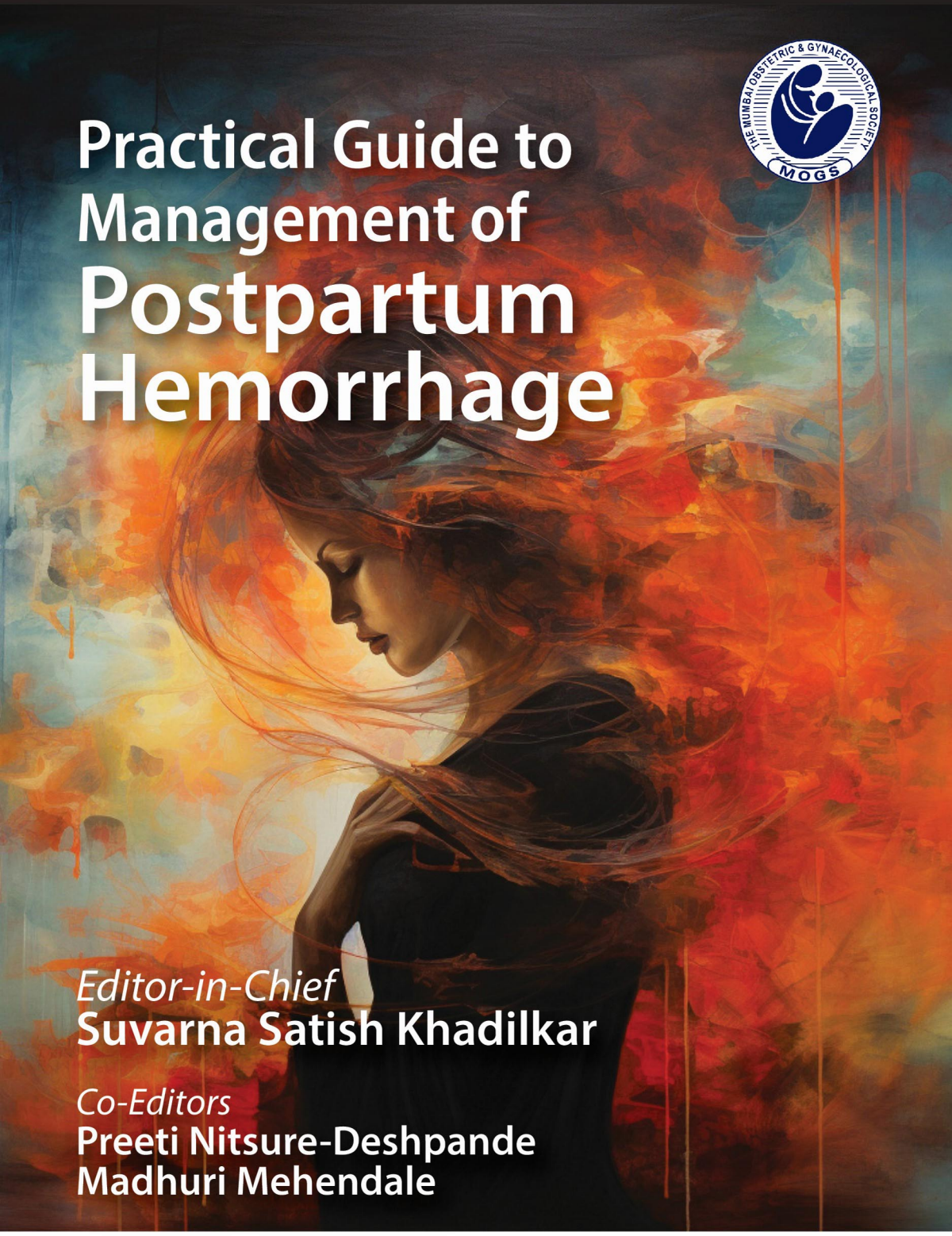
Practical Guide to Management of Postpartum Hemorrhage



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Estimation of Blood Loss and the Golden Hour

