Management of Postpartum Hemorrhage in Low Resource Settings
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INTRODUCTION
The global rate of maternal mortality is 260/100,000 live births, and approximately 500,000 mothers are lost annually as a result of pregnancy-related issues1. Rates of death are disproportionately high in developing countries, where maternal mortality as high as 920/100,000 live births has been recorded in sub-Saharan Africa2.

Overall, postpartum hemorrhage (PPH) affects 1–5% of all deliveries3,4, and approximately 30% of maternal deaths are due to hemorrhage, mainly in the postpartum period. Most maternal deaths due to PPH occur in developing countries in settings (both hospital and community) where there are no birth attendants or where birth attendants lack the necessary skills or equipment to prevent and manage PPH and shock5. Under such circumstances, it is not surprising that almost 99% of maternal deaths occur in developing countries6, and 45% of postpartum deaths occur within 1 day of delivery7. The Millennium Development Goal of reducing maternal mortality by 75% by 20158 will remain beyond our reach unless governments act in partnership with the obstetric community to confront the problem of PPH in the developing world as a priority.

Of deaths due to PPH, 90% occur in women who have none of the so-called classic risk factors, although some conditions do predispose to PPH. It is a preventable cause of death, as evidenced by the decline in hemorrhage-related mortality in the developed world. The maternal mortality rate (MMR) is 35-times lower in the developed world compared with that in developing countries (14 versus 400/100,000 live births)2.

PREDISPOSING FACTORS
It is very important to evaluate the following issues in the antenatal period, as they significantly affect a parturient’s response to a given blood loss.

(1) Anemia Iron-deficiency anemia affects 66–80% of the world’s population11. Anemia, in particular severe anemia, increases the risk of PPH-related maternal morbidity and mortality.

(2) Maternal depletion syndrome This is an extremely important consideration in developing countries where mothers have diminished nutritional status due to early marriage and repeated pregnancies12,13.

(3) Obstetric conditions Mothers with pre-eclampsia, multiple pregnancies, retained placenta, abruptio placentae, placenta previa, operative vaginal delivery, prolonged labor, pyrexia in labor, etc. are more prone to PPH.

(4) Medical infrastructure In developing countries, significant numbers of deliveries occur in the home or rudimentary health centers, often with minimally skilled birth attendants14. This is despite the fact that a critical component of safe delivery practice is to have a competent health worker with at least midwifery skills present at every birth along with plans that provide transport to a referral facility should this be necessary1,14.

INDIAN SCENARIO
Rural India is representative of the scope and magnitude of the international problem, where 50% of births occur at home or in rudimentary facilities without a physician in attendance. The MMR in India currently is estimated at 254/100,000 live births with PPH being responsible for 30% of these deaths9. This figure mimics that cited above on a worldwide basis.

Although a blood loss of 500 ml of blood following vaginal delivery or 1000 ml following cesarean section represents the standard and accepted definition of PPH, we propose that a more practical definition of PPH in terms of the developing world would be any blood loss that causes a physiological change (e.g. low blood pressure) that threatens the woman’s life. Such a definition would also more accurately reflect the fact that anemic women in developing countries are far more susceptible to adverse outcomes as a result of smaller blood losses after delivery. Thus, the addition of ‘a 10% drop in hemoglobin level’ to the definition would provide an objective laboratory measure for health care providers who may not be able to assess accurately the true quantity of loss. However, such an addition would presume that even this simple test was available and, in reality, it is not.
ADEQUACY OF THE DELIVERY SETTING

Countries can be classified in terms of the resources available at the time of delivery.

Low resource settings

Low resource settings are locations where significant numbers of deliveries occur in the home or in rudimentary health centers, often in the presence of minimally skilled birth attendants. Examples of such settings include the developing countries of sub-Saharan Africa such as Nigeria, Senegal and Uganda, while countries in southern Asian are exemplified by India, Bangladesh, Pakistan and Nepal.

High resource settings

High resource settings are locations where most deliveries are conducted in a well-equipped hospital with trained medical and paramedical staff, adequate medications, equipment and space, and facilities to transfer a patient to a center with more complex technology and techniques, as well as a 24-hour power supply and refrigeration facility.

PRINCIPLES OF MANAGEMENT

The principles of management of PPH are outlined below.

(1) Quick and efficient management is extremely important, as a recent Egyptian study showed that 88% of deaths occur in the first 4 hours after onset of PPH15. Other data from WHO note that if left untreated, the parturient can die within 2 hours.

