

# Chapter 3. Levels and Causes of Maternal Morbidity and Mortality

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**Abstract:** In 2013, 289000 maternal deaths took place globally. Maternal mortality has declined by 45% between 1990-2013, and while considerable progress has been made particularly in recent years, it is now extremely unlikely that the goal of reducing maternal mortality by 75% will be met. Women face the higher risk of maternal death in South Asia and Sub-Saharan Africa. The most important direct causes are hemorrhage, hypertension, abortion, and sepsis; however, the proportion of deaths due to indirect causes is increasing everywhere and HIV has a big role to play for mortality in Africa. The most frequent complications are anemia and depression, but prolonged and obstructed labor has the highest burden of diseases because of disabilities associated with fistulas. The risk of maternal deaths has two components: the risk of getting pregnant, which is a risk related to fertility and its control or lack of control; and the obstetric risk of developing a complication and dying while pregnant or in labour. The obstetric risk is highest at the time of delivery. The chapter introduces what is known about the determinants of these risks as well as broader reproductive rights and inter-sectorial approaches. The acceleration of maternal deaths reduction will require improving quality of care in referral and primary health care facilities.

## Introduction

In September 2000, 189 world leaders signed a declaration on eight Millennium Development Goals (MDGs) to improve the lives of women, men, and children in their respective countries (United Nations Millennium Declaration, 2000). Goal 5 calls for the reduction of maternal mortality by 75 percent between 1990 and 2015. Goal 5 was later supplemented by MDG 5b on universal access to contraception. MDGs 5a and 5b have been important catalysts for the achieved reductions in maternal mortality levels in many settings over recent years.

Despite the substantial progress, challenges remain. The majority of low-income countries (LICs) have not made sufficient progress to meet MDG5a, particularly in Sub-Saharan Africa and post-conflict settings. The post-2015 agenda on sustainable development will be broader than the MDG agenda, with a greater number of non-health goals and a strong focus on inequity reduction; the new agenda is likely to include an absolute reduction in maternal mortality as a marker of progress (UN 2013, <http://sustainabledevelopment.un.org/owg.html>). The framing of this new indicator is expected to be in terms of targets for preventable maternal deaths (Bustreo and others 2013; Gilmore and others 2012).

The International Classification of Diseases (ICD 10) defined maternal death as “[The] death of a women while pregnant or within 42 days of the end of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes.” (p.156) (WHO, 2010) Subsequent guidance on the classification of causes distinguished nine groups of underlying causes, from abortive outcomes to

unanticipated complications of management, non-obstetric causes, and coincidental causes (box \_\_. 1) (WHO 2012).

**Box \_\_.1 Underlying Causes of Maternal Deaths**

- Pregnancies with abortive outcome
- Hypertensive disorders
- Obstetric hemorrhage
- Pregnancy-related infection
- Other obstetric complications
- Unanticipated complications of management
- Non-obstetric complications
- Unknown or undetermined
- Coincidental causes

*Source: WHO 2012.*

In spite of the increased global focus on maternal mortality as a public health issue, little detailed knowledge is available on the levels of maternal mortality and morbidity and the causes and reasons for their occurrence. A large proportion of maternal deaths occurs in settings where vital registration is deficient and where many women who are sick do not access services. To obtain data on population levels of maternal mortality in these settings, special surveys are needed, including the following (Abouzahr, 1999):

- RAMOS (Reproductive Age Mortality Study) studies, which investigate all reproductive age deaths
- Demographic and Health (DHS) surveys, which interview women about their sisters' survival in adulthood (the sisters are from the same mother)
- Smaller studies, which use the indirect sisterhood method
- National investigations, which add questions to censuses
- Verbal autopsy studies, which provide information on causes and circumstances of deaths.

Maternal death studies require large sample sizes; recent national level data are often nonexistent, and maternal mortality tracking relies principally on mathematical models. This reliance has led to a repeated call for countries to improve their vital registration systems and to strengthen other mechanisms for informing intervention strategies, such as the Maternal Death Surveillance and Response system proposed within the new accountability framework (WHO 2013). Accountability is a central part of UN Secretary General Ban Ki-Moon's 2010 global strategy to accelerate progress for women's and children's health. The new accountability framework includes recommendations on improvements in resource tracking, international and national oversights and data monitoring (including maternal mortality) (Commission on Information and Accountability for Women's and Children's Health, 2011)

Information on maternal morbidity is frequently collected in hospital studies, which are only representative of the patients who seek care. Community-based studies are rare in low-income

settings and suffer from methodological limitations, particularly when they rely on self-reporting of obstetric complications. Self-reporting is known not to agree sufficiently with medical diagnoses to estimate prevalence. In particular, studies validating retrospective interview surveys have found that women without medical diagnoses of complications during labour frequently reported symptoms of morbidity during surveys, a phenomenon which can lead to an over-estimation of prevalence (Ronsmans et al, 1997). In addition, the focus of community-based studies has been on direct obstetric complications; little is known about the nature and incidence of many indirect complications during pregnancy or the postpartum period, which can also occur in non-pregnant women. For example, reliable population-based estimates of the occurrence of diabetes during pregnancy do not exist in low income settings.

