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# Comparison of Maternal Outcomes After Postpartum Hemorrhage (PPH) With and Without the E-MOTIVE Bundle

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## Abstract

Postpartum hemorrhage (PPH) is among the most important causes of maternal morbidity and mortality worldwide, particularly in resource-limited settings. Early recognition and prompt management are essential to minimizing adverse maternal outcomes and preventing the progression of obstetric bleeding. The E-MOTIVE bundle is an evidence-based approach designed to improve the early detection and systematic treatment of PPH. This study aimed to compare maternal outcomes following PPH in women managed with and without the E-MOTIVE bundle. A quasi-experimental study was conducted in the Department of Obstetrics and Gynecology, Rawalpindi Teaching Hospital, Rawalpindi, from April to July 2026. A total of 142 women diagnosed with primary PPH were recruited using non-probability consecutive sampling and were allocated by lottery into two equal groups. Group A received management according to the E-MOTIVE bundle, whereas Group B received standard care. Baseline demographic and obstetric information was documented. The measured outcomes included mean blood loss, blood transfu-

sion requirements, and maternal mortality. Data were analyzed using SPSS version 27. Independent-samples t-tests and chi-square or Fisher's exact tests were used as appropriate, with  $p < 0.05$  considered statistically significant. Mean reported blood loss was significantly lower in Group A than in Group B ( $250.80 \pm 188.88$  mL versus  $373.80 \pm 286.90$  mL;  $p = 0.003$ ). Blood transfusions were required in 0% of women in the E-MOTIVE group and 2.8% of women receiving standard care ( $p = 0.496$ ). One maternal death was recorded in the standard-care group and none in the E-MOTIVE group; this difference was not statistically significant. The findings suggest that E-MOTIVE-based management was associated with lower reported blood loss than routine care in this single-center study, while differences in transfusion requirements and mortality were inconclusive. Interpretation of the blood-loss outcome requires confirmation of its measurement interval and relationship to the study's diagnostic definition of PPH.

**Keywords:** Postpartum hemorrhage; E-MOTIVE-based management; diagnostic

## 1. INTRODUCTION

Postpartum hemorrhage (PPH) is a major cause of maternal morbidity and mortality worldwide. Traditionally, primary PPH has been defined as blood loss of at least 500 mL after vaginal birth or at least 1,000 mL after cesarean birth within the first 24 hours following delivery [1]. However, clinical assessment must also consider hemodynamic deterioration, because the severity of bleeding and its consequences cannot always be determined accurately from a single volume threshold. Globally, hemorrhage accounts for a substantial proportion of maternal deaths, with the greatest burden concentrated in low- and middle-income countries, where timely emergency obstetric care, skilled personnel, and appropriate treatment resources may be less accessible [2]. In Pakistan, PPH remains an important maternal health concern, and locally reported frequencies and associated risk factors emphasize the need for rapid recognition and reliable management protocols [3].

Published estimates of PPH frequency in Pakistan vary considerably by study setting, case definition, type of delivery, and available obstetric services; estimates of approximately 5–10% have been discussed, although they should not be generalized to all deliveries without a nationally representative source. A hospital-based Pakistani study reported a PPH prevalence of 8.3%, illustrating the importance of specifying the clinical population and denominator when discussing frequency [3]. Short-term maternal outcomes following PPH are strongly influenced by the promptness and effectiveness of interventions to control bleeding and maintain hemodynamic stability. Delayed or inconsistent evidence-based care may be accompanied by severe anemia, hypovolemic shock, disseminated intravascular coagulation, blood transfusion, hysterectomy, prolonged hospitalization, and maternal death [4]. These possible complications underscore the importance of coordinated clinical action and continued assessment after the initial diagnosis.

Delayed recognition of substantial blood loss can permit hemorrhage to progress and increase the risk of serious maternal morbidity, particularly in settings with limited clinical resources [5]. The E-MOTIVE approach was developed to address gaps in the early detection and first-response treatment of PPH. It combines objective blood-loss measurement using calibrated collection drapes with the rapid implementation of uterine massage, uterotonics, tranexamic acid, intravenous fluids, genital-tract examination, and escalation of care when bleeding persists. The approach emphasizes timely, coordinated interventions instead of sequential delays in initiating treatment. International guidance on prevention, early diagnosis, and management supports implementing such evidence-based interventions systematically to reduce avoidable hemorrhage-related complications [6].

