translated into Swahili and evaluated by the local management at the labor ward before the survey was conducted.

Data analysis

Data analysis was conducted using R (version 4.3.2) and RStudio (version 2023.12.0+369). Mean and SD was calculated in RStudio and stratified analysis (Supplement) with p-values was conducted using t-test for comparison of level of experience, and one-way ANOVA (Analysis of Variance) for comparison of roles and participation in prior training or the initial training in March 2022. Results are presented by mean (SD) unless specified otherwise. P-value < .05 was considered statistically significant.

The qualitative data was analysed using thematic analysis inspired by Braun and Clarke[27]. After reading and re-reading the dataset to ensure familiarity with the data, the data was coded inductively by the last author using NVIVO and discussed and revised together with the first author. The first and last author developed tentative themes which were revised after discussions among all authors. A final set of themes were then developed.

We followed STROBE guidelines in combination with SRQR guidelines to report this cross-sectional mixed method study (Supplementary files; “STROBE_checklist” and “SRQR_checklist”).

Results

Demographic details of participants in questionnaire

Out of 34 health care providers (HCPs) questioned, 100% consented in participating in the survey. The team of HCPs at HLH consists of doctors (N=2, 5.9%), nurses (N=13, 38.2%), midwives (N=8, 23.5%) and ward attendants (N=4, 11.8%). In addition, there are intern doctors (N=2, 5.9%) and intern nurses (N=3, 8.8%) on rotation at the labor ward. Mean experience (years present at the labor ward) in the survey is 5.8 years, but with a significant difference between roles. The mean experience stratified by role is 2 years for doctors, 9.14 years for midwives and 16 years for ward attendants. The interns are only stationed at HLH for a few months, and this is reflected in the survey where they report a mean experience of only 3 months.

29 out of 34 (86%) of HCPs had observed or participated in simulation training on the use of VE. The average number of simulations observed was 11.9 and an average number of simulations participated in was 4.9. 20 (58%) have participated in an operative vaginal delivery using VE and 17 (50%) have performed the procedure. (Table 1: Characteristics of health care providers)

Table 1: Characteristics of the health care providers

Variables	Numbers (%) Total = 34
Years of experience	
Less than 1 year	10 (29.4)
1 to 5 years	12 (35.3)
6 to 10 years	5 (14.7)
More than 10 years	3 (8.8)
Mean (SD) years of experience	5.8 (7.4)
Role	
Doctor	2 (5.9)
Intern Doctor	2 (5.9)
Nurse	13 (38.2)
Intern Nurse	3 (8.8)
Midwife	8 (23.5)
Ward Attendant	4 (11.8)
Prior training in VE	
Yes	13 (38.2)
No	20 (58.8)
Participation in initial training in VE in March 2022	
Yes	24 (70.6)
No	10 (29.4)
Observed simulation training in VE at the labour ward	
Less than 5	2 (5.9)
5 to 10	17 (50)
11 to 20	7 (20.6)
More than 20	2 (5.9)
Participation in simulation training in VE at the labour ward	
None	4 (11.8)
1 to 5	15 (44.1)
6 to 10	7 (20.6)
More than 10	2 (5.9)
Observed clinical use of VE at the labour ward	
None	8 (23.5)
1 to 5	13 (38.2)
6 to 10	4 (11.8)
More than 10	3 (8.8)
Number of VE performed	
None	12 (35.3)
1 to 5	15 (44.1)
6 to 10	1 (2.9)
More than 10	1 (2.9)

Results of the quantitative questionnaire

When assessing the Safe Vacuum training the response (range 1-5) was positive with a result of 4.39 (0.56) for the overall satisfaction with the training (Figure 1: Safe vacuum trainings). The participants were satisfied in the training program and experienced that the training helped prepare them for clinical practise. The training was perceived as in line with clinical realities and resources at the labor ward and was adequate to their clinical level. Participants felt supported by the management in the labor ward.

24 out of 34 (70.6%) of the participants attended the initial training in March 2022, and they found it useful to combine the training in VE with training on obstructed and prolonged labor.