This chapter addresses the **\_\_\_\_\_** In the next section, we use the most recent estimates from the World Health Organization (WHO) to show that women face a higher risk of maternal death in Sub-Saharan Africa. We discuss the recent findings of a WHO meta-analysis, which show that the most important direct causes are hemorrhage, hypertension, abortion, and sepsis; however, the proportion of deaths due to indirect causes is increasing everywhere. We then focus on pregnancy-related complications, including non-fatal illnesses, such as antenatal and postpartum depression, using the findings from systematic reviews conducted by the Child Health Epidemiology Reference Group (CHERG). The most frequent complications are anemia and depression, but prolonged and obstructed labor has the highest burden of diseases because of fistulas, according to the work done by the Institute for Health Metrics and Evaluation (IHME). We discuss the broader determinants of maternal morbidity and mortality, and we conclude by making the links with the interventions highlighted in **chapter x**.

## Maternal Mortality Levels and Trends

The WHO, in collaboration with the United Nations Children's Fund (UNICEF), the United Nations Population Fund (UNFPA), the World Bank, and the United Nations Population Division (UNPD) publishes global estimates of maternal mortality, which is excerpted in this chapter. A complete description on the methodology and underlying data and statistical model can be found in the publication and online at [www.who.int/reproductivehealth/publications/monitoring/maternal-mortality-2013/](http://www.who.int/reproductivehealth/publications/monitoring/maternal-mortality-2013/).

### MMR Levels and Trends, 1990 to 2013

Globally, the total number of maternal deaths decreased by 45 percent from 523,000 in 1990 to 289,000 in 2013. The global MMR declined by 45 percent, from 380 maternal deaths per 100,000 live births in 1990 to 210 in 2013—an average annual decline of 2.6 percent.

All MDG regions experienced a decline in MMRs between 1990 and 2013, with the highest reduction in Eastern Asia (65 percent), followed by Southern Asia (64 percent), Northern Africa and South-eastern Asia (57 percent), Oceania (51 percent), Sub-Saharan Africa (49 percent), Caucasus and Central Asia (44 percent), Western Asia (43 percent), Latin America and the Caribbean (40 percent). Although the Caucasus and Central Asia experienced a relatively low level of decline, its already low MMR of 70 maternal deaths per 100,000 live births in 1990 made it more challenging to achieve the same decline as another region with a higher 1990 MMR value.

Despite an initial increase in maternal mortality in regions highly affected by HIV, evidence suggests that maternal mortality due to HIV peaked in 2005 but then showed signs of decline in 2010 and 2013, most likely due to increased availability of anti-retroviral medication.

Of the 183 countries included in this exercise, 11 countries which had high levels of maternal mortality in 1990 are categorized as “on track”, having reduced maternal mortality by 75%. These are: Maldives (93%), Bhutan (87%), Cambodia (86%), Equatorial Guinea (81%), Lao People’s Democratic Republic (80%), Romania (80%), Timor-Leste (78%), Cabo Verde (77%), Eritrea (77%), Nepal (76%), Rwanda (76%). An additional 63 countries are characterized as ‘making progress’ towards the MDG goal, while 13 countries have made ‘insufficient progress’. There are, however, two countries that have made ‘no progress’.

These estimates should be viewed in context; accurate data on maternal mortality is lacking for the majority of countries. The range of uncertainty indicates that the true total number of maternal deaths in 2013 could plausibly be as low as 221 000 to as high as 405 000. Similarly, the global MMR plausibly ranges from 160 to 290 maternal deaths per 100,000 live births.

## **Disproportionate Burden in Developing Countries**

Developing countries continue to account for 99 percent (286,000) of the global maternal deaths. The MMR in developing regions (230 per 100,000) is 14 times higher than that in developed regions (16 per 100,000). The majority of maternal deaths occur in Sub-Saharan Africa (179,000) and Southern Asia (69,000). Sub-Saharan Africa alone accounts for 62 percent of maternal deaths and has the highest MMR, at 510 maternal deaths per 100,000 live births. Eastern Asia has the lowest among developing regions, at 33 maternal deaths per 100,000 live births. Of the remaining MDG developing regions, four had low MMR: Caucasus and Central Asia (39); Northern Africa (69); Western Asia (74); and Latin America and the Caribbean (85). Three had moderate MMR: South-eastern Asia (140); Southern Asia (190); and Oceania (190). The adult lifetime risk of maternal mortality, the probability that a 15-year-old woman will die eventually from a maternal cause in Sub-Saharan Africa is the highest at 1 in 38; this number is in contrast to 1 in 140 in Oceania; 1 in 200 in Southern Asia; 1 in 310 in South-eastern Asia; and 1 in 3,700 among women in developed countries. The global adult lifetime risk of maternal mortality is 1 in 190.