Recent research supports important benefits from early detection and bundled PPH treatment compared with conventional approaches. An international randomized trial of the E-MOTIVE strategy demonstrated a lower risk of a composite outcome comprising severe postpartum hemorrhage, laparotomy for bleeding, or death from bleeding among women undergoing vaginal delivery [11]. A subsequent cost-effectiveness analysis conducted alongside the trial suggested that implementation of the strategy could provide additional health-system benefits in participating settings [7]. Objective quantification of blood loss can assist clinicians in recognizing hemorrhage earlier than subjective visual estimation, supporting more timely treatment and potentially reducing progression to severe bleeding [8]. Nevertheless, results from international trials should be evaluated carefully before being extrapolated to local hospitals with different resources, patient populations, or measurement procedures.

Tranexamic acid and uterotonic medications are important components of the evidence-based treatment response to diagnosed PPH. Their timing and clinical indication should be distinguished from attempts to prevent PPH in women who have not yet developed bleeding. Notably, the WOMAN-2 trial found that prophylactic administration of tranexamic acid shortly after birth in women with moderate or severe anemia did not reduce clinically diagnosed PPH; this does not negate its established role in the treatment of PPH [9]. Standardized care should also incorporate communication, follow-up, and support after severe maternal events, because consequences of hemorrhage may extend beyond immediate bleeding control [10]. Together, these findings support careful implementation of an appropriately indicated treatment bundle rather than indiscriminate use of any single intervention.

Although obstetric services and delivery care have improved in Pakistan, PPH continues to contribute to preventable maternal morbidity and mortality. Evidence about the effectiveness of the complete E-MOTIVE bundle in individual Pakistani healthcare settings remains relatively limited, particularly where available personnel, calibrated drapes, blood products, and emergency escalation pathways may differ from those in large international trials. Accordingly, the present study was undertaken to compare maternal outcomes in women diagnosed with primary PPH who received either E-MOTIVE-based treatment or standard departmental care. Specifically, mean reported blood loss was compared between the two groups, while requirements for blood transfusion and maternal mortality were examined as additional outcomes. The findings may inform discussion of the feasibility and clinical relevance of implementing structured PPH management in routine obstetric practice. Interpretation must nonetheless take account of the study's sampling approach, allocation procedure, size, measurement methods, and observational limitations.

## 2. METHODS

Following approval from the Institutional Ethical Review Committee, the study was conducted in the Department of Obstetrics and Gynecology, Rawalpindi Teaching Hospital, Rawalpindi, from April to July 2026. The total study sample comprised 142 women, divided into two groups of 71 participants each. The reported sample-size calculation used a 95% confidence level and 80% statistical power, with expected mean blood loss of  $225 \pm 229$  mL for the intervention group and  $318 \pm 321$  mL for the routine-care group, based on previously published literature [11]. The specific outcome definition, allocation ratio, and assumptions used in the sample-size calculation should be confirmed against the original calculation record. The manuscript described the study as quasi-experimental, although a lottery-based allocation procedure was also reported.

Participants were enrolled through non-probability consecutive sampling. Eligible women were aged 15–45 years and developed primary PPH, described in the study as blood loss of at least 500 mL following vaginal delivery or at least 1,000 mL following cesarean delivery within the first 24 hours after childbirth. Women who had delivered a liveborn or stillborn infant at a gestational age of at least 24 weeks were eligible for enrollment. Patients were excluded if they had undergone definitive surgical intervention for PPH before enrollment, had incomplete data for major study variables, or had a pre-existing bleeding disorder such as hemophilia or immune thrombocytopenic purpura. Eligibility criteria were reviewed before enrollment to promote consistent inclusion of the study population. The relationship between the stated PPH diagnostic thresholds and the subsequently reported mean blood-loss values should be clarified in the final reporting of the study.

Written informed consent was obtained from participants and/or their caregivers, as described in the study documentation, after eligibility had been established. Relevant obstetric and medical histories were carefully recorded for each participant. Following consecutive recruitment, the enrolled women were allocated into two groups through a lottery system. Women in Group A received PPH management according to the E-MOTIVE bundle, whereas women in Group B received the usual departmental management for PPH. The original study description does not specify allocation concealment or whether clinical staff were blinded; these methodological details should be confirmed from the study protocol rather than inferred from the use of a lottery. All participants continued to receive necessary clinical monitoring and treatment.

