Research article

Effectiveness of a training workshop in improving the accuracy of visual estimation of blood loss at delivery

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Abstract

Objectives: To explore the effectiveness of training healthcare workers in improving visual estimation of blood loss at delivery with evidence from a low resource setting.

Methods: A training programme customized with local instruments used at childbirth was conducted at De Zoysa Hospital for Women in year 2019 for all categories of healthcare workers involved with obstetric care. Capacity of healthcare workers to accurately estimate blood loss was assessed before and after the training programme using simulated case scenarios with known volumes of blood. Statistical significance of the difference in pre- and post-training scores were evaluated using related samples Wilcoxon Signed Ranked Test and the association between scores and category of healthcare workers, place of work, and duration of work experience were evaluated using independent samples median test and Spearman correlation.

Results: This programme included voluntary participation of 81 healthcare workers. Median (IQR) of pre-training and post-training scores were 0.00 (0.00-20.00) and 40.00 (40.00-80.00), respectively. The post-training improvement was statistically significant across all healthcare workers categories irrespective of place of work and their work experience.

Conclusions: Short term improvement in accuracy of visual estimation of blood loss by healthcare workers involved in obstetric care can be achieved by customized training irrespective of their place of work and work experience. Further research is needed to assess long term effects of training and the impact on patient outcomes in real clinical settings.

Key words: visual estimation of blood loss, post-partum haemorrhage, accurate estimation of post-partum blood loss, training workshops, low-resource settings

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Background

Severe Post-Partum Haemorrhage (PPH), defined as blood loss of over 1000 ml following delivery, complicates up to 11% of births. Despite being preventable in most instances, it accounts for one fourth of all maternal deaths in the world[1]. This figure is as high as 65% in some countries[1,2].

Sri Lanka reports the lowest Maternal Mortality Ratio (MMR) in the South Asia region for many decades, mainly due to a well-developed health infrastructure and skilled attendance at birth[3]. Recent years have seen a shift in the leading causes of maternal deaths to medical disorders such as cardiac and respiratory diseases. However, in 2012 and 2016, obstetric hemorrhage featured as the main cause, underscoring the omnipresent threat of death due to hemorrhage in every delivery[4].

Underestimation of blood loss at delivery is a major contributory factor to delayed diagnosis of PPH[5]. Due to physiological adaptations in pregnancy, changes in the commonly used clinical parameters tend to be masked until blood loss is over 1000 ml[6]. Reliance upon these commonly used parameters could lead to a false sense of security, delaying initiation of effective interventions. Estimation of blood loss accurately would provide the most effective parameter to direct treatment for obstetric hemorrhage. The problem of failure to recognize the severity of bleeding contributing to maternal deaths has been reported even from developed countries[7].

Accurate estimation of blood loss can be a challenge for healthcare workers (HCW) as the measurement would be a subjective, proxy measure most of the time. In many countries visual estimation of blood loss is used. However, visual assessment of blood loss has been shown in many studies to underestimate the severity of PPH by 30-50%[8-10]. Stafford et al reported that underestimation is more likely when the blood loss is greater than 1000 ml[11], the very situation that is associated with a high mortality rate.

To overcome this limitation, objective assessment of blood loss has been tried with blood-collecting bags specifically designed for obstetrics. Nevertheless, they have been shown not to improve the outcomes of PPH[12]. In addition, these bags are not available in most parts of the world. Hence, in the absence of effective methods to assess the blood loss at delivery objectively, visual estimation of blood loss is an indispensable skill for anyone who practices obstetrics. Therefore, it is important to look for solutions to overcome the inherent limitation of visual estimation of blood loss and to improve its reliability.

Evidence from around the world has shown that education and training of HCW significantly improves the accuracy of the estimation of blood loss[11,13-15]. Regular training programs on visual estimation of blood loss therefore have been recommended for HCW engaged in maternity care[16]. In addition to such regular training, visual aids like posters help in accurate estimation of blood loss[15,17]. Training courses and one-to-one training have also been shown to increase the accuracy of visual estimation by HCW[14,18]. However, use of universal visual aids may not be accurate as the surgical materials and utensils used may differ across settings, resulting in inaccurate estimations (Figure 1). Therefore, it is important that each setting should conduct training with the estimated volumes being individualized to materials and utensils used locally.

Despite these recommendations, regular educational and training programs are hardly ever conducted to the HCW in institutions providing obstetric care in Sri Lanka nor visual aids are a common sight in delivery rooms or theatres.