At the country level, two countries account for 31 percent of global maternal deaths: India At 17% (50 000) and Nigeria at 14% (40 000). Four countries account for 3 percent to 7 percent of global maternal deaths: Democratic Republic of the Congo (21,000), Ethiopia (13,000), Indonesia (8800), Pakistan (7900), the United Republic of Tanzania (7900). Together with Kenya (6300), China (5900), and Uganda (5900) these 10 countries account for 58 percent of the global maternal deaths estimated to occur in 2013.

Of all the 183 countries and territories covered in this analysis, Chad and Somalia also have the highest adult lifetime risk of maternal mortality at 1 in 15 and 1 in 18, respectively.

The estimated lifetime risk for maternal mortality in high-income countries is 1 in 3400 in comparison to low-income countries where the risk is 1 in 52.

**Box 2: HIV Infection and Maternal Mortality**

The consideration of maternal deaths among HIV-infected women is a separate but related estimation process. Worldwide, in 2013, an estimated 7500 maternal deaths were attributed to HIV (an indirect cause of maternal deaths as the condition usually pre-exists pregnancy and this cause of death is not specific to pregnant women only); 6800 (91 percent) of these deaths were in Sub-Saharan Africa. Southern Asia was a distant second, with less than 400 deaths. The proportion of maternal deaths was attributed to HIV was highest in Sub-Saharan Africa (3.8 percent) and the Caribbean (2.8 percent). Without HIV, the MMR for Sub-Saharan Africa would be 491 maternal deaths per 100,000 live births, rather than 510.

Eight countries have a proportion of HIV-attributable maternal deaths of 10 percent or more: South Africa (41.4); Botswana (23.5); Swaziland (18.6); Zambia (15.4); Lesotho (14.8); Namibia (13.9%); Mozambique (13); Gabon (10.4).

HIV alone accounted for 5.5 percent (3.8-7.6) of global maternal deaths. Underreporting and misclassification of indirect maternal deaths due to HIV/AIDS are particularly problematic in death certificate coding and when countries rely on verbal autopsy to ascertain cause of death. This highlights the need for review of deaths of HIV-infected women temporal to pregnancy; the women may die from HIV or with HIV while pregnant. As methods for global maternal death estimation evolve, the evidence for the parameters needed to estimate indirect maternal HIV deaths and further clarification on the use of ICD-10 codes will standardize and improve our understanding of maternal and HIV death tallies.

## Medical Causes of Maternal Deaths

Complementing the work of estimating the number of maternal deaths, the WHO focused on elucidating the understanding of their causes. Most maternal deaths do not have a well-defined cause. Nevertheless, using the available data, nearly 73 percent of all maternal deaths between 2003 and 2009 were attributable to direct obstetric causes; deaths due to indirect causes accounted for 27.5 percent (95 percent CI, 19.7-37.5) of all deaths. The major causes of maternal mortality, in descending order, are as follows (Say et al, 2014):

- Hemorrhage, 27.1 percent (19.9-36.2); more than two thirds (72.6 percent) of deaths from hemorrhage were classified as postpartum hemorrhage
- Hypertension, 14.0 percent (11.1-17.4)
- Sepsis, 10.7 percent (5.9-18.6)
- Abortive outcomes, 7.9 percent (4.7-13.2)

- Embolism and other direct causes, 12.8 percent.

The following three causes of deaths (abortive outcomes, obstructed labor and indirect causes) are of considerable programmatic interest but are particularly difficult to capture.

### **Deaths from Abortive Outcomes**

Say et al's study (2014) estimates that 7.9 percent (4.7-13.2) of all maternal deaths were due to abortive outcomes, including spontaneous or induced abortions and ectopic pregnancies. This percent is lower than previous assessments, which estimated mortality due to unsafe abortion at 13 percent. In classifying maternal deaths due to abortion, and more specifically to unsafe abortion - defined as "termination of an unintended pregnancy carried out either by persons lacking the necessary skills or in an environment which does not conform to minimal clinical standards or both" (WHO, 1993)- there is a particular risk for misclassification, which may lead to underreporting. The ICD does not have a specific code for unsafe abortion; accordingly, deaths attributed to unsafe abortion are often documented within special studies. Even where induced abortion is legal, the religious and cultural values in many countries can mean that women do not disclose abortion attempts, and relatives or health care professionals do not report these deaths as such. Underregistration of deaths may be the result of the stigmatization of abortion, which affects the information reported by relatives and informants, and which may result in intentional misclassification by providers where abortion is restricted.