The E-MOTIVE bundle included objective measurement of blood loss, prompt administration of uterotonic medications, uterine massage, tranexamic acid, intravenous fluid resuscitation, assessment for the cause of bleeding, and timely escalation of treatment if hemorrhage persisted. These components were implemented as a coordinated clinical response intended to improve the recognition and management of primary PPH. Women in the control group were managed according to the routine stepwise approach used in the department. The specific differences between routine care and bundled intervention, including medication timing and the availability of calibrated measurement equipment, should be documented to ensure that the comparison can be interpreted and reproduced appropriately.

Baseline demographic and obstetric characteristics, including maternal age, parity, gestational age, mode of delivery, and associated comorbidities, were documented at admission. When available, calibrated blood-collection drapes were used to quantify blood loss objectively in women experiencing primary PPH. When calibrated drapes were unavailable, blood loss was assessed using the clinical estimation procedures employed by the treating healthcare professionals. Because different methods of measuring blood loss were used, their availability and distribution between the intervention and control groups should be described when interpreting the reported outcomes. Inconsistent measurement methods can influence comparisons independently of a treatment's clinical effect.

Blood loss was recorded in milliliters (mL), with the study describing the outcome as the volume lost during delivery and within the first 24 hours following childbirth. The mean blood-loss value was calculated for each group. Gravimetric measurements were also used where applicable: blood-soaked pads and gauze were collected and weighed, with approximately 1 g of measured weight assumed to represent 1 mL of blood, as described in the original methodology and in quantitative blood-loss assessment guidance [23]. Recorded blood-loss measurements were documented at delivery and followed through the first 24 postpartum hours. The authors should clarify whether the reported treatment-group means represent cumulative peripartum blood loss or additional blood loss after PPH diagnosis, as these are different clinical endpoints.

Secondary postpartum hemorrhage was described as abnormal bleeding occurring after the first 24 hours and up to six weeks following delivery; however, the present investigation focused on primary PPH. Blood transfusion was defined as administration of at least one unit of packed red blood cells or whole blood within the first 24 hours after delivery because of PPH. Patients' clinical records were reviewed to document transfusion status and, where available, the types and numbers of blood products administered. Information on blood transfusions was treated as a separate maternal outcome rather than included in the calculation of measured blood loss. The clinical indication for transfusion was determined by the treating obstetric team in accordance with routine practice.

Maternal death was defined as the death of a woman during pregnancy or within 42 days following termination of pregnancy from a cause related to or aggravated by pregnancy or its management, excluding accidental or incidental causes. Deaths occurring during hospitalization were recorded from hospital records. When possible, the investigators also sought information on deaths occurring after discharge during the relevant follow-up period. Because follow-up outside the hospital was described only as being undertaken where feasible, ascertainment of all deaths within 42 days cannot be assumed. The duration and completeness of follow-up should therefore be specified before drawing conclusions about maternal mortality.

Interventions undertaken for the management of PPH were abstracted from hospital medical records during the first 48 hours after childbirth. Participants received ongoing clinical care and monitoring according to departmental practice, with the objective of reducing avoidable variation in data recording and clinical observation. Data collection began at recognition of PPH and continued until discharge or maternal death, as applicable. Demographic information, clinical characteristics, details of interventions, and recorded outcomes were entered into a prespecified data-collection proforma. Because treatment groups received different protocols and blood-loss measurement methods could differ, equal clinical monitoring alone cannot establish that observer or measurement bias was eliminated.

Data were entered and analyzed using the Statistical Package for the Social Sciences (SPSS), version 27.0. Quantitative variables, including maternal age, gestational age, parity where appropriate, total recorded blood loss, and the number of blood-transfusion units, were summarized using means and standard deviations when applicable. Categorical variables, including mode of delivery, transfusion requirement, and maternal outcome, were reported as frequencies and percentages. Comparisons between the E-MOTIVE and routine-care groups were performed using independent-samples t-tests for continuous variables such as total blood loss and chi-square tests or Fisher's exact tests for categorical variables such as transfusion requirement and maternal mortality. A two-sided p-value below 0.05 was considered statistically significant. Stratified analyses were undertaken according to maternal age, gestational age, and parity because these characteristics were considered possible effect modifiers. Post-stratification group comparisons were performed with independent-samples t-tests, chi-square tests, or Fisher's exact tests, as appropriate, with the same significance threshold. No multivariable model or adjustment for multiple subgroup testing was described, and subgroup findings should therefore be regarded as exploratory unless supported by an analysis plan.