(2) Quick assessment of the patient’s condition must be made, as well as a decision as to whether she can be treated locally or must be transferred to a higher level facility as quickly as possible after initial resuscitation.

(3) Arrangement of adequate manpower is mandatory, as treatment of PPH cannot under any circumstances be considered a one-person show.

(4) Arrangement for adequate fluid replacement and blood products when necessary is a crucial part of the initial resuscitation plan.

(5) Correct estimation of blood loss is essential. In most instances, estimation of blood loss is accomplished visually despite the fact that numerous studies show that this method is up to 50% less accurate than other methods16–18. Early and accurate estimation of blood loss is crucial because replacement is so often required. The estimation of blood loss from a caesarean section is generally more accurate than after vaginal delivery, because during vaginal delivery blood is generally mixed with amniotic fluid. Estimation is enhanced using the methods outlined in Table 1 after letting the amniotic fluid drain out as much as possible19. Details regarding the use of a drape under the parturient’s buttocks to facilitate blood collection are presented in Chapter 11.

Medical management

Table 2 lists the drugs used in the management of PPH.

Misoprostol

In developing countries available medical facilities are often erratic or non-existent. The most important basic facilities required for safe delivery include staff with appropriate training, around the clock availability of the same, and the presence of a 24-hour electricity supply and refrigeration for the maintenance of uterotonic medications. It is this latter requirement that has turned the attention of many caregivers in the developing world to misoprostol. This medication requires no refrigeration, is inexpensive and can be administered by individuals with little or no professional training (see Chapter 42).

Analysis of the cost of misoprostol use in developing countries should not be limited to the cost of the tablets. Costs of misoprostol treatment, trained birth
attendant (TBA) training, hospital referrals, hospitalization, IV fluids and blood transfusions should be borne in mind. (These data can be derived from the literature and from field data.) Examples of cost models are shown below.

**Cost model for misoprostol arm**

TBA training cost + TBA time cost + drug cost + cost of side-effects + cost of transport + cost of hospitalization + cost of treatment for PPH

**Cost model for standard care arm**

Cost of transport + cost of hospitalization + cost of treatment for PPH

Different studies show that more than 80 TBAs are needed to attend 10,000 deliveries and the cost of a 5-day training per TBA including teachers and materials is US dollars 10.05 (Table 3). On average a home delivery costs US dollars 2, while 1000 µg misoprostol costs US dollars 2.75. Cost of hospital stay is US dollars 27.60 per day, patient transportation to a higher referral center is US dollars 5.31 and hydration of a patient is US dollars 4.48. Blood transfusions are generally very expensive and can cost as much as US dollars 63.87. Table 3 shows that the implementation of a comprehensive misoprostol strategy would save US dollars 115,336 per 10,000 births in transport, hospital fees, IV therapy and blood transfusions (Table 3). On average a home delivery costs US dollars 2, while 1000 µg misoprostol costs US dollars 2.75. Cost of hospital stay is US dollars 27.60 per day, patient transportation to a higher referral center is US dollars 5.31 and hydration of a patient is US dollars 4.48. Blood transfusions are generally very expensive and can cost as much as US dollars 63.87. Table 3 shows that the implementation of a comprehensive misoprostol strategy would save US dollars 115,336 per 10,000 births in transport, hospital fees, IV therapy and blood transfusions (range US dollars 13,991–1,563,593 per 10,000 births)27.

**Table 3** Estimation of cost-effectiveness of misoprostol

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Quantity/cost (US dollars)</th>
<th>References</th>
</tr>
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<tbody>
<tr>
<td>Number of TBA needed to attend 10,000 deliveries</td>
<td>83</td>
<td>20, 21</td>
</tr>
<tr>
<td>Cost of 1 home delivery</td>
<td>$2</td>
<td>22</td>
</tr>
<tr>
<td>Cost of 5 day training per TBA, teachers and materials</td>
<td>$10.05</td>
<td>21, 23</td>
</tr>
<tr>
<td>Cost of 1000 µg misoprostol</td>
<td>$2.75</td>
<td>24, 25</td>
</tr>
<tr>
<td>Cost of hospital bed/day</td>
<td>$27.60</td>
<td>—</td>
</tr>
<tr>
<td>Cost of transportation to hospital</td>
<td>$5.31</td>
<td>—</td>
</tr>
<tr>
<td>Cost of IV fluid/IV cannula</td>
<td>$4.48</td>
<td>—</td>
</tr>
<tr>
<td>Cost of blood transfusion</td>
<td>$63.87</td>
<td>21, 26</td>
</tr>
</tbody>
</table>

TBA: trained birth assistants

A joint statement of the International Confederation of Midwives (ICM) and the International Federation of Gynecology and Obstetrics (FIGO), and a 2007 WHO recommendation for the prevention of PPH advocate the use of misoprostol in situations where no oxytocin is available or the birth attendant’s skills are limited. Therefore, misoprostol can play an important part in the strategy to reduce PPH in countries where most births occur in the home (see Chapter 42).