### **Deaths from Obstructed Labor**

Obstructed labor is commonly considered or diagnosed as a clinical cause of maternal death. However, in terms of death classification, it may be hard to capture because deaths occurring after obstructed labour and its consequences may be coded under hemorrhage or sepsis. This practice is especially problematic in settings where verbal autopsies are used to determine cause of death, because verbal autopsy methods vary; a lack of consistent case definitions and confusion regarding hierarchical assignment of causes affects the validity of the study data. In total, complications of delivery accounted for 2.8 percent (1.6-4.9), and obstructed labor accounted for 2.8 percent (1.4-5.5) of all maternal deaths globally, both reported within the "other direct" category, which totals to 9.6 percent (6.5-14.3).

### **Deaths from Indirect Causes**

The review found that when combined, the indirect causes of maternal death are now the most common cause of maternal death. Breakdown of deaths due to indirect causes suggests that over 70 percent of indirect causes is from preexisting medical conditions, including HIV, exacerbated by pregnancy. However, these estimates should be considered carefully, given the phenomenon of misattribution of indirect maternal causes of death. Underestimation of 20 percent to 90 percent of maternal deaths has been described in a number of settings. In Austria, misclassification was significantly higher for indirect deaths (81 percent, 95 percent CI 64–91 percent) than direct deaths (28 percent, 95 percent CI 21–36 percent), while in the United Kingdom, indirect deaths may account for up to 74 percent of underreported maternal deaths from 2003–05 (Karimian-Teherani et al (2002); CEMCH, 2007)

## Global Distribution of Maternal Deaths

The global distribution was influenced by the two regions, Sub-Saharan Africa and Southern Asia, which account for [Q: 85 percent on page 3] of all maternal deaths (WHO, 2012b). While estimated regional cause of death distribution (CoDDs) are quite uncertain for many causes, point estimates show substantial differences across regions. Hemorrhage accounted for 36.9 percent (24.1-51.6) of deaths in the Northern Africa, yet only for 16.3 percent (11.1-24.6) in developed regions.

Hypertensive disorders were a particularly important cause of death in Latin American and the Caribbean, contributing 22.1 percent (19.9-24.6) of all maternal deaths in the region. Almost all sepsis deaths occurred in the developing countries, and the percentage of deaths was highest at 13.7 percent (3.3-35.9) in Southern Asia. Only a small proportion of deaths are estimated to result from abortion in Eastern Asia, 0.3 percent (0.2-2.0), where access to abortion is generally less restricted. Latin America and the Caribbean, and Sub-Saharan Africa, have a higher proportion of deaths in this category than the global average, 9.9 percent (8.1-13.0) and 9.6 percent (5.1-17.2), respectively. Another direct cause, embolism, accounted for more deaths than global average in South-eastern Asia and Eastern Asia, 12.1 percent (3.2-33.4) and 11.5 percent (1.6-40.6), respectively.

The proportion of deaths due to indirect causes was highest in Southern Asia, 29.3 percent (12.2-55.1); followed by Sub-Saharan Africa, 28.6 percent (19.9-40.3); indirect causes also accounted for more than one-fourth of the deaths in the developed regions. The overall proportion of HIV maternal deaths is highest in sub-Saharan Africa, 6.4 percent (4.6-8.8 percent).

## Trends

The continued dearth of basic information in most LICs, where most of the deaths occur, impedes the ability to address the question of changes in causes of maternal deaths over time. In determining trends in maternal deaths, it is reasonable to conclude that the proportion of indirect deaths is increasing in all regions. The actual indirect causes differ, in that HIV deaths are highest in Sub-Saharan Africa, but other medical causes are highest in developed regions and Eastern Asia.

## Medical Causes of Maternal Morbidity

### Perceived Morbidity

Where women do not access services easily, surveys are conducted to measure their health status. Diagnoses are difficult to make with accuracy in survey conditions without confirmation from a clinical examination, laboratory reports, or medical records (Ronsmans and others 1997). However, surveys provide evidence of women's lived experience of health and morbidity during pregnancy. Overall, many women complain about ill health in pregnancy and the puerperium. Studies of self-reports in low-income settings typically find that above 70 percent of women reports signs or symptoms of a pregnancy-related complication (Lagro and others 2003). In a Nepal study, women reported, on average, three to four days per week with symptoms of illness during the pregnancy (Christian and others 2000). The type of symptoms reported varied according to gestational age, with nausea and vomiting more common in early pregnancy, and swelling of the hands and faces more common toward the end of the pregnancy. Counterintuitive changes in self-reported ill health have been described for the postpartum period, with anticipated declines in symptoms over time sometimes followed by rises (Filippi and others 2007; Saurel-Cubizolles and others 2000), as self-



perceived ill health is not simply a result of biological changes but also of social support and influences.