### 3. RESULTS

As shown in Table 1, mean maternal age was  $30.56 \pm 8.12$  years in Group A and  $29.92 \pm 7.35$  years in Group B, with no statistically significant difference ( $p = 0.619$ ). The distribution across age categories was likewise comparable: 46.5% of women in Group A and 49.3% in Group B were aged 15–30 years, whereas 53.5% and 50.7%, respectively, were aged 31–45 years ( $p = 0.737$ ). Regarding the parity categories used in the original dataset, 31.0% of Group A and 21.1% of Group B were recorded as nulliparous, whereas 69.0% and 78.9%, respectively, were assigned to the combined primi/multiparous category ( $p = 0.181$ ). This difference was not statistically significant. The definition of the combined parity category should be clarified because primiparity and nulliparity must be distinguished consistently according to the time at which parity was assessed.

Mean gestational age was also similar between Group A and Group B ( $37.81 \pm 1.31$  weeks versus  $38.00 \pm 1.58$  weeks;  $p = 0.447$ ). Most participants in both groups delivered at 37–42 weeks of gestation, while a smaller proportion delivered at 33–36 weeks. Similarly, 62.0% of women in Group A and 60.6% of women in Group B delivered vaginally, whereas 38.0% and 39.4%, respectively, underwent cesarean delivery ( $p = 0.863$ ). These findings suggest that the observed baseline demographic and obstetric distributions were broadly comparable across the study groups. None of the recorded differences in the characteristics presented in Table 1 reached the prespecified level of statistical significance.

Maternal outcome comparisons are presented in Table 2. The reported mean blood loss was significantly lower in Group A than in Group B ( $250.80 \pm 188.88$  mL versus  $373.80 \pm 286.90$  mL;  $p = 0.003$ ). The reported median blood-loss values were also lower in the E-MOTIVE group [193 mL (reported interval: 50–789 mL)] than in the standard-care group [387 mL (reported interval: 50–1554 mL)]. The original table labels these intervals as interquartile ranges, but whether they actually represent ranges or quartiles requires verification against the underlying data. No woman in Group A required a blood transfusion, compared with two women (2.8%) in Group B. However, this difference was not statistically significant ( $p = 0.496$ ), and the small number of transfusion events limits the conclusions that can be drawn about this secondary outcome.

No maternal deaths were recorded in Group A, whereas one maternal death (1.4%) occurred in Group B. The difference between groups was not statistically significant ( $p = 1.000$ ), as shown in Table 2. The results therefore demonstrate a statistically significant difference in the reported mean blood-loss measure but do not establish a statistically significant improvement in either the blood-transfusion outcome or maternal mortality. The clinical interpretation of the blood-loss findings also depends on whether the measurements represent additional bleeding after diagnosis or cumulative bleeding from delivery through the postpartum period.

Stratified comparisons of mean blood loss across maternal and obstetric subgroups are presented in Table 3. Among women aged 15–30 years, reported mean blood loss was  $226.36 \pm 195.30$  mL in Group A and  $324.34 \pm 239.81$  mL in Group B (reported  $p = 0.030$ ). Among women aged 31–45 years, the respective values were  $272.03 \pm 183.06$  mL and  $421.89 \pm 322.38$  mL ( $p = 0.016$ ). In the nulliparous category, the corresponding mean values were  $231.05 \pm 189.05$  mL and  $370.00 \pm 203.24$  mL ( $p = 0.040$ ). Among participants classified as primi/multiparous, the means were  $259.67 \pm 190.08$  mL and  $374.82 \pm 306.90$  mL, respectively ( $p = 0.025$ ). The  $p$ -values are reproduced as reported; their consistency with the underlying statistical outputs, particularly for the younger age category, should be verified before publication.

When stratified by gestational age, women delivering at 33–36 weeks had reported mean blood loss of  $229.89 \pm 117.13$  mL in Group A versus  $288.80 \pm 211.91$  mL in Group B (reported  $p = 0.047$ ). For women delivering at 37–42 weeks, the corresponding mean values were  $253.84 \pm 197.65$  mL and  $387.74 \pm 296.47$  mL ( $p = 0.004$ ). These comparisons are included in Table 3. Although the direction of the reported mean differences consistently favored the E-MOTIVE group, the  $p$ -value for the 33–36-week subgroup requires confirmation from the original analysis, and the subgroup findings should not be interpreted as demonstrating uniform treatment effects without formal tests of interaction. The subgroup analyses also involved multiple comparisons, increasing the need for cautious interpretation.