Suvarna Satish Khadilkar, Preeti Nitsure-Deshpande

INTRODUCTION

Postpartum hemorrhage (PPH) affects 2% of women worldwide. Globally, it is the leading cause of maternal mortality. It is responsible for 27% of maternal deaths.[1]

Hemorrhage is the leading cause of maternal mortality in Asia and Africa. Mortality due to PPH is preventable to a large extent. In refractory cases, the point of error most of the time is either delayed diagnosis due to inexperienced labor attendants with inaccurate assessment of blood loss or unavailability of the resuscitative facilities.[2]

Primary PPH is defined by the Royal College of Obstetricians and Gynaecologists (RCOG) as a blood loss of >500 mL in 24 hours. The RCOG defines minor PPH as a blood loss of 500–1,000 mL and major PPH is more than 1,000 mL of blood loss. Moderate PPH is said to have occurred when the blood loss is more than 1,000 mL and severe hemorrhage is defined as a blood loss of more than 2,000 mL. The American College of Obstetricians and Gynecologists (ACOG) defines this as cumulative blood loss of 1,000 mL or more or blood loss accompanied by signs or symptoms of hypovolemia within 24 hours following the birth process.[3] The World Health Organization (WHO) defines severe PPH as a blood loss of more than 1,000 mL.[1]

Definition of PPH by various organizations worldwide is given in **Table 1**.[4]

The effect of blood loss depends on the *patient's weight*[1] *and the original hematocrit*. Categorizing the blood loss solely on volume can underestimate blood loss and should be based on percentage of *total blood volume lost*.[1]

First clinical signs appear only after 30% of blood loss occurs.[2]

In an average 50 kg patient, the total amount of blood volume is 5,000 mL. Hence, a blood loss of 1,500 mL, which corresponds to 30%, manifests with signs of hemodynamic instability.

There is a concept of allowable blood loss based on patient's weight and hematocrit.[5]

In our country, lower average body weight and anemia are very common and hence delayed diagnosis is dangerous.

In pregnant women, blood volume increases by 40–50% and cardiac output increases by 45%. Fall in blood pressure and tachycardia present later due to physiological changes of pregnancy. Majority of the pregnant women

TABLE 1: Definition of postpartum hemorrhage (PPH) by various organizations.

Guidelines	*Vaginal/cesarean delivery*	*Vital signs*	*Comments*
International Federation of Gynecology and Obstetrics	Loss >500 mL/>1,000 mL	For clinical purposes, any blood loss that has the potential to produce hemodynamic instability should be considered a PPH	Clinical estimates of blood loss are often inaccurate
American College of Obstetricians and Gynecologists	Cumulative blood loss ≥1,000 mL, regardless of route of delivery	Signs or symptoms of hypovolemia; important to recognize that the signs or symptoms of considerable blood loss are substantial	Excess of 500 mL after vaginal delivery is an alert; when postpartum bleeding exceeds expected volumes (500 mL in a vaginal delivery or 1,000 mL in a cesarean delivery), a careful and thorough evaluation should be undertaken
Royal College of Obstetricians and Gynaecologists	Estimated blood loss of 500–1,000 mL (minor PPH) and >1,000 mL (major PPH)	Pulse and blood pressure normal until blood loss exceeds 1,000 mL; tachycardia, tachypnea slight fall in systolic blood pressure with blood loss of 1,000–1,500 mL; >1,500 mL systolic blood pressure 80 mm Hg, worsening tachycardia, tachypnea, and altered mental state	A blood loss of >40% of total blood volume (approximately 2,800 mL) is generally regarded as "life-threatening"
Society of Obstetricians and Gynaecologists of Canada	Loss >500 mL/>1,000 mL	Any blood loss that has the potential to produce hemodynamic instability should be considered PPH	The amount of blood loss required to cause hemodynamic instability depends on the pre-existing condition of the woman
Royal Australian and New Zealand College of Obstetricians and Gynaecologists	Estimated blood loss 500 mL; severe PPH after blood loss of 1,000 mL	Clinical signs of shock or tachycardia, which include an accurate appraisal of blood loss (both concealed and revealed), assessment of the mother	It is important to consider both the patient's previous hemoglobin level and her total blood volume for the assessment of the severity of PPH