## **Severity of Conditions**

Since the early 1990s, maternal health specialists have tried to distinguish between women with severe and less severe conditions in their measurement of morbidity (Stones and others 1991). Maternal deaths are relatively rare events, and they believe that cases at the very severe end of the maternal morbidity spectrum have two useful characteristics: they are more frequent than maternal deaths, and they share useful similar characteristics to maternal deaths, including some common risk factors. Women who nearly died during pregnancy, labor, or post-pregnancy, but survived, usually because of chance or good hospital care, are maternal “near-misses” (WHO 2011). Depending on the definitions used and on the country and hospital settings, maternal near-misses occur for 0.05 to 15 percent of hospitalized women (Tuncalp and others 2012). The WHO has recently developed operational definitions of near-misses to facilitate comparisons between settings (WHO 2011).

Nevertheless, it is worth noting that the cause patterns of maternal mortality, near-misses, and less severe morbidity differ, depending on the case fatality of certain conditions and the ease of halting the progression of disease (Pattinson and others 2003).

## **Definition of Maternal Morbidity**

The WHO Maternal Morbidity Working Group (MMWG) defines maternal morbidity as “any health condition attributed to and/or aggravated by pregnancy and childbirth that has a negative impact on the woman’s wellbeing” (Firoz and others 2013, page 795). The MMWG emphasises the wide range significance of indirect conditions in the morbidity that women experience during pregnancy, delivery, or post-pregnancy by listing and dividing more than 180 diagnoses into 14 organ dysfunction categories, ranging from obstetric to cardio-respiratory and rheumatology conditions.

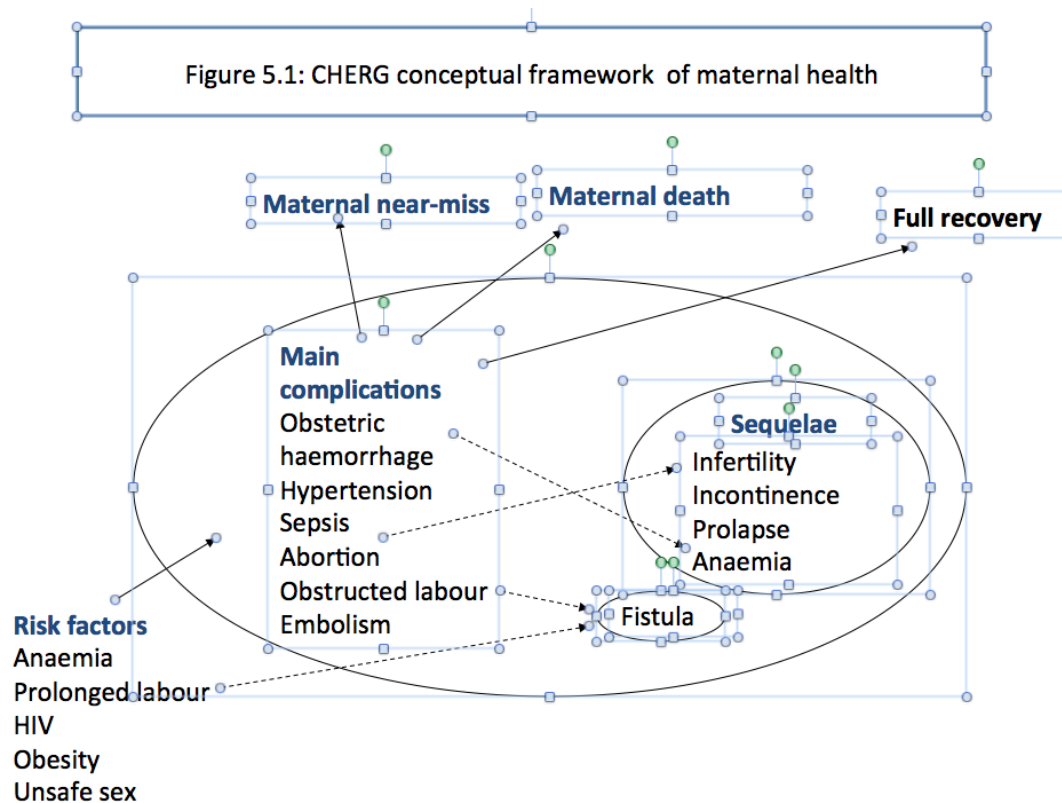
The negative impact of pregnancy-related ill health is also highlighted on the basis of subsequent disabilities, including how severely the functional status is affected and for how long. While the origins of maternal morbidity occur during pregnancy, the sequelae might take several months to manifest themselves. This is a major difference from maternal mortality, where deaths are counted during pregnancy and up to one year after pregnancy, but more frequently within 42 days. To capture the negative impact of morbidities requires a longer reference period than expressed in the death definition.