**Table 1.** Comparison of baseline characteristics between the study groups

| Variable                     | Group A (E-MOTIVE) | Group B (standard care) | p-value |
|------------------------------|--------------------|-------------------------|---------|
| Mean maternal age (years)    | $30.56 \pm 8.12$   | $29.92 \pm 7.35$        | 0.619*  |
| Age group                    | 15–30 years        | 33 (46.5%)              | 0.737** |
|                              | 31–45 years        | 38 (53.5%)              |         |
| Parity                       | Nulliparous        | 15 (21.1%)              | 0.181** |
|                              | Primi/multiparous  | 56 (78.9%)              |         |
| Mean gestational age (weeks) | $37.81 \pm 1.31$   | $38.00 \pm 1.58$        | 0.447*  |
| Gestational age              | 33–36 weeks        | 9 (12.7%)               | 0.805** |
|                              | 37–42 weeks        | 62 (87.3%)              |         |
| Mode of delivery             | Vaginal            | 44 (62.0%)              | 0.863** |
|                              | Cesarean           | 27 (38.0%)              |         |

\*Independent-samples  $t$ -test; \*\* Pearson's chi-square test. Group sizes:  $n = 71$  in each group. The original parity category "primi/multiparous" requires a precise operational definition.

**Table 2.** Comparison of maternal outcomes between the study groups

| Variable                              | Group A (E-MOTIVE)  | Group B (standard care) | p-value |
|---------------------------------------|---------------------|-------------------------|---------|
| Mean reported blood loss (mL)         | $250.80 \pm 188.88$ | $373.80 \pm 286.90$     | 0.003*  |
| Median blood loss (reported interval) | 193 (50–789)        | 387 (50–1554)           | –       |
| Blood transfusion                     | Yes                 | 2 (2.8%)                | 0.496** |
|                                       | No                  | 69 (97.2%)              |         |
| Maternal mortality                    | Yes                 | 1 (1.4%)                | 1.000** |
|                                       | No                  | 70 (98.6%)              |         |

\* Independent-samples  $t$ -test; \*\* Fisher's exact test. Original intervals were labeled "IQR"; their actual definition and the period covered by blood-loss measurements must be verified against the source data.

**Table 3.** Stratified comparison of mean reported blood loss between the study groups

| Subgroup               | Group A (E-MOTIVE)  | Group B (standard care) | Reported p-value |
|------------------------|---------------------|-------------------------|------------------|
| <i>Maternal age</i>    |                     |                         |                  |
| 15–30 years            | $226.36 \pm 195.30$ | $324.34 \pm 239.81$     | 0.030*           |
| 31–45 years            | $272.03 \pm 183.06$ | $421.89 \pm 322.38$     | 0.016*           |
| <i>Parity</i>          |                     |                         |                  |
| Nulliparous            | $231.05 \pm 189.05$ | $370.00 \pm 203.24$     | 0.040*           |
| Primi/multiparous      | $259.67 \pm 190.08$ | $374.82 \pm 306.90$     | 0.025*           |
| <i>Gestational age</i> |                     |                         |                  |
| 33–36 weeks            | $229.89 \pm 117.13$ | $288.80 \pm 211.91$     | 0.047*           |
| 37–42 weeks            | $253.84 \pm 197.65$ | $387.74 \pm 296.47$     | 0.004*           |

\* Independent-samples  $t$ -test as stated by the original authors. Values are means  $\pm$  standard deviations. The reported  $p$ -values for the 15–30-year and 33–36-week subgroups require verification against the original SPSS output.

## 4. DISCUSSION

The present study compared maternal outcomes after postpartum hemorrhage among women managed using the E-MOTIVE bundle and those receiving the usual standard of care. The results showed significantly lower reported mean blood loss in the E-MOTIVE group than in the standard-care group ( $250.80 \pm 188.88$  mL versus  $373.80 \pm 286.90$  mL;  $p = 0.003$ ). In addition, no woman in the intervention group underwent blood transfusion or experienced maternal death, whereas two

women required transfusion and one maternal death occurred in the standard-care group. These latter differences were not statistically significant. The difference in measured blood loss is consistent with the potential value of coordinated early PPH treatment, but it does not by itself establish the mechanism through which the bundle acted, especially because the methods of measuring the reported outcome need clarification. The findings should therefore be interpreted in the context of study design, sample size, and reporting limitations.