**Surgical management**

As mentioned previously, and noted in several other chapters of this book, the majority of deaths due to PPH occur in the first few hours after the onset of bleeding. It is also true that most bleeding is due to atony which responds to medical management in most instances. However, medical management alone is not always effective and often must be supported by surgical interventions, some of which can be applied in settings which are not fully equipped for abdominal interventions. Of these more simple techniques, tamponades can be effective because they apply pressure at the site of the placental detachment. Commonly used materials for uterine tamponade and described in other chapters of this book are variable length ribbon gauze, condom catheter, Foley catheter, Sengstaken–Blakemore tube, Bakri balloon, etc. Of these, the use of ribbon gauze, condom catheters and Foley catheters are low cost and very effective in low resource settings. In contrast, the Bakri balloon and Sengstaken–Blakemore tube are expensive and not widely available or affordable in developing countries (Table 4). At the other end of the spectrum, major surgical procedures such as internal iliac artery ligation (see Chapter 52), systemic devascularization or obstetric hysterectomies are not only very expensive, but also accompanied by increases in secondary costs due to prolonged hospital stay. Their widespread application is also hampered by the lack of expertise in performing the operations. Uterine artery embolization (see Chapter 49) can also be an effective procedure, but again it is expensive and needs expert radiology facilities.

**Table 4** Cost of surgical equipment and procedures

<table>
<thead>
<tr>
<th>Method</th>
<th>Material/facility needed</th>
<th>Provider of treatment</th>
<th>Cost in India</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ribbon gauze</td>
<td>Can be done in minor OT</td>
<td>Medical officer</td>
<td>Low cost</td>
</tr>
<tr>
<td>Condom catheter</td>
<td>Widely available</td>
<td>Medical officer</td>
<td>Low cost</td>
</tr>
<tr>
<td>Foley catheter</td>
<td>Widely available</td>
<td>Medical officer</td>
<td>Rs 95</td>
</tr>
<tr>
<td>Bakri balloon</td>
<td>Not widely available</td>
<td>Medical officer</td>
<td>Rs 11,000</td>
</tr>
<tr>
<td>Sengstaken–Blakemore tube</td>
<td>Not widely available</td>
<td>Experienced person</td>
<td>Expensive</td>
</tr>
<tr>
<td>B-Lynch suture</td>
<td>Major OT set-up</td>
<td>Medical officer</td>
<td>Moderate cost</td>
</tr>
<tr>
<td>Uterine artery ligation</td>
<td>Major OT set-up</td>
<td>Medical officer</td>
<td>Moderate cost</td>
</tr>
<tr>
<td>Ovarian artery ligation</td>
<td>Major OT set-up</td>
<td>Medical officer</td>
<td>Moderate cost</td>
</tr>
<tr>
<td>Internal iliac ligation</td>
<td>Major OT set-up</td>
<td>Experienced person</td>
<td>Expensive</td>
</tr>
<tr>
<td>Obstetric hysterectomy</td>
<td>Relatively good hospital set-up</td>
<td>Experienced person</td>
<td>Expensive</td>
</tr>
<tr>
<td>Uterine artery embolization</td>
<td>Good hospital set-up with radiology facility in OT</td>
<td>Experienced person</td>
<td>Expensive</td>
</tr>
</tbody>
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OT: operating theater; Rs: rupees
HEALTH CARE INFRASTRUCTURE IN RURAL INDIA

The Indian health care industry (used here as a model of the events occurring in other developing nations) is seen to be growing at a rapid pace and is expected to become a US dollars 280 billion industry by 2020.28 Even so, the vast majority of the country suffers from a poor standard of health care infrastructure, which has not kept up with the growing economy. Despite having centers of excellence in health care delivery, the numbers of such facilities are limited and they are inadequate in meeting the current health care demands. From a practical point of view, it is important to recognize that 40% of primary health centers in India are understaffed. India also faces a huge needs gap in terms of availability of number of hospital beds per 1000 population. With a world average of 3.96 hospital beds per 1000 population, India has a long way to go to bring its present statistic of 0.7 hospital beds per 1000 population to a more reasonable level.