## **Principal Morbidity Diagnoses**

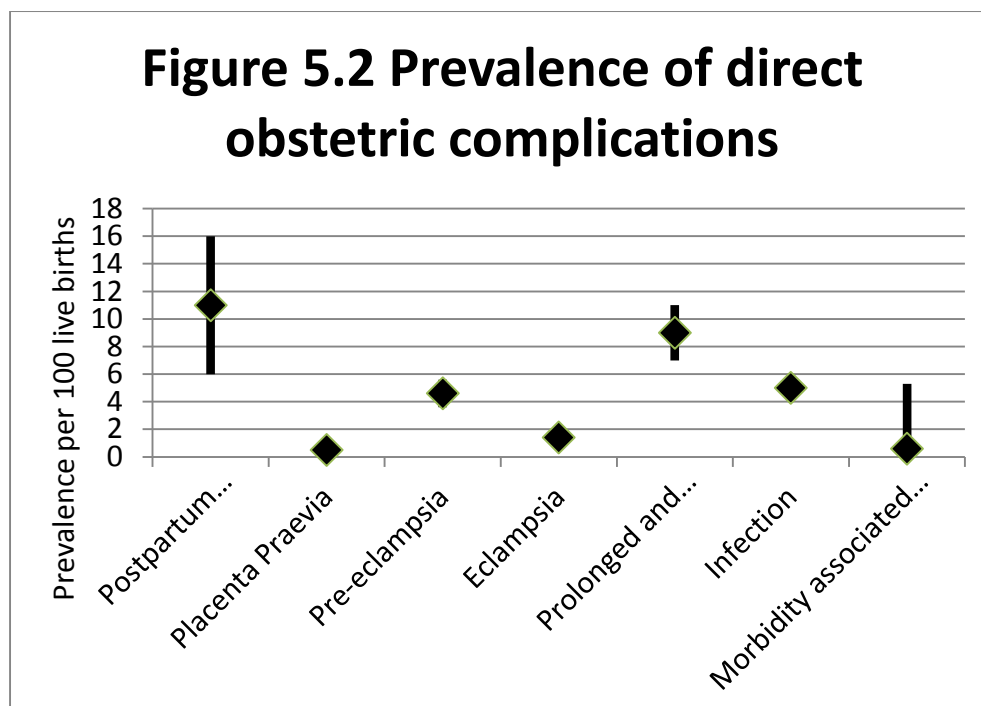
The principal medical causes of mortality are also important morbidity diagnoses, but they are not the only ones to consider. To this list must be added other contributing factors to mortality, such as depression and anemia, because of their frequency or severity. We must also add the sequelae of difficult labor, such as incontinence, fistulas, and prolapse. A further consideration is the presence of comorbidities, which complicate the management, diagnosis, and classification, such as obstructed labor followed by infection.

**Figure 4.1** includes a conceptual framework used by the CHERG on how different maternal conditions interact. Long-term health sequelae are associated with certain diagnoses in pregnancy. For example, neglected obstructed and prolonged labors are associated with obstetric fistulas. Also

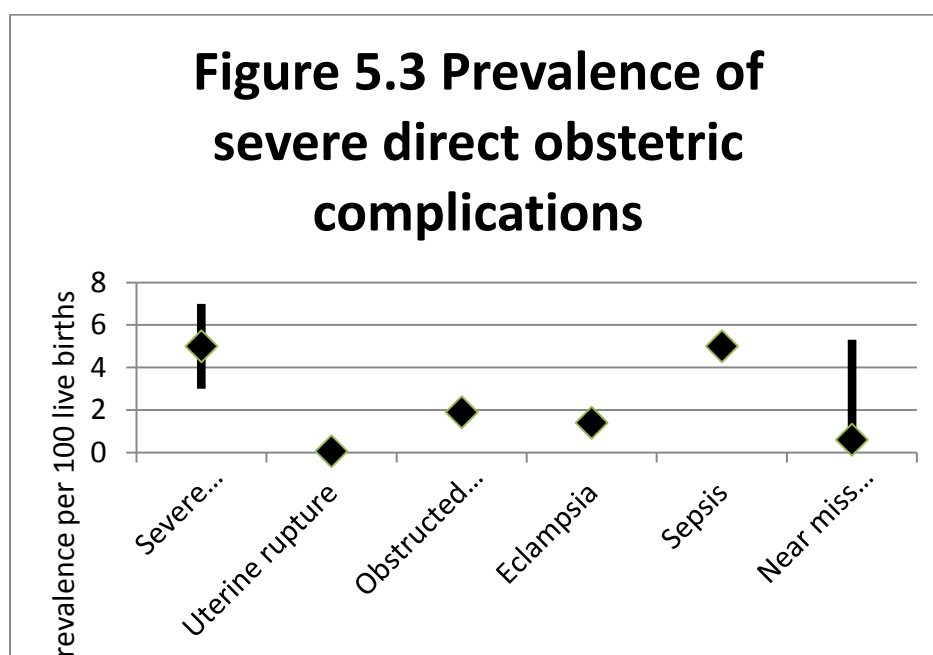
included in the conceptual framework are medical risk factors. One of these, obesity, has reached a global epidemic and has been linked with increasing levels of hypertension and diabetes. The management of pregnancy and childbirth, including cesarean section, is also a risk factor for future problems, for example, placenta previa. Female genital mutilation is associated with adverse maternal and perinatal outcomes, including postpartum hemorrhage and emergency caesarean, particularly in its most severe form (WHO Study Group 2006).