In this backdrop, the objective of this study was to assess the effectiveness of a training program on visual estimation of blood loss during the delivery among HCW providing obstetric care at a tertiary care hospital in Sri Lanka.

Methods and materials

A two-phase study was conducted at the De Soysa Hospital for Women (DSHW), Colombo, Sri Lanka in 2019. The DSHW caters to both low and high-risk pregnancies and serves as a referral hospital for specialized tertiary obstetric care.

In the first phase, surgical utensils and materials commonly used at delivery like sanitary napkins, gauze swabs, vaginal packs, surgical towels, general surgical towels, galley pots, kidney trays and bowls were identified. Amounts of blood that would be held by these utensils were then determined using date-expired blood packs obtained from the National Blood Bank. First, the above-named materials and utensils were soaked or filled to different extents (e.g., a quarter or half or fully soaked or filled) using date-expired blood.

These were photographed individually, and the volumes of blood required were noted. This process was repeated three times for each utensil and the average volumes required were calculated for each utensil. The figure was rounded off to one that could be easily remembered without affecting the estimation of the volume significantly. A simple, but comprehensive discussion-based Power Point presentation was prepared as a teaching-aid, using the photographs and recorded volumes. A poster was also created depicting the commonly used utensils along with their average and other volumes and distributed to each ward after the study (Figure 1).

In phase two of the study, two training workshops were conducted two months apart for HCW employed at the DSHW. Healthcare staff involved in providing obstetric care in DSHW was invited to participate. Each workshop was limited to 40 participants to enable individual attention and to facilitate discussion.

At the workshops, participants were invited to take part in a pre-test, which was conducted in the form of an Objective Structured Clinical Examination (OSCE). It comprised of five separate test stations that required the participants to estimate the volume of blood that was contained in a combination of utensils and materials commonly used in obstetric practice. In order to simulate the stressful nature of a real clinical scenario, only one minute was given per station. Each participant was assessed out of 100 marks and each station was given 0 or 20 marks with strict criteria.

This session was followed by a lecture on PPH and on estimation of blood loss using photographs taken during the first phase of the study. The lecture also included different scenarios combining materials and utensils soaked and filled to different levels, as an interactive exercise. Both training programs were conducted by two Registrars in Obstetrics using the Power Point presentation prepared in the Phase 1 of the study.

This was followed by a post-test, which again comprised of five OSCE stations of one minute each, that were different to those of the pre-test. The post test was done immediately after the workshop and participants did not have access to the poster during the test. Participants' ability to accurately estimate the blood loss at the pre and post-tests was assessed by accepting responses as correct only if the answer was within five percent (5%) of the correct volume, in order to ensure a higher level of accuracy.

Figure 1.

Figure 2.

Median scores were calculated for both pre- and post-training. Significance of the difference of pre- and post-test scores was determined using the Related Samples Wilcoxon Signed Rank Test. The difference of scores was also assessed for its association with the years of work experience and the category of HCW using non-parametric tests.

Results

The participants included many categories of HCW from different working stations of the hospital. As depicted in the table 1, nursing officers comprised the majority (n=59, 72.8%) and they also had the longest median (IQR) work experience of 8.0 (8.0) years. Apart from two male doctors rest of the participants were females.

Pre- and post-training scores displayed a skewed distribution. Table 2 depicts how pre- and post-training scores were distributed among the study participants. Pre-training median score was zero among all types of health care categories including doctors. The highest post-training median score was reported by doctors (80.0), followed by midwives (60.0) and nursing officers (40.0).

We first analyzed if any of the study participant groups scored better than others at the pre- or post-training tests. As presented in the table 3, the difference between pre- and post-training scores were statistically significant for all categories of healthcare workers (doctors, nursing officers and midwives), all stations of work (LR, ward and theatre) and people with different work experience (< 5 years, 6-10 years, >10 years).

Secondly, we assessed if the pre- and post-training scores as well as the improvement in scores following the training program were different in between the groups we considered under 'category of healthcare worker', 'main place of work' and 'duration of work experience'. Results shown in the table 4 highlight that neither pre-score, post-score nor the improvement in scores following the program were different between doctors, nursing officers or midwives. Similarly, the above-mentioned scores did not differ according to their main place of work or duration of work experience.