Experience of team training conducted in the ward were also clearly positive with 97.1% of HCPs agreed or strongly agreed that biweekly training is useful in ensuring that VE is used in clinical practise. They found it useful in maintaining their skills in VE, and the team training fits with the workflow of the labor ward. (Figure 2: Team training conducted in the ward)

Clinical mentorship was conducted by an experienced obstetrician for two weeks after the initial training (Figure 3: Clinical mentorship). HCPs found this important to ensure the use of VE in clinical practise and in maintaining skills in VAB. It did not interfere with the workflow of the labor ward.

Assessment of the clinical preparedness for vacuum at the ward was also mainly positive (Figure 4: Clinical preparedness for vacuum). HCPs used the SOP while performing the procedure and found it helpful. The participants used checklists during VE and this was considered useful. Although questions regarding the equipment for the procedure were mainly positive, a slightly lower assessment was noted concerning the equipment. HCPs experienced that the equipment for VE was available when needed, with a score of 4.0 (0.78)) and 4.03 (0.83) for questions 15 and 19, respectively. Equipment was suitable for performing the procedure.

When stratified for role, experience level and participation in prior training or the initial training on VE in March 2022, no statistically significant variation was found between different roles at the labor ward. Subgroup analysis of experience level showed a statistically significant difference in the use of SOP (4.69 (0.48) vs. 3.94 (0.44); *P* .003) and in the evaluation of the usefulness of the SOP (4.54 (0.52) vs. 4.12 (0.50); *P* .04), with higher scores amongst HCPs with less than 2 years of experience.

Use of SOP was less common amongst HCPs who had prior training in VE and attended the initial training in March 2022, compared to the group who had no previous training (3.80 (0.42) vs. 4.71 (0.49); *P* .023). The usefulness of checklists was considered greater in HCPs with no previous training compared to the overall score (4.86 (0.38) vs. 4.38 (0.70); *P* .016). HCPs who had only attended the initial training in 2022 considered the usefulness of checklists lower than HCPs with only prior training (4.23 (0.60) vs. 4.67 (0.58); *P* .032). Participants of the initial training found the equipment more suitable for the procedure than HCPs with other prior training (4.23 (0.44) vs. 3.67 (1.53); *P* .047).

(Supplementary file “Health care provider score subgroup analysis”)

Qualitative results

13 skilled birth attendants were interviewed, 4 medical doctors and 9 nurse/midwives. The

participant had on average (mean) 5,4 years of experience (range 6 months to 17 years). Four themes were identified: Initial Scepticism and Cultural Beliefs, Skill Acquisition and Clinical Competence,

Navigating Language Barriers and Consent Challenges and Improved Maternal Health and Community Education.

Initial Scepticism and Cultural Beliefs

All the participants had heard about vacuum prior to the training and described an initial

scepticism about the device and the damages that it could cause the foetus.

Before the training, I was worried about the device, my worry was that if I use it to pull the baby, the baby's head will probably being hurt. (Participant 11)

They also described the many misconceptions about its safety that existed in the communities where they came from and how this affected the HCPs beliefs about the device:

We live in this community, and we live with our relatives. There are some of our relatives who do not believe that this device, if you use to pull out the baby, has a positive effect. Many have a misconception that this device they use to pull my baby's head, the skin may come out… and that that babies who are pulled out by vacuum, those babies will have brain problems later. (participant 6)

And that this was also shared among HCPs.

There are other health care providers who don't understand if it's a good method, a simple method to help a baby. They are still in the mindset that the vacuum is harmful. They think they will get asphyxia, suffer injury, damage while pulling the head. (participant 8*)*

It was also highlighted how negative perceptions among HCPs could be changed through training:

But if we have negative thoughts, I think those negative thoughts are going to be transmitted to society and we may find a barrier for those who need care, mothers and their relatives to refuse this help and make this completely disappear(…) So I believe if we provide adequate education first for the workers themselves and build capacity in order to eliminate those negative thoughts, providing vacuum assisted deliveries will be a sustainable service. (Participant 1)