Source: Adopted from FOGSI GCPR; 2021.[4]

TABLE 2: Clinical signs and symptoms.[4]

	Stage 1	*Stage 2*	*Stage 3*	*Stage 4*
Blood loss	<15%	15–30%	30–40%	>40%
Blood loss (cc)	<750 cc	750–1,500 cc	1,500–2,000 cc	>2,000 cc
Pulse rate (beats/min)	<100	>100	>120	>140
Respiratory rate (breaths/min)	14–20	20–30	30–40	>35
Blood pressure	Normal	Decreased	Decreased	Decreased
Mental status	Normal/slightly anxious	Mildly anxious	Confusion and lethargy	Confusion

tolerate blood loss till 1,000 mL and show symptoms after 1,500 mL blood loss occurs.[1]

Accurate estimation of blood loss has to be an essential component of conduct and monitoring of all labors and cesarean sections. If the blood loss is underestimated, it will be detrimental as it can lead to delayed treatment for PPH, increased morbidity, and mortality. Depending upon the rate of blood loss, the laboring woman may develop multiorgan failure and mortality within few hours **(Table 2)**.

While on the other hand, if blood loss is overestimated, it leads to the hazards of overtreatment. Most women with PPH require blood transfusion. Blood transfusion has its own risk of infection, circulatory overload, acute lung injury, anaphylaxis, and transfusion reaction. Transfusion-associated circulatory overload (TACO) and delay in blood transfusion are the main causes of death. Alloimmunization occurs in 1–6%.[1]

Hence, it is essential to accurately assess volume of blood loss and the need for blood transfusion.

Assessment of blood loss in surgery is an integral part of clinical practice. However, no accurate practical methods/tests are available for measuring blood loss intraoperatively. The decision for blood transfusion is taken once hemodynamics is compromised or based on individual judgment of the surgeon or anesthetist. Most of the time the decision is taken at the end of surgery after counting mops and pads on visual blood loss.

METHODS OF ESTIMATION OF BLOOD LOSS

Visual estimation of blood loss is the most common method used to assess blood loss. It is a notoriously inaccurate method of estimation of blood loss.[2] It is the traditional method. It needs no equipment. But it can lead to underestimation or overestimation. There is even a variation between practitioners.

This is because if most of the blood is absorbed by surgical gauze and not collected in collection bottles it can be difficult to estimate it. Though pre- and

postprocedure weighing of gauze (gravimetric) is known, it is not in routine use either due to unavailability or time-consuming nature of procedure.[6]

Various attempts have been made to improve the accuracy of visual estimation of blood loss. A *visual analog scale (VAS)* has been suggested. In a study reported in the Journal of Trauma and Emergency Medicine (2016), an experiment was conducted where aspirated blood was used to soak surgical gauze. Different percentage of stained gauze was photographed to create a visual analog scale. Random pattern of staining of gauze was used. Absorptive capacity of various sizes of gauze was established till they were dripping with blood (supersaturated). The reduction in absorption was determined when gauze was wetted with normal saline.

Three different sizes of gauze were used such as 10 × 10 cm, 30 × 30 cm, and 45 × 45 cm. Serial spilling was done using 3, 10, and 40 mL for various sizes of gauze respectively. A scale was created to show 25%, 50%, 75%, and 100% soakage of gauze and supersaturation. Saline wetting reduced the soakage capacity of the gauze by 25%. Clinical scenarios and pictures have been used to teach. These analogs lessen the errors but do not eliminate them.

Direct or volumetric estimation is a more accurate method. Calibrated under buttock drapes **(Fig. 1)** and canisters are used to improve estimates. It is easier and more accurate than visual estimation. Overestimation may occur due to amniotic fluid and urine and underestimation may occur due to missed swabs and uncollected fluids. It is real-time and easy. It needs basic equipment.