This section focuses on 10 groups of diagnoses that can lead to direct obstetric deaths or associated long-term ill health (see [chapter x](#)): pregnancy with abortive outcomes, hypertensive diseases of pregnancy, obstetric hemorrhage, pregnancy-related infections, obstructed and prolonged labor, anemia, fistulas, postpartum incontinence, postpartum prolapse, and postpartum depression. There are other important indirect conditions that we do not consider here, but which are discussed in other DCP volumes, including HIV, TBs, STIs and Malaria [[Q: Insert volume number](#)] in pregnancy. [Figures 4.2 and 4.3](#) summarize the prevalence of the considered conditions.



Source:



Source:

## Abortive Outcomes

Morbidity with abortive outcomes comprise several diagnoses including ectopic pregnancy, abortion, and miscarriage, as well as other abortive conditions (WHO 2013) (box 5.2).

**Ectopic Pregnancy.** Although ectopic pregnancy can have very serious morbidity and mortality consequences, and there have been reports of increased incidence over time, it remains a rare event

(less than 2 per 100 deliveries) (Stulberg and others 2013). This condition has a high case fatality where urgent surgical care is not available. However, no systematic review of its global prevalence has been published since the 1980s.

***Induced Abortion.*** Induced abortion is a very safe procedure, safer than childbirth when performed in a suitable environment and with the right method. Among unsafe abortions, the morbidity and mortality burden is large. Information on the incidence of unsafe abortion and subsequent outcomes at the population level is particularly challenging to obtain because of fear of disclosure. On the basis of estimates derived from hospital data (adjusted for bias in such data), an estimated 22 million unsafe abortions occur every year (WHO 2011); of these, an estimated five million women are subsequently hospitalized (Singh 2006), mostly because of bleeding (44 percent of admitted cases) or infections (24 percent) (Adler and others 2012a). On average, 237 women experience a severe maternal morbidity associated with induced abortion for every 100,000 live births in countries where abortion is unsafe (Adler and others 2012b). Evidence indicates that the morbidity patterns associated with unsafe abortion are being transformed by the rapid growth of the medical abortion market, with the incidence of severe morbidity episodes declining more rapidly than the incidence of less severe episodes (Singh and others 2012).

## Box \_\_.2 Definitions of Obstetric Causes of Maternal Morbidities and Deaths

**Abortive outcomes** include abortion, miscarriage, ectopic pregnancy, and other abortive conditions (WHO 2013). Abortive outcomes take place before 28 weeks during pregnancy, but this time definition varies among countries, with lower cutoffs of 24 weeks used.

**Preeclampsia** is characterized by high blood pressure and protein in the urine; women are diagnosed with **eclampsia** when the preeclampsia syndrome is associated with convulsions.

**Obstetric hemorrhage** refers to anomalous or excessive bleeding because of an early pregnancy loss, a placental implementation abnormality (including placenta previa or placental abruption) or because of an abnormality in the process of childbirth.

**Pregnancy-related infections** include puerperal sepsis, infections of genitourinary tract in pregnancy, other puerperal infections, and infections of the breast associated with childbirth (WHO 2013).

**Prolonged labour** is labor lasting more than 12 hours, in spite of good uterine contractions and good cervix dilatation. In **obstructed labor**, the fetal descent is impaired by a mechanical barrier in the birth canal, despite good contractions (WHO 2008). Causes of obstructed labor include cephalopelvic disproportion, abnormal presentations, fetal abnormalities, and abnormalities of the reproductive tract.

*Sources:* WHO 2008, 2013.

## Hypertensive Diseases

Women in pregnancy or the puerperium can suffer from preeclampsia, eclampsia, and chronic hypertension. Eclampsia and preeclampsia tend to occur more frequently in the second half of pregnancy; less commonly, they can occur up to six weeks after delivery. While medication can alleviate the symptoms and their negative effects, the only cure for the pregnant woman is expedited delivery. The etiology of the condition remains unclear.

According to a recent systematic review, the global prevalence of preeclampsia is 4.6 percent (CI 2.7-8.2), and the prevalence of eclampsia is 1.4 percent (CI 1.0-2.0) (Abalos and others 2013). The review found evidence of regional variation, with Sub-Saharan Africa having the highest incidence of eclampsia and preeclampsia. Preeclampsia and eclampsia are more common among women in their first pregnancy, women who are obese, women with preexisting hypertension, and women with diabetes. All of these characteristics are increasingly more common in pregnant populations. Preeclampsia and eclampsia are associated with perinatal deaths, abruption placenta, and cardiovascular disease in later life.