Skill Acquisition and Clinical Competence

The participants explained how attending the training sessions had made them understand that the procedure was safe. They also described gaining confidence and proficiency in performing vacuum assisted deliveries, overcoming initial doubts and uncertainties:

Before receiving the training, I didn't know anything about how to use the device, but after attending I got experience of how to do it, and I also found that the fear goes away. In the beginning I was worried that the

device can cause problems but after practicing my confidence increased and I was not afraid because of the trainings that I attended regularly, so it was very helpful. (Participant 13)

They also described the immense joy delivering a healthy baby to a healthy mother by vacuum assisted delivery after being trained:

I really felt good because the baby came out well, mother was fine and I felt comfortable doing something I've never done before, so I enjoyed it. (Participant 10)

Several participants believed the training should be longer and with smaller groups ensuring that everyone could practice the procedure:

The time should be increased, maybe we should do it for three to four hours or more, and also the equipment should be increased so that everyone can be supervised by the teacher and see that everyone has the ability to pull out the baby (Participant 7)

Navigating Language Barriers and Consent Challenges

The main barrier faced by the participants who performed the procedure during clinical practice was related to obtaining informed consent and communicating effectively with patients during vacuum-assisted deliveries. They also described the complexities of navigating language barriers when mothers did not speak Kiswahili and ensuring patient understanding and consent in high-stress labor environments:

The challenge I face is when the mother has no understanding because maybe she is not informed before the contraction has increases, maybe she is referral, she is at the point when the contractions increases and in the delayed second stage. When we tell her we will use vacuum, she starts to fear, she says how about the baby and we are so many people there in the procedure. She start to be shocked, why are so many people? She starts to fear that what problem I got, why people calling each other? Another challenge is also language, maybe the mother doesn't know how to speak Swahili which makes it difficult to understand each other. Those are the challenges we face. (Participant 8)

Improved Maternal Health and Community Education

All the participants believed that increasing knowledge and use of vacuum assisted deliveries had many positive effects on maternal and newborn outcomes by reducing the number of caesarean sections:

We have been loosing mothers because of the complications that accompany cesarean sections. Vacuum has helped to reduce cesarean sections and the various complications that are caused by them.. (Participant 1)

The participants highlighted the importance of community education in dispelling misconceptions and promoting acceptance of the procedure to further increase use of the procedure, also beyond the hospital:

I mean our mothers should be educated about the so-called vacuum device, which is the device used to deliver our mother, our baby, so that education can be provided to all our health centers in the country, sorry, this education should be given to all our mothers in the country, because we have many health facilities that are capacitated by our hospital, in our Tanzania country, I would prefer that this education be provided to all, not just to the centers around us that surround us. (Participant 6)

Discussion

This study assesses the usability, feasibility, and acceptability of implementing a capacity building intervention in the use of VE and explore the experience of HCPs involved in the training and clinical use of VE at a labor ward in a rural setting in Tanzania. Our findings indicate that HCPs found the training useful and well-adjusted to their level of experience. They found the training program and simulation scenarios relevant to their clinical reality and resources available of the labor ward. Most found it useful to combine training in VE with training on prolonged and obstructed labor. The participants felt supported by the management of the labor ward in the use of VE. HCPs found the biweekly team training and clinical mentorship to be useful in maintaining their skills in VE and did not interfere with the daily workflow of the ward. Sustaining initial training, through biweekly training sessions and frequent hands-on supervision, has been shown to be effective in other settings in LMICs [15].

HCPs experienced increased competency and overcame their initial scepticism and fear of the procedure through training and clinical use of VE. Several commented on their previous beliefs that VE cause brain-damage to the newborn and that this misconception is common in their local community. Interestingly, they also mention that this perception is prevalent amongst HCPs in other medical fields. While previous studies have found that misconceptions about VE influenced decision-making in management of prolonged labor[28], we have been unable to identify previous studies describing such misconceptions about VE. Fear of blame in case of adverse outcome has been shown to decrease use of VE in other parts of Tanzania[17]. When misconceptions are prevalent there is increased risk of blame in case of adverse outcome after VE through confirmation bias. This indicates that dissemination of knowledge to tackle misconceptions among other medical professions and hospital management is a key part in implementation of VE, and the importance of conducting debriefings after each procedure to create a safe working environment where HCPs can address complications and adverse outcome and enhance factors that lead to a successful procedure.