Types of facilities

Three broad categories of facilities are generally available in developing nations: public, private and traditional. The official Indian policy on public facilities requires that there should be one subcenter, or sometimes an aid-post, staffed by one trained nurse (ANM), for every 3000 individuals. These subcenters provide the first point of care, while the primary health centers or community health centers are the next step, leaving the referral hospitals to deal with the most serious health problems. A primary health center serves 20,000–30,000 individuals and has on average five or six medical personnel appointed, including at least one doctor.

Private facilities include a wide variety of options ranging from facilities run by people who have completed their medical training and have additional postgraduate medical degrees, to traditional birth attendants (Daima’s) and pharmacists who in most cases have no formal medical training whatsoever. The degree to which such facilities come under the oversight of any governmental or academic authority is minimal and the quality of care provided varies enormously.

The problem of health care

Delivery of high-quality social services to the poor is never easy, and several factors make it especially difficult. The decision about when and where to seek health care often has very little to do with the nature of the medical condition itself. It often relates to what is available close to a person when help is needed, but it could just as well reflect how the person is feeling about life in general and health in particular. These considerations aside, obtaining health care at any facility depends on a combination of one or more of the following factors: availability or non-availability of doctors at primary health centers; inadequate physical infrastructure and facilities; insufficient quantities of drugs; lack of accountability to the public and lack of community participation; and lack of set standards for monitoring quality care, etc.

STRATEGIES TO PREVENT MATERNAL MORTALITY FROM POSTPARTUM HEMORRHAGE IN LOW RESOURCE SETTINGS

It is important to build strategies to manage preventable causes of maternal death in low resource settings.

Short-term strategies

Prevention where there is a skilled provider

When women give birth with a skilled provider at home or in a hospital facility, up to two-thirds of PPH can be prevented using safe, low-cost, evidence-based practices. Advantages to this set-up are:

1. Skilled health care providers are able to diagnose the risk factors early and accurately;
2. Blood loss can be estimated during delivery;
3. Active management of the third stage of labor (AMTSL) can be provided to all patients in addition to less expensive uterotonics (misoprostol);
4. Cell phone calls to a more experienced health care provider can be made for advice regarding onsite management or early referral to an institution or center with more advanced therapeutic capabilities.

Prevention where there is no skilled provider

About 66% of births in the least developed countries occur in the home without skilled providers to perform AMTSL. In these low resource settings, use of misoprostol can be a life-saving intervention as it is inexpensive, readily available without refrigeration, can be taken orally without supervision of a medical provider, and provides significant reduction in blood loss from acute PPH and acute severe PPH (see Chapters 13–15).

Community-based emergency care or home-based life-saving skills (HBLSS) can be used in settings where there is no skilled provider. Anyone who attends a delivery can be taught simple home-based life-saving skills.

Community-based obstetric first aid with HBLSS is a family and community focused program that aims to increase access to basic life-saving measures and decrease delays in reaching referral facilities. Family and community members are taught techniques such as uterine fundal massage and emergency preparedness. Field tests suggest that HBLSS can be a useful adjunct in a comprehensive PPH prevention and treatment program. Key to the effectiveness of treatment is the early identification of hemorrhage and prompt initiation of treatment.

Long-term strategies

For long-term efficacy, community involvement and development of political will is important. Aspects of such programs include:
(1) **Education of women** Patients in low resource settings generally have a low socioeconomic status. Many are illiterate or have minimal education. Despite this fact, programs that strive to improve pregnancy related morbidity and mortality must include some discussions related to female health education and PPH. Premarital and periconceptional counseling play a vital role in decreasing pregnancy related complications as well as PPH. Girls and young women should be educated regarding the ideal age at marriage, proper spacing of children and correction of anemia before pregnancy or during the antenatal period well before delivery.

(2) **Awareness** The level of awareness regarding the diagnosis and treatment of PPH must increase among health care workers at all levels, and information must be provided to both male and female health workers as well as health assistants and other paramedic staff. Sometimes, involvement of social workers and/or respected personalities from a given locality may help to increase awareness levels.