Table 1. Descriptive data of the study population

Variable	**Category of healthcare worker**		
	Doctors	**Nursing officers**	**Midwives**
Number (%)	9 (11.1%)	59 (72.8%)	13 (16.1%)
Main place of work*			
Labour room	9	39	9
Ward	9	28	9
Operating theatre	9	5	4
Duration of work experience			
Median (IQR)	8.0 years (1-12 yrs)	2.0 years (1-6 yrs)	5.5 years (3-19 yrs)

* Many study participants worked at more than one station. Hence the total indicated here exceed the total number of healthcare workers in each category.

Table 2. Pre- and post-scores by the category of healthcare worker

	Minimum score		Maximum score		Median (IQR)	
	Pre-training	Post-training	Pre-training	Post-training	Pre-training	Post-training
All participants (n=81.100.0%)	0.0	0.0	60.0	100.0	0.0 (0.0-20.0)	40.0 (40.0-80.0)
Category of healthcare worker						
Doctors (n=9, 11.1%)	0.0	40.0	20.0	100.0	0.0 (0.0-10.0)	80.0 (40.0-100.0)
Nursing officers (n=59, 72.8%)	0.0	0.0	60.0	100.0	0.0 (0.0-20.0)	40.0 (40.0-80.0)
Midwifes (n=13, 16.1%)	0.0	20.0	40.0	100.0	0.0 (0.0-30.0)	60.0 (30.0-70.0)
Main place of work						
Labour room (n=15, 18.5%)	0.0	20.0	40.0	100.0	0.0 (0.0-40.0)	40.0 (40.0-80.0)
Ward (n=57, 70.3%)	0.0	0.0	60.0	100.0	0.0 (0.0-20.0)	60.0 (40.0-80.0)
Theatre (n=9, 11.1%)	0.0	0.0	20.0	100.0	0.0 (0.0-10.0)	60.0 (30.0-80.0)
Duration of work experience						
≤ 5 years (n=47, 58.1%)	0.0	0.0	60.0	100.0	0.0 (0.0-20.0)	60.0 (40.0-80.0)
6-10 years (n=13, 16.0%)	0.0	0.0	20.0	80.0	0.0 (0.0-20.0)	40.0 (30.0-80.0)
> 10 years (n=21, 25.9%)	0.0	0.0	40.0	100.0	0.0 (0.0-20.0)	40.0 (30.0-70.0)

IQR – inter-quartile range

Table 3. Statistical significance for the pre- and post-training test scores by the category of healthcare worker, main place of work and duration of work experience

	Total number (%)	Pre-training median score (IQR)	Pre-training median score (IQR)	P value for the difference in the median pre- and post-training scores*
All participants	81 (100.0)	0.00	40.00	<0.001
Category of healthcare worker				
Doctors (n=9, 11.1%)	9 (11.1)	0.0 (0.0-10.0)	80.0 (40.0-100.0)	0.007
Nursing officers (n=59, 72.8%)	59 (72.8)	0.0 (0.0-20.0)	40.0 (40.0-80.0)	<0.001
Midwives (n=13, 16.1%)	13 (16.1)	0.0 (0.0-20.0)	40.0 (20.0-70.0)	0.003
Main place of work				
Labour room (n=15, 18.5%)	15 (18.5)	0.0 (0.0-20.0)	60.0 (20.0-60.0)	0.003
Ward (n=57, 7 0.3%)	57 (70.3)	10.0 (0.0-0.0)	30.0 (40.0-80.0)	<0.0001
Operating theatre (n=9, 11.1%)	9 (11.1)	20.0 (0.0-30.0)	40.0 (40.0-80.0)	0.038
Duration of work experience				
≤ 5 years	47 (58.1)	0.0 (0.0-20.0)	60.0 (40.0-80.0)	<0.0001
6-10 years	13 (16.0)	0.0 (0.0-20.0)	40.0 (30.0-80.0)	0.003
> 10 years	21 (25.9)	0.0 (0.0-20.0)	40.0 (30.0-70.0)	<0.0001

* Related samples Wilcoxon Signed Ranked Test

Table 4. Statistical significance for the pre- and post-training scores and improvement of scores after the training program according in between the groups considered under category of healthcare worker, place of work and duration of work experience