Participants who had attended the initial training found the equipment more suitable than participants with no or other prior training. This indicates that HCPs who were more acquainted with the equipment also found it more suitable for the procedure. The qualitative interviews showed that HCPs preferred to be taught in smaller groups and requested that the training equipment be increased to facilitate this. The

use of the SOP was considered useful and is used regularly. HCPs with less than 2 years' experience and participants who had attended neither prior training nor the initial training in March 2022 had a higher usage of the SOP and found it more useful. HCPs with no previous training also found the checklists more useful while performing VE. This indicates that the use of checklists and SOP is particularly beneficial when introducing a new clinical procedure that most of HCPs are unfamiliar with. It is also important to note that while HCPs with more experience and training reported lower use of the tools, they too found the SOP and checklists to be useful.

Interestingly, the main barrier faced when using VE in clinical practice was difficulties in conveying information about the procedure and obtaining consent from women in labor due to language barriers. HCPs find it hard to give proper information to women in active labor due to the pain and anxiety of the situation, and the lack of a common language further complicates the ability to inform the patients. Effective communication between HCPs and the woman giving birth is a critical component of intrapartum care[29]. Previous studies have shown that language barriers are a major obstacle for health equity and are a risk factor for obstetrical injuries[30], as well as being associated with inadequate follow-up during pregnancy[31]. As a result of our study findings, greater priority has been placed on communication with the woman during VAB in training sessions.

In our opinion, there are several valuable lessons from this study regarding future capacity building efforts aiming to increase the use of VE in LMICs. Simulation training with biweekly training sessions is considered to be feasible in the clinical workflow at the ward. Simulation training, in the setting of new-born resuscitation, has been shown to be effective in maintaining acquired clinical skills[32]. Although there are no studies on VE training and frequent simulation training, it is not unreasonable to expect similar effect from simulation training on VE.

Dissemination of knowledge to other HCPs and hospital management is important to ensure support and a safe work environment when implementing VE.

Difficulties in communication in a multi-lingual population was a significant barrier in the clinical usage of VE and future projects might benefit from increased emphasis on communication with the women giving birth as part of the simulation training.

There are several limitations of this study. It is a single-site study with a small sample size and is thus not generalizable to other hospitals or countries. The questionnaire and semi-structured interview were developed and tailored for this specific setting and are, as such, not validated. All participants work at the same ward, which might influence their opinion and responses.

All eligible HCPs at the labor ward consented to participate in the survey and 13 of these participated in the qualitative interview, this is a major strength to this study. We consider the study findings to provide important insights into HCPs experiences of the implementation of VE in a rural setting, we also believe that further studies are needed focusing on women's experience of vacuum assisted delivery in the same setting.

Further studies are needed to assess the clinical implications of the implementation of VE in this setting.

Conclusion

This study showed that implementation of clinical use of VE through biweekly simulation on mannequin, team training, clinical mentorship and use of checklists and SOP is considered acceptable and feasible by HCPs working in a rural hospital in Tanzania. This type of training programs can improve quality of health care for women in labor and increase confidence and competence of HCPs in the use of VE. The study findings highlight the importance addressing misconceptions about the risks associated with VE among HCPs as well as on communication with the mother during VAB/VE training sessions.

Declarations

Author Contribution

All authors participated in conceiving and designing the study. MH drafted the first draft of the manuscript. JEL, FF, YM, HLE, AS, and SRL were involved in the methodology, and data collection. Quantitave data was analysed by MH, and qualitative data was analysed by MH and SRL. MH is the guarantor.

Acknowledgement

Ethics approval and consent to participateThe authors declare that the research adhered to the principles for protection of privacy and voluntary participation chartered in the Declaration of Helsinki. A consent for publication was not obtained as it was not applicable for this study.

Data Availability

Data are available on reasonable request

Amendment statement

At the request of the editor, we have added a statement on the principles of protection of privacy and voluntary participation, as well as a note on consent for publication, under the *Participants* in *Methods* section in the manuscript above.