A gravimetric method is where the blood loss is determined by assessing the difference in weight of the swabs and drapes before and after the use. Every gram of weight is equivalent to 1 mL of blood. It is more accurate than visual estimation, easy, and can be done in real time. It needs equipment and is time-consuming. There is a risk leading to overestimation and underestimation. Additionally, it depends on the hematocrit.

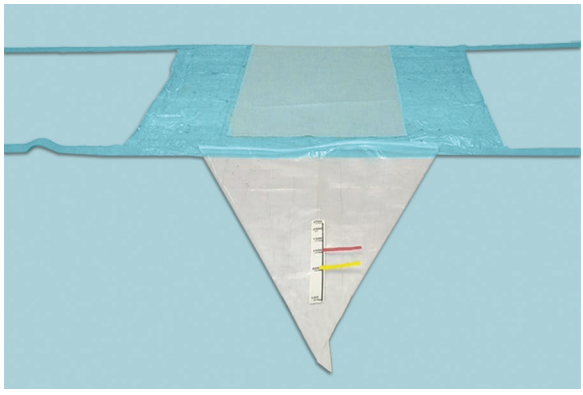
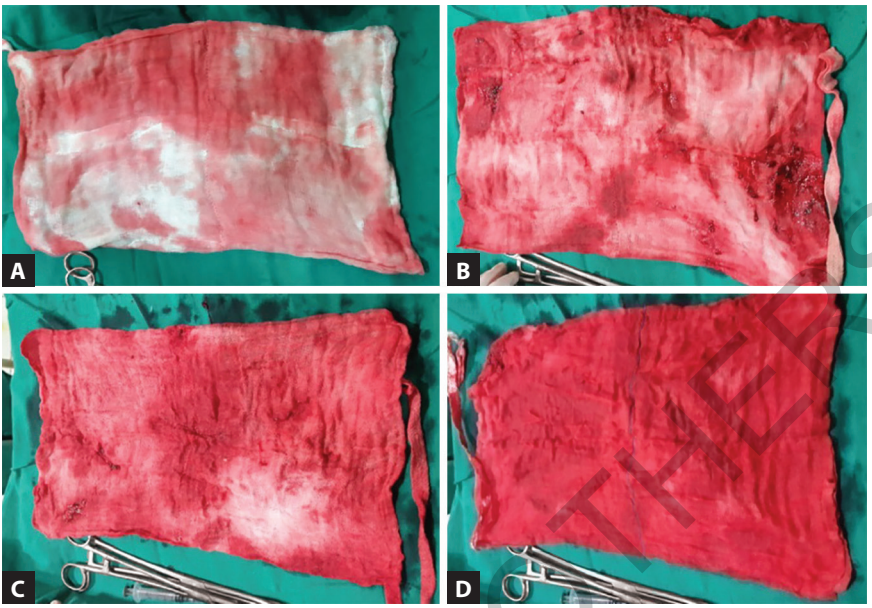


Fig. 1: Direct or volumetric estimation.



Figs. 2A to D: Poster displaying standard-sized mops soaked in known quantity of blood: (A) 25 mL; (B) 50 mL; (C) 75 mL; and (D) 100 mL.
Source: Khadilkar SS, Sood A, Ahire P. Quantification of peri-partum blood loss: training module and clot conversion factor. J Obstet Gynaecol India. 2016;66(Suppl 1):307-14.

A study was conducted to compare direct (volumetric) and gravimetric (weight) methods. In direct methods mean blood loss measured was more.[7]

Visual estimation has its own limitations and there are inaccuracies in estimation by visual method. There is a need for an objective method for accurate estimation. Hence, a study was conducted to overcome fallacies of routine practices in labor room. We observe that labor notes do not always include accurate blood loss. So, it is very difficult to know whether patient has had significant bleeding amounting to PPH. Authors studied various methods for estimation of blood loss. Gravimetric and direct measurement methods were studied in both vaginal and cesarean sections. *Gravimetric (weight)* estimation and *visual estimation of spilled blood with pictures and posters* were used **(Figs. 2A to D)**. These simulated scenarios were used to train healthcare professionals. These certainly improved the visual estimation accuracy. However, under- and overestimation were observed in all the different professional healthcare groups.