	Total number (%)	P value for the pre-training score	P value for the post-training score	P value for the improvement following the training program
Category of healthcare worker				
Doctors (n=9, 11.1%)	9 (11.1)	0.48*	0.23*	0.19*
Nursing officers (n=59, 72.8%)	59 (72.8)			
Midwives (n=13, 16.1%)	13 (16.1)			
Main place of work				
Labour room (n=15, 18.5%)	15 (18.5)	0.11*	0.97*	0.59*
Ward (n=57, 70.3%)	57 (70.3)			
Operating theatre (n=9, 11.1%)	9 (11.1)			
Duration of work experience				
Correlation with the duration of work experience in years	81 (100.0)	0.33**	0.09**	0.13**

* Friedman ANOVA test

** Spearman's correlation co-efficient test

Discussion

During the initial planning phase of the study, it was noted that the teaching aids commonly used in similar training programmes in Sri Lanka do not represent the utensils commonly used practically. Therefore, to address this limitation of training programmes, utensils and materials commonly used in Sri Lanka practically were selected and different volumes of blood held by each instrument was estimated during the phase one of the study. We believe our training programme to be the first local programme to train health care workers with commonly used utensils, hence improving the practical applicability of the skills gained at the training programme.

When comparing these utensils with those traditionally used to teach at similar training programmes, it was obvious that they differ not only in the volumes, but also with the nomenclature of utensils and materials in common use in the local setting. This may have contributed to the unusual low scores obtained by all the categories of health care workers in the pre-test, even by the participants who have participated in similar training programmes previously.

In our study, pre-training score with a median (IQR) of 0.00 (0.00-0.20) as depicted in Table 2 indicates poor capacity of the study participants to accurately estimate blood loss. This result is in concordance with findings from other studies[8-11]. Furthermore, poor pre-training scores being common to all HCWs regardless of category, place of work and length of experience indicates the need to offer training to all HCWs involved in maternity care, irrespective of their designation and years of work experience. Many of the participants had not been given the opportunity for training in this important aspect during their basic training. This emphasizes the need to include such focused teaching into core training.

Significant improvement of scores following the training program across all categories of healthcare worker as depicted in the table 3 provides evidence that training could improve the accuracy of visual estimation of blood loss at least in the short term. The post test was done immediately after the workshop. This finding also correlates well with findings from similar studies[20]. The use of customized training material may have contributed significantly towards the improvements of the accuracy of visual estimation of blood loss after the training programme.

Pre- and post-training median scores and the improvement in scores following the training were not different among different categories of healthcare worker, as shown in Table 4. This indicates the usefulness of such training irrespective of the nature of the basic training previously received.

Similarly, neither the place of work nor the duration of work experience had a significant impact on the knowledge scores (Table 4). This highlights the importance of providing training to HCWs irrespective of the working station and whether they are frequently exposed to situations that require visual estimation of blood loss, to achieve better outcomes.

Unexpectedly, the length of work experience displayed a negative correlation with the post-training scores and the improvement of scores (Table 5), indicating the more experienced the HCW is, lesser will be the improvement in scores. This negative correlation was at significant levels among doctors and midwives, but not in the nursing category. This may reflect the necessity of the training program to be tailor made to address possible other contributory factors such as attitudes and ability to understand the concepts and contents. This is more relevant in settings like Sri Lanka, where junior HCWs depend on senior HCWs to gain knowledge on subject areas which are covered in their basic training programs such as visual estimation of blood loss at child birth.

Limitations

Simulated case scenarios not being able to impose the stress of managing live patients might have an impact on the accuracy of visual estimation. However, we have tried to minimize this effect by conducting the pre and post-tests by allowing only one minute to complete the task, using real blood, strict standards for marking and awarding a certificate of competency only if a mark of 70% was achieved in the post-test. In addition, having been conducted at a single station limits the ability to generalize study findings.

Conclusion and recommendations

In conclusion, these results emphasize the need for methodical training and education for all categories of HCW on visual estimation of blood loss. Estimation of blood loss is a vitally important skill for all HCW providing obstetric care since the management of haemorrhage in pregnancy is best based on the volume lost. Reliance on changes in vital parameters could prove disastrous in pregnancy, since due to the increase in blood volume, changes in vital parameters begin to appear only with the loss of significant volumes, unlike in non-pregnant counterparts. We recommend that this indispensable skill be reinforced amongst HCW involved in obstetric care regularly. The amount of blood volumes held by different utensils in the local setting must be measured and incorporated to the training programs. We discourage the use of universal teaching aids in teaching visual estimation of blood loss unless they have been validated in the local setting in terms of volumes and nomenclature used. Further studies to assess the long-term impact of these training programmes in improving the patient outcomes in real clinical settings are recommended.

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