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Figures

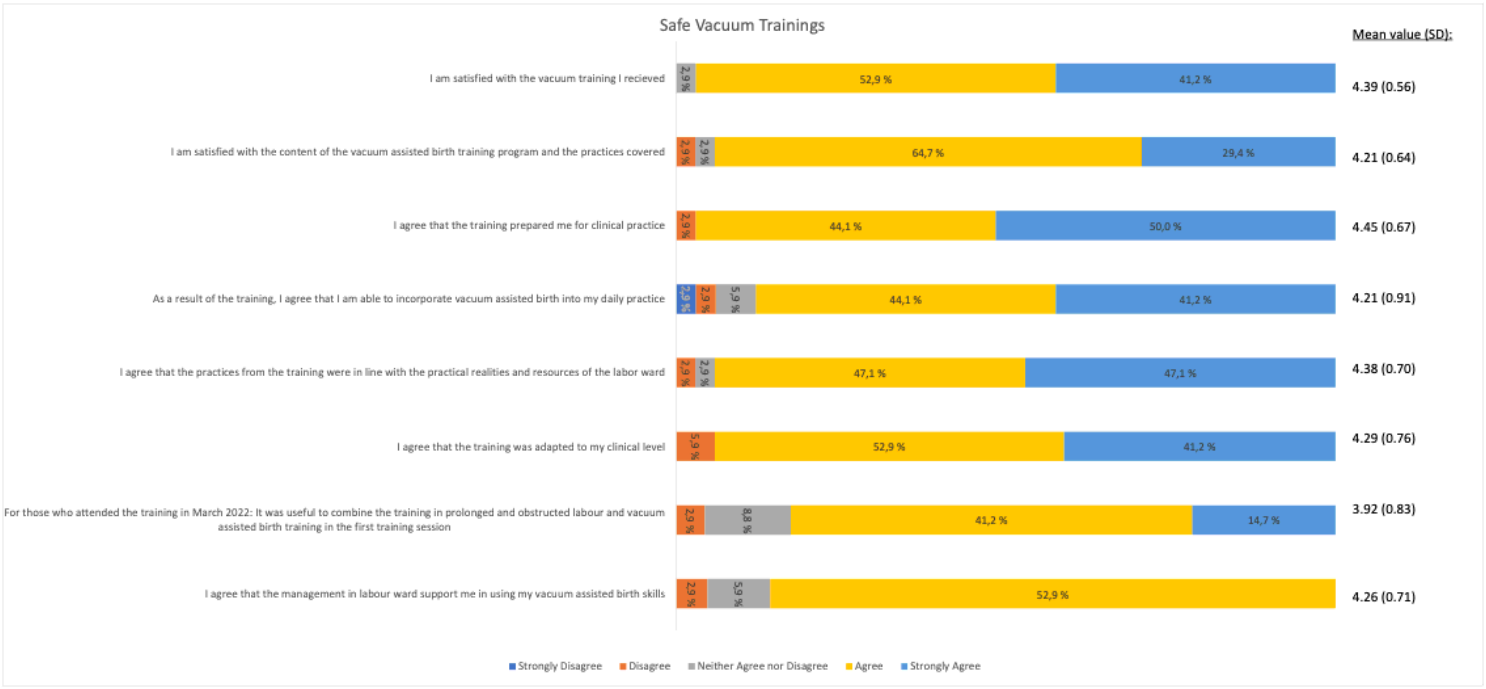


Figure 1

Safe Vacuum Trainings

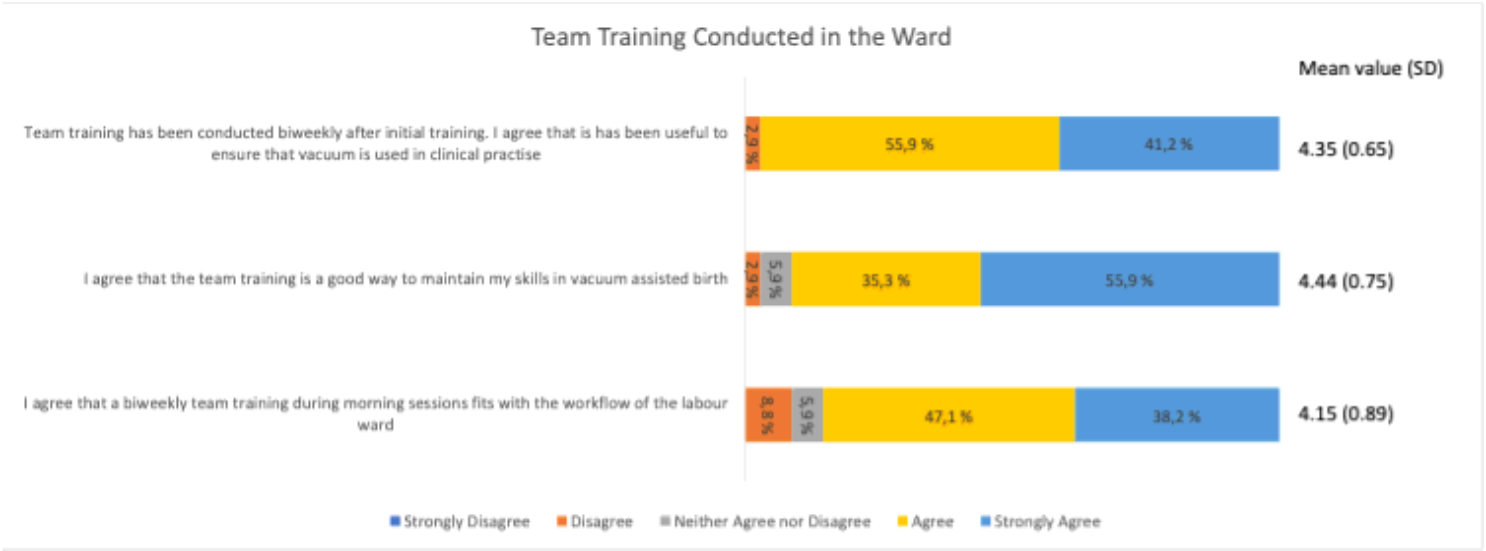


Figure 2