In this study, plastic drapes were used for direct measurement. Blood was allowed to drain in measuring *jars. This gave higher accuracy*. V drapes if available should be used for direct measurement instead of plastic drapes.

Weighing blood clots does not give exact amount of the blood volume lost. So, a novel clot conversion factor was devised to assess the precise lost blood volume.

Whole blood volume lost in milliliters = Clot conversion factor × weight of clot in gram[2]

Clot conversion factor is an objective tool that depends on hemoglobin. If hemoglobin is low, clot will weigh less. Hence, clot conversion factor will be more. The clot conversion ranges from 1.39 to 1.51 in incremental fashion with decreasing hemoglobin percentages.

If a fist-sized clot equal to 50 g is passed, the actual blood loss will be 71.5 mL with clot conversion factor of 1.43 used for the hemoglobin range of 9–11 g%.

Visual estimation was more erroneous in situations with more severe blood loss.

This study showed that rather than pure visual estimation, quantification of the blood loss by direct measurement is better. With training combined gravimetry and other techniques accuracy can be improved and used when V drapes are not available.[2]

In another study, the concept of *allowable blood loss* which was calculated in advance was used.

A fixed number of mops of a standard size was given during surgery, based on absorption capacity of mops and the allowable blood loss calculated. It was estimated that a mop of 30 × 30 cm holds 100 mL and 4 × 4 cm holds 10 mL of blood.[7] This is an *indirect gravimetric* estimation *where number of mops is the objective tool*.

If more mops were needed then a decision for blood transfusion was taken. The decision was taken during the surgery without waiting for signs and laboratory results.

For adult females, the estimated blood volume is 65 mL/kg approximately.

Based on the estimated blood volume and original hematocrit of the patient the allowable is calculated preoperatively.

The standard rule for transfusion trigger is based on the 10/30 rule which stipulates that the hemoglobin should be maintained above 10 g/dL and hematocrit should be at or above 30.

Allowable blood loss = EBV × (Hct initial – Hct Final)/Hct initial

For Example: If EBV = 3,250 mL, initial Hct is 40 and final hematocrit is 30

Allowable blood loss = 3,250 × 40 – 30/40

= 812 mL

If 8 mops of 30 × 30 cm are soaked and 10 mops of 4 × 4 cm are soaked, 900 mL is the estimated blood loss.

This concept alerts the team when mops are taken and *does not allow a delay in blood transfusion. It saves the golden hour.* However, in this method the soakage of mops is subjectively assessed.

Photometry is another method of blood loss estimation that uses a spectrophotometer. It measures the light intensity passing through a

sample. The hemoglobin is stabilized and extracted from all the blood lost and collected. The hemoglobin mass is compared to the preoperative hemoglobin and total blood loss is calculated. The alkali hematin method is the gold standard. It is accurate within 10% but some processes *take up to 20 hours* to complete.

Colorimetry is a method of blood loss estimation that utilizes the Triton™ system. Quantity of blood loss is assessed by using this smartphone app. A *photograph of the swabs and visual pictures* of the canisters are used. The smartphone app uses a "feature extraction technology"—a type of artificial intelligence to assess the hemoglobin mass while filtering the contaminants. Preoperative hemoglobin is entered in the data which gives us an estimation of the blood loss. It is very accurate and correlates to photometry. It is real-time, quick, and accessible. It has been used in the operation theaters. It needs specific equipment and is time-consuming.[1]

Triton system uses the preop hemoglobin, visual picture of mop, weight of the clot, and volume of blood in canisters.[8] It is more accurate than visual, gravimetry, and volumetric analysis. The Triton System needs to be downloaded and purchased.

Mop picture (AI visual) + Clot weight (sent on blue tooth) + Canister blood picture (volumetry) + V-drape (Volumetry) + Preoperative hemoglobin is inserted.