(3) **Involvement of specialty in district level** Generally almost all of the facilities required for management of PPH are available at the district level. District health officials should make leaflets for attending mothers in the antenatal clinic about the dangers of PPH, correction of anemia, improving nutrition, etc. There should be regular seminars and continuing medical education programs with emphasis on PPH. There should be regular and repeated PPH drills (see Chapter 36) especially involving junior doctors.

(4) **Availability of tertiary care institution** Excellent co-ordination of different departments, experienced doctors, paramedic staff and relevant facilities is the most important treatment component that is available on a 24-hour basis in a tertiary care unit. Any delay in starting treatment in patients referred from a lower level should be avoided.

(5) **Transport/infrastructure** Treatment of PPH and its sequelae demand very rapid action or intervention. Because so many rural communities are truly isolated, not only in India, but also in other developing countries, the most basic arrangements must be thought of in advance. The use of a cell phone method of triage and referral for local transportation has proved useful in many areas of the world where there is no access to ambulances or a 24-hour flying squad with experienced medical and paramedic personnel with basic life-saving support. The use of the NSAG (Chapter 39) is very helpful when the need arises to transport a patient.

(6) **Involvement of government** Strong political will and strengthening health policy for mothers are very important. At the minimum, governments in developing countries should increase health expenditure, strengthen health policies for mothers along with the health infrastructure, increase health awareness, improve the armamentarium of drugs and equipment, and train birth attendants and people in the community with HBLSS.

(7) **Involvement of non-governmental organizations (NGOs)** Involvement of NGOs is very important when governments fail to take the necessary steps, especially in remote areas of the country. Their roles are to help provide necessary funds for increasing health awareness, training birth attendants and training for HBLSS.

(8) **Involvement of professional societies** Local professional bodies such as the obstetrics and gynecological society or national bodies like the Federation of Obstetric and Gynaecological Societies of India (FOGSI) also can take a very important role in decreasing maternal mortality from PPH. Some of their functions include arranging continuing medical education and seminars on PPH throughout the country, performing medical audits, determining the cost-effectiveness of various training programs and assisting the government to determine whether progress is being made towards decreasing mortality from PPH.

(9) **Involvement of international bodies** Organizations such as WHO, FIGO and ICM can play an important role by improving access to knowledge and guidance, providing support, and advocating/facilitating more investment in management and development.

(10) **Emergency obstetric care (EmOC)** The International Conference on Population and Development led the way to an increased understanding of the pathways to avert maternal deaths and disabilities as well as providing strategies to achieve the most favorable results. Although the provision of EmOC is generally accepted as the corner stone of any successful approach to reduce maternal deaths and disabilities, its integration into existing health services and monitoring of its use remain a challenge to existing health systems in developing countries.

The United Nations process indicators describe the vital elements and performance of health systems for women with obstetric complications. EmOC is one of the three-pronged strategies, taken by United Nations Family Planning Association (UNFPA) in the millennium development goals at the Millennium Summit 2000 to reduce maternal mortality, the other two being family planning and skilled attendance at every birth. EmOC refers to a series of functions performed in health care facilities that can prevent the death of a woman experiencing complications of pregnancy. Used properly and in a timely fashion, it can go a long way to averting death from PPH.

To be qualified as a basic EmOC center, the health care provider should be able to administer
intravenous or intramuscular antibiotics, uto-
tonic agents and anticonvulsants. Staff should be
able to perform manual removal of placenta,
assisted vaginal delivery and removal of retained
products of conception. Well-trained nurses and
midwives can perform most functions at basic
EmOC facilities, and most, if not all, of the
requirements can be accomplished in the absence
of an operating theater.

Comprehensive EmOC refers to the ability to
perform a more complex surgical intervention
such as cesarean section to relieve obstructed labor
and the ability safely to collect, screen and store
blood. In general qualified medical personnel and
paramedic staff are required to perform the func-
tions of a comprehensive EmOC facility, as is an
operating theater.

CONCLUSION
Considering the magnitude of the problem and the
fact that PPH is literally a ‘serial killer’ responsible for
the deaths of thousands of women per year, cost-
effective means to combat the problem are of particu-
lar importance to developing nations.

These same considerations mean that information
directed only towards the medical fraternity and health
workers will never be sufficient. A combined effort
involving society organizations, NGOs and doctors to
create awareness and training will go much further in
reducing preventable maternal mortality and prevent-
ning the disruption of family fabric.

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