Team training Conducted in the Ward

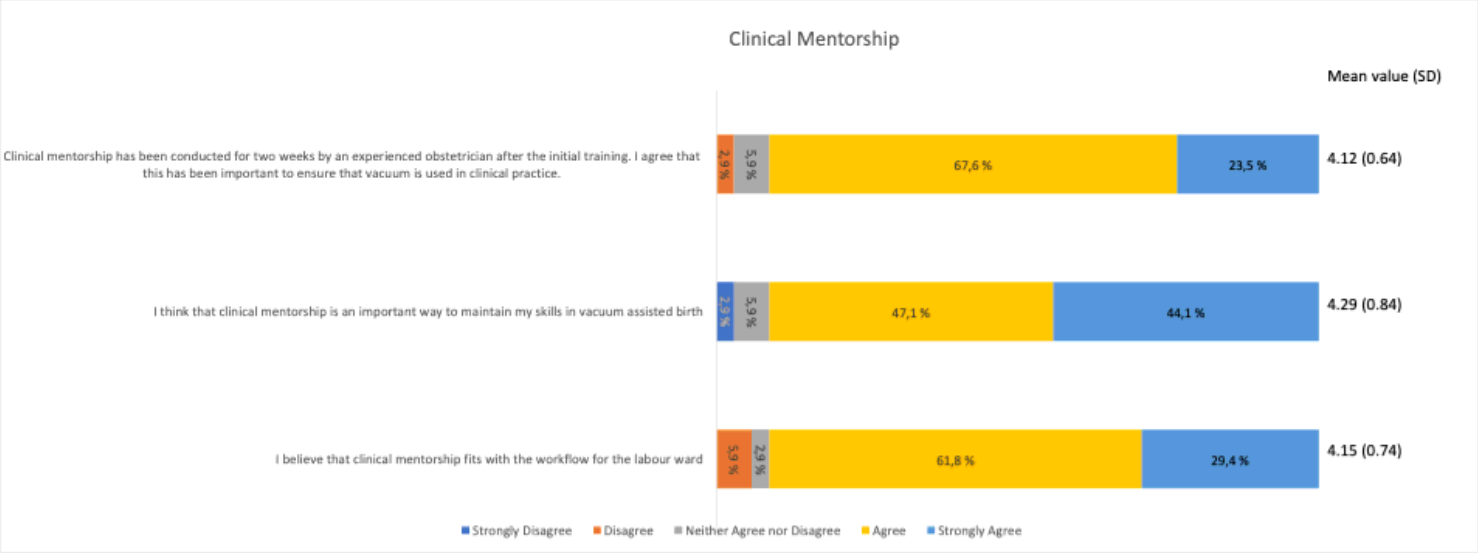


Figure 3

Clinical Mentorship

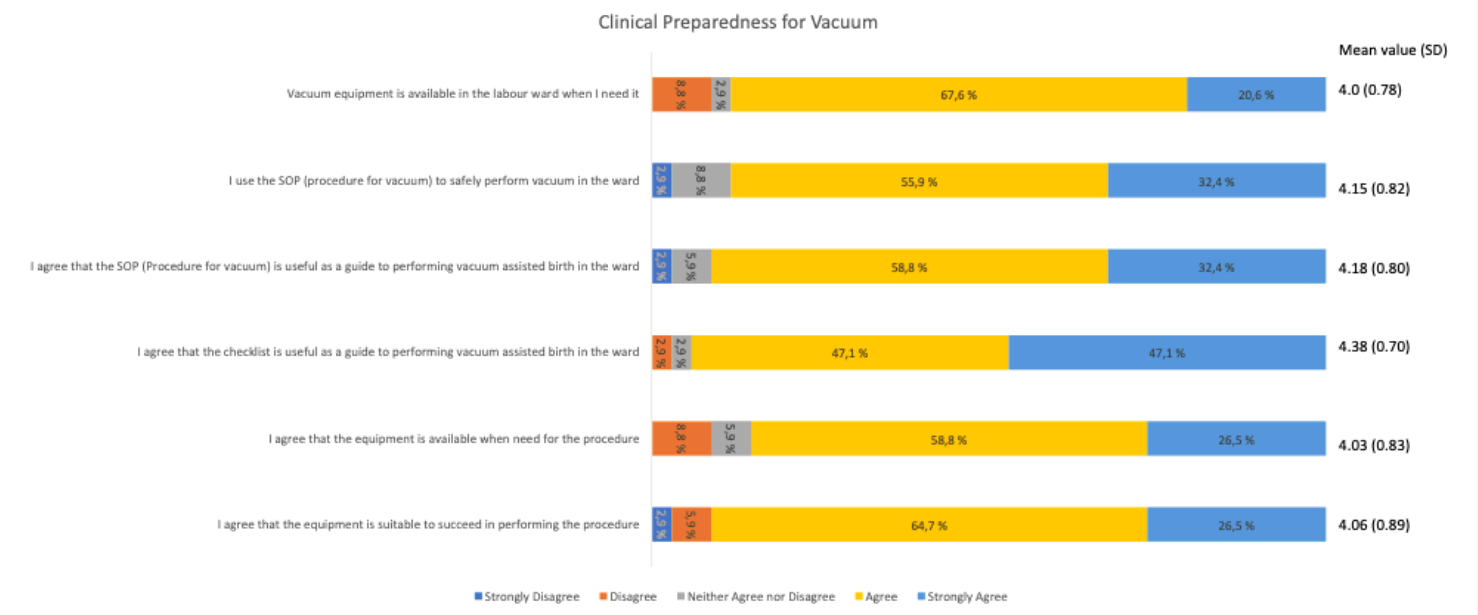


Figure 4

Clinical Preparedness for Vacuum

Supplementary Files

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- healthcareproviderscoresubgroupanalysis.pdf
- Appendix3Interviewguide.pdf

- Appendix1SOPVEHLH.docx
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