Machine learning algorithms are now evolving. Machine learning is a branch of artificial intelligence and computer science which focuses on data and algorithms to mimic the way humans learn and gradually increases accuracy. It can be used to predict when the blood transfusion will be needed and predict PPH.[1]

OTHER BEDSIDE HEMORRHAGE ASSESSMENTS

Hemoglobin levels during PPH are of little value with a steep decline 6 hours postdelivery and they stabilize 24–48 hours postdelivery. A real-time assessment is required. *HemoCue is a point-of-care test* that uses photometry to give hemoglobin in 45 seconds. A hemoglobin of 6 g/L generally needs blood transfusion. The RCOG recommends clinical as well as hematological assessment to manage blood transfusion.

There are two point-of-care tests to assess clotting: *Thromboelastography (TEG)* and *rotational thromboelastography (ROTEM)*. They use citrated blood to study formation and breakdown of clot. Resistance is measured over time and shown in a graphical form. They use an algorithm to assess hypofibrinogenemia and decrease platelet counts. They assess the requirement for fresh frozen plasma and fibrinogen and cryoprecipitate.

Lactate levels are available in some blood gas analyzers. Lactate ≥4 mmol/L is associated with shock, increased mortality, and need for massive transfusion of blood products.

After 24 hours the hematocrit estimates of blood loss in retrospect. It may be used in replenished blood loss.

CLINICAL ASSESSMENTS

The use of early warning scores that consider the normal physiological changes seen in pregnancy such as *Modified Early Warning Score* was recommended by the Centre of Mother and Child Enquiries report 2003–2007 (UK). These early warning scores show good sensitivity and specificity when predicting maternal morbidity allowing targeted management of critically ill women. But it has lower sensitivity when detecting complications associated with PPH, because changes in heart rate and blood pressure commonly present as late signs of shock. Early warning scores by themselves are not reliable at predicting the volume of blood loss, however, when hemorrhage is concealed they may be important in detection and triggering further investigation.

Shock index is calculated by dividing the heart rate by the systolic pressure. It may be a useful tool for morbidity and mortality and risk of developing shock. In nonobstetric patients, the normal shock index is 0.5–0.7, but thresholds are different in obstetric patients because of physiological changes in pregnancy. A shock index above 0.9 in women with PPH increases the risk of blood transfusion, surgical intervention, and admission to ICU. However, shock index can be falsely reassuring in case of fluid resuscitation and hypertension. More studies are needed to assess importance of shock index.

DISADVANTAGES AND INADEQUACIES OF METHODS OF ESTIMATION OF BLOOD LOSS

Reasons for wrong visual estimation may be blood drained in second stage of labor is often not estimated. Absorbent bed sheets and drapes used to cover mattresses absorb some amount of blood which is not estimated. When clots are passed there is no tool available to assess the volume of blood loss. There is more significance in case of secondary PPH and abruption. Even in the absence of the above factors visual estimation is difficult. Underestimation of blood loss is detrimental as it leads to delay in treatment.

Visual estimation varies amongst different team members and sometimes there is no agreement.

Quantitative measures are expensive and not freely available. We seek more objective methods.

Anesthetists tend to overestimate and surgeons tend to underestimate blood loss.[6]

TABLE 3: Monitoring of mother postsecond stage of labor.

Time post-delivery	*Temperature (98–98.9°F)*	*Pulse (60–100 beats/min)*	*BP (90/60 to 120/80 mm Hg)*	*CVP (if any) (8–12)*	*RR (12–18 breaths/min)*	*Shock index (0.5–0.7)*	*Blood loss—Objective (<500 mL)*
0 hours							
30 minutes							
1 hour							
1.5 hours							
2 hours							
6 hours							
10 hours							
14 hours							
18 hours							
24 hours							

(CVP: central venous pressure; RR: respiratory rate)

MONITORING OF MOTHER POSTSECOND STAGE LABOR

Early detection will be possible only with accurate objective estimation of blood loss along with close monitoring of the patient as given further. The risk of bleeding and postpartum collapse may remain up to 24 hours. Close monitoring and timely action with early detection will go a long way in prevention of maternal morbidity and mortality due to PPH **(Table 3)**.