Postpartum hemorrhage remains a leading cause of maternal morbidity and mortality globally, especially in low- and middle-income countries where recognition, transport, and access to emergency obstetric management may be delayed [12]. Recent international guidance has accordingly emphasized standardized evidence-based hemorrhage protocols and prompt implementation of first-response care to reduce severe complications [13]. The present finding of lower reported blood loss in the intervention group is directionally consistent with evidence from international studies of early detection and bundled PPH treatment [11]. However, the present comparison involves a much smaller single-center population and should not be regarded as a direct replication of the large international trial.

The international E-MOTIVE trial involved hospitals in Kenya, Nigeria, South Africa, and Tanzania and demonstrated that early objective detection followed by bundled treatment reduced the risk of a composite of severe bleeding, laparotomy for hemorrhage, or death from bleeding [11]. This trial provides more direct evidence for the E-MOTIVE approach than studies focusing on individual uterotonic medicines. Separately, a review of heat-stable carbetocin highlights the opportunities and implementation challenges associated with uterotonic strategies in low- and middle-income settings [14]. Borovac-Pinheiro and colleagues emphasized that accurate identification of PPH should consider clinical signs and blood-loss measurements, and that reliance on blood-loss thresholds alone can delay diagnosis [15]. These publications collectively underscore the need to distinguish early recognition, drug selection, and bundled clinical management rather than treating all three as identical interventions.

The lower mean blood loss reported in the E-MOTIVE group could plausibly reflect the combined implementation of uterine massage, uterotonic treatment, tranexamic acid, intravenous fluids, examination, and prompt escalation of care. Nevertheless, the current data do not isolate the contribution of any individual bundle component, and a mechanistic explanation cannot be confirmed from the reported aggregate results. Delays in initiating effective PPH treatment are a recognized concern in clinical guidance, which recommends systematic implementation and coordinated emergency response [16]. In a large health-system evaluation, Shields et al. found that introducing comprehensive maternal hemorrhage protocols was associated with reduced blood-product use, including a significant reduction in units transfused per 1,000 births [17]. Likewise, Main et al. reported improvements in severe maternal morbidity related to hemorrhage following implementation of a state-level perinatal quality initiative [18]. These studies support structured protocols, although differences in design and outcomes limit direct numerical comparisons with the present study.

No participant in the E-MOTIVE group required a blood transfusion, whereas two women, representing 2.8% of the standard-care group, were transfused. Although this numerical difference may be clinically relevant when viewed alongside other measures of blood loss, it was not statistically significant ( $p = 0.496$ ), and only two transfusion events were observed overall. It would therefore be inappropriate to conclude that the present study has demonstrated a reduction in transfusion requirements. Evidence from an Indian cross-sectional study by Gaur and colleagues describes the clinical profile and determinants of PPH rather than the effectiveness of a transfusion-reduction intervention [19]. More direct evidence for the potential benefits of standardized hemorrhage management comes from clinical protocol and implementation studies, such as the work by Shields et al. [17].

Evidence from Ethiopia similarly illustrates the burden of primary PPH and the clinical factors that may be associated with its occurrence. Zenebe and colleagues investigated PPH frequency and associated determinants among women delivering in the Gedeo Zone, but their observational study did not evaluate blood-product consumption before and after implementation of an E-MOTIVE response system [20]. Consequently, its findings should be used to contextualize PPH risk and resource requirements rather than to assert that the E-MOTIVE bundle reduced transfusions in Ethiopia. The present study suggests the possibility of better early hemorrhage control, but direct confirmation would require larger samples, consistent quantification of blood loss, and adequately powered assessment of transfusion outcomes.

No maternal deaths occurred in the intervention group, compared with one maternal death in the routine-care group. Given the very small number of deaths, the difference was not statistically significant ( $p = 1.000$ ) and should not be described as proof of a mortality benefit. Pacheco and colleagues provide an overview of medical approaches to treating PPH, emphasizing the importance of appropriate and timely therapy, but their review is not a direct comparative mortality trial of the E-MOTIVE bundle [21]. Similarly, a systematic review and meta-analysis of obstetric emergency team training reported evidence of potentially improved patient outcomes while drawing attention to limitations in the underlying studies [22]. Together, these sources support training and timely intervention as components of quality care, without establishing that the single death difference observed in the current study was attributable to the intervention.

The exploratory stratified analyses presented in Table 3 showed lower reported mean blood loss in the E-MOTIVE group across the maternal-age, parity, and gestational-age categories presented. However, the statement that statistically significant

differences occurred in every subgroup requires confirmation of the original statistical analyses, because two reported p-values are not reproduced by independent t-tests using the published summary data. Further, statistically significant findings within several strata do not, in themselves, demonstrate that treatment effects are consistent across subgroups; such a conclusion requires formal interaction testing. FIGO recommendations by Begum and colleagues emphasize the importance of objective measurement of blood loss after birth, rather than reporting a randomized comparison of E-MOTIVE effects across parity or delivery subgroups [23]. The implementation evaluation by Peng and colleagues assessed maternal safety bundles in Arkansas, providing relevant quality-improvement context, but not direct evidence for uniform E-MOTIVE effects in nulliparous and multiparous women [24].

Overall, the findings add local information to the international literature concerning standardized management of postpartum hemorrhage. The observed between-group difference in reported mean blood loss supports further assessment of the E-MOTIVE approach in Pakistani obstetric services, particularly in resource-limited contexts where delayed detection and fragmented response may contribute to avoidable harm. Staff training, protocol familiarization, teamwork, and simulation may improve readiness to recognize and respond to obstetric emergencies. A systematic review and Bayesian meta-analysis of hemorrhage drills and simulation interventions suggested possible improvements in some adverse outcomes while cautioning that much of the available evidence came from methodologically weak pre-post studies [25]. Therefore, adoption decisions should combine the strongest available clinical evidence with local feasibility assessment, staff preparation, equipment availability, monitoring, and ongoing audit rather than relying on this single-center result alone.

The study has several important limitations. First, the sample was relatively small and was recruited at a single tertiary-care hospital, limiting generalizability to other healthcare settings and populations. Second, the manuscript describes both a quasi-experimental design and allocation through a lottery system, and the precise allocation and concealment procedures need clarification. Third, blood-loss measurement was not described as uniform across all participants; some women were assessed with calibrated drapes and others with clinical estimation methods. Fourth, the reported mean blood-loss measures were below the diagnostic thresholds used for participant inclusion, so the outcome measurement interval requires explicit clarification. Fifth, few blood transfusions and maternal deaths occurred, limiting statistical power for these outcomes. In addition, some subgroup p-values and the reported median intervals need verification. Finally, the extent of follow-up after discharge was uncertain, so longer-term maternal outcomes and complete 42-day mortality ascertainment could not be established confidently from the supplied methods.

## 5. CONCLUSION

The present study found lower reported mean blood loss among women with primary postpartum hemorrhage who received the E-MOTIVE bundle than among those managed with routine standard care. The between-group difference in the reported blood-loss measure was statistically significant, and the direction of the observed effect favored the intervention group. Fewer blood transfusions and maternal deaths were recorded in the E-MOTIVE group; however, the differences in these secondary outcomes were not statistically significant and should not be presented as demonstrated improvements in transfusion rates or survival. The results are consistent with the clinical rationale for early recognition and coordinated delivery of evidence-based treatments, including uterine massage, uterotonic medication, tranexamic acid, intravenous fluid resuscitation, examination, and timely escalation of care. Nevertheless, the interpretation of the blood-loss findings depends on clarifying the exact timing and methods of measurement, as well as resolving the statistical reporting issues identified in the subgroup analyses. Subject to these clarifications, the E-MOTIVE approach may offer a valuable framework for improving PPH management in resource-limited obstetric settings. Larger, carefully reported comparative studies with standardized measurement and adequate follow-up are needed to evaluate its effect on severe maternal outcomes more confidently.

### Author Contributions

All authors contributed equally to the conception, development, preparation, and revision of the manuscript. All authors reviewed and approved the final version of the manuscript.

### Conflict of Interest

The authors declare that they have no conflicts of interest relevant to the present study.

### Data Availability

The de-identified supporting data can be obtained from corresponding author upon a reasonable request.

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