The fourth stage of labor, i.e., first 2 hours after delivery is very important. Monitoring will help early detection of PPH (*E* of EMOTIVE bundle approach in obstetric hemorrhage).

Monitoring and necessary action in the golden hour, i.e., the first hour after detecting hemorrhage is vital to save life of the patient. The concept of the Golden Hour was introduced for trauma patients by R Adams Cowley, founder of Baltimore's Shock Trauma Institute, in the year 1975. He stated: "The first hour after injury will largely determine a critically injured person's chances for survival".[9] The delay in instituting treatment can be detrimental.

MORBIDITY AND MORTALITY DUE TO PPH

As per the Sample Registration Survey (SRS) data, India has successfully achieved a major milestone to bring the maternal mortality ratio (MMR) below 100 per lakh live births by 2020; by bringing it down to 97 per lakh live births in 2018–2020 from 130 per lakh live births in 2014–2016. *8 states* have achieved SDG targets including the five southern states of Tamil

Nadu, Kerala, Andhra Pradesh, Telangana, Karnataka, Maharashtra, Gujarat and Jharkhand of bringing MMR below 70 per lakh live births by 2030.[10]

India similar to many other countries with high MMR registers only a fractional part of births, deaths, and vital events. Maternal deaths are high in rural areas and are less likely to be recorded. India has an SRS since the last 5 decades to monitor fertility and mortality covering over 1 million national representative homes. In 2017, the United Nations estimated that India represents 12% of global maternal deaths.[11]

Trends in maternal mortality over 20 years examine 10,000 maternal deaths among 4.3 million live births identified by SRS. The Million Death Study analyzed 1,500 maternal deaths with assigned causes in a nationally representative-population-based mortality survey. In 2014, the MMR was 122 per lakh live births. 47.2% of the deaths were due to PPH. Hemorrhage, pregnancy-related infection, and hypertension were the three leading causes of maternal mortality in India **(Table 4)**.

Sample proportions are weighted for sampling probability and national totals are rounded to the nearest hundred.[11]

Postpartum hemorrhage can cause morbidity including anemia, renal failure, disseminated intravascular coagulation, pulmonary and visceral injury, hysterectomy, and cardiac arrest. It is the chief reason for admission to the intensive care unit (ICU) for obstetric patients. Additionally, it can affect the patient psychologically, cause post-traumatic stress disorder, postnatal depression, and have a negative impact on bonding.[1] Sheehan's syndrome is a well-known sequel of massive PPH. It occurs due to acute ischemia of pituitary gland after PPH, leading to pan-hypopituitarism.

Hence measures for prevention and detection of PPH are important to prevent maternal morbidity and mortality.

TABLE 4: Causes of maternal death in the Million Death Study in 2007–2014, projected national total deaths in 2020.[11]

Cause of death	*Sample size*	*Proportion (with 95% CI)*	*National totals in 2020 (95% CI)*
Direct causes			
Hemorrhage	735	47.2%	11,200 (10,600–11,900)
Pregnancy-associated infections	183	12%	2,800 (2,400–3,300)
Hypertensive disorders	109	6.7%	1,600 (1,300–2,000)
Abortion	78	4.9%	1,200 (900–1,500)
Other direct causes	313	19.6%	4,700 (4,100–5,200)
Indirect causes	147	9.8%	2,300 (2,000–2,800)
Total	1,565	100%	23,800 (21,700–26,000)

The American College of Obstetrics and Gynecology has made some recommendations for quantification of obstetrics hemorrhage.

TIPS FOR QUANTIFICATION OF BLOOD LOSS IN VAGINAL DELIVERY[13]

- Quantification of blood loss is a team effort.
- Create a list of dry weights for delivery items that may become blood-soaked with directions on calculation.
- Begin the quantification immediately after delivery of the baby. Keep in mind fluid collected before delivery is the amniotic fluid.
- Record the total volume collected in the under-buttock drape.
- Add the fluids collected in the drapes to the blood volume measured by weighing soaked items to determine cumulative blood loss.
- Weigh all soaked blood material and clots. 1 g clot is equal to 1 mL blood loss.

TIPS FOR QUANTIFICATION OF BLOOD LOSS IN CESAREAN DELIVERY[13]

- Begin the quantification when amniotic membranes rupture and after the baby is delivered.
- Suction and measure all amniotic fluid within suction canister before delivery of the placenta.
- After delivery of the placenta measure amount of blood loss in the suction canister and drapes. Notify the team and document the amount of blood loss in milliliters.
- Early detection by accurate assessment of blood loss will help implement hemorrhage bundle approach successfully.
- Before adding the irrigation fluid, ensure that the scrub team communicates when irrigation begins.
- Add the fluids collected in the drapes to the blood volume measured by weighing soaked items to determine cumulative blood loss.
- Weigh all soaked blood material and clots. Calculate the weight and convert it into milliliters.
- Add the volume of blood calculated by weight with volume of quantified blood in the suction canister.
- Lap pads dampened with normal saline contain minimal fluid. When they become saturated with blood, weigh them as a dry lap pad.
- Early detection by accurate assessment of blood loss will help implement hemorrhage bundle approach successfully.

SUMMARY

Recommendations:

- Quantitative methods of measuring peripartum blood loss have been shown to be more accurate than visual estimation in determining obstetric blood loss.[12]

- Every new medical healthcare professional posted in labor unit should undergo training for visual assessment of blood loss before joining. Training module should show pictures of blood-soaked drapes, sponges and containers, and floor spills.
- Educative charts regarding visual assessment of blood loss should be displayed in the labor room and operation theater.
- Calibrated nonabsorbent drapes must be used on labor table as absorbent drapes soak the blood and hamper accurate assessment of blood loss.
- Implementation of quantitative assessment of blood loss includes use of direct measurement as well as protocols for collecting and reporting a cumulative record of blood loss postdelivery.
- Ready reckoner for clot conversion factor, for calculation of actual blood loss depending on weight of clot and hemoglobin of the patient, should be displayed in labor ward for emergency use.
- In low-resource setting if a measuring jar is not possible, simple tool of measurement like a standard-sized cotton cloth/linen which gets completely soaked with 500 mL of blood should be made available.[2]
- Ready reckoner for allowable blood loss based on patient's weight and original hemoglobin should be available.
- The ACOG recommends that "Interprofessional protocols for the assessment of blood loss, including quantitative assessment, for both vaginal and cesarean births, are best developed by a multidisciplinary team".

The concept of the Golden Hour between life and death is applicable to scenarios like sepsis and PPH. We need to find ways for rapid diagnosis to capitalize on the Golden Hour. In sepsis, lactate levels have been used as markers internationally. Until we find such a marker for PPH, mock obstetric drills, training on visual analog scales displayed in labor ward and operation theaters, colorimetry using apps, and vital indices are critical in saving the lives of mothers. Early detection is the first step in implementing hemorrhage bundle approach successfully.

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Practical Guide to Management of
Postpartum Hemorrhage

Postpartum hemorrhage is the leading cause of maternal mortality in India. Maternal mortality in India has declined significantly from 437 per 100000 live births to 97 per 100000 live births by 2020. The Sustainable Development Goal for maternal mortality ratio set by the United Nations for 2030 seems tangible and attainable. It has been a remarkable trend of decline in maternal mortality ratio. However, there is a huge discrepancy in performance of various states with The 9 Empowered Action Group States and Assam still having a maternal mortality ratio of 137 per 100000 live births.

Improving awareness and hence interventions in control and management of postpartum hemorrhage can go a long way in saving maternal lives. The author conceived the idea of this book with this aim in mind. This book highlights the medical and surgical management of postpartum hemorrhage. Many untouched areas like retained placenta, lacunae in estimation of blood loss have been clarified and role of modern interventions like artificial intelligence and intraoperative cell salvage have been elucidated. The book covers analysis of why mothers die of hemorrhage and proposed preventive strategies. It is truly a handbook for every practicing obstetrician to help maximize the golden hour.

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