## Obstetric Hemorrhage

Women can experience anomalous or excessive bleeding because of an early pregnancy loss, a placental implementation abnormality, and an abnormality in the process of childbirth. The systematic review by Cresswell and others (2013) found a global prevalence of 0.5 percent for placenta previa (CI: 0.4-0.6). An equivalent systematic review for placental abruption has not been published, but most papers on this condition suggest an approximate prevalence of 1 percent (Ananth and others 1999).

Postpartum hemorrhage is a major cause of maternal morbidity worldwide. A systematic review found a global prevalence of blood loss equal to or greater than 500 ml of 10.8 percent in vaginal deliveries (CI:9.6-12.1) (Calvert and others 2012); the prevalence of severe hemorrhage (equal to or greater than 1,000 ml) was 2.8 percent (CI:2-4-3.2). The review includes many study settings in which active management of the third stage of labor is practiced. The prevalence of postpartum hemorrhage in home deliveries is probably higher. Postpartum hemorrhage is associated with anemia, which can persist for several months after birth (Wagner and others 2011)

Recent years have witnessed increasing trends in the incidence of hemorrhage in high income settings ( Mehrabadi and others 2013). This trend has been linked to changes in risk factors, such as pregnancies at older ages, obesity, and previous caesarean delivery, as well as to better data capture systems (Kamara and others 2013). These risk factors are also increasingly more common in LICs.

## Pregnancy-Related Infections

Puerperal sepsis is the pregnancy-related infection that causes the greatest concern because of its severity. There has been no recent published review of the prevalence of sepsis since the work conducted in early 2000s for the Global Burden of Diseases (Dolea and Stein 2003). In this review, Dolea and Stein calculated that the incidence of sepsis ranged from 2.7 and 5.2 per 100 live births according to world region. Since then, a recent community-based study in India found that the incidence of puerperal sepsis in the first week postpartum was 1.2 percent after home delivery and 1.4 percent after facility-based delivery. The incidence of fever was higher at 4 percent overall in the same Indian study (Iyengar 2012). Another study in India found a high incidence of puerperal infections at home (10 percent) and of fever (12 percent), but the study used broader definitions and followed women for 28 days (Bang and others 2004). Risk factors for infections include HIV and cesarean section.

## Prolonged and Obstructed Labor

An unpublished systematic review by Adler and others yielded only 16 published population-based studies of obstructed and prolonged labor worldwide since 2000. The studies could not be combined through meta-analysis to obtain a global prevalence because of high heterogeneity, which was largely attributed to differences in case definitions. However, the median prevalence was estimated to be 1.9 per 100 deliveries for obstructed labor, and 8.7 per 100 deliveries for combined obstructed and prolonged labor. A systematic review of articles from 1997-2002 reporting on uterine rupture found extremely low prevalence in the community setting (median 0.053, range 0.016-0.30 percent), but it included a study with self-reporting, which tends to overestimate the prevalence of rare conditions (Hofmeyr and others 2005).

## Anemia

Anemia—when the number of red cells or hemoglobin (Hb) concentration has reached too low a level in the blood—is a commonly diagnosed condition during pregnancy or the postpartum period. Its main symptoms include excessive fatigue; it can contribute or lead directly to a maternal death when Hb concentration has reached particularly low levels. Anemia has many different causes, including blood loss; infection-related blood cell destruction; and deficient red blood cell production because of sickle cell disease, parasitic diseases such as hookworm or malaria, nutritional deficiency, including iron deficiency.

During pregnancy, anemia is diagnosed when Hb levels are below the threshold of 11 g/dl. Anemia is classified as severe when the levels reach 7 g/dl. Anemia is well-documented in low-income settings thanks to the ease of collecting hemoglobin levels by lay fieldworkers in survey conditions. Using 257 population-based data sets for 107 countries, Stevens and others (2013) estimate that globally 38 percent (CI:34-43) of pregnant women have anemia, and 0.9 percent (CI:0.6-1.3) have severe anemia. Pregnant women in Central and West Africa appear particularly affected (56 percent are anemic, and 1.8 percent are severely so). However, global prevalence trends have improved since 1995 (Stevens and others 2013). The review by Wagner and others (2012) demonstrated that women who suffer severe blood loss during childbirth may remain anemic for several months during the postpartum period.

## Postpartum Depression

Mental health disorders during pregnancy and the postpartum period include conditions of various severity and etiology, ranging from baby blues to postpartum depression and puerperal psychosis, as well as post-traumatic stress disorders linked, for example, to the death of a baby. The most common of these disorders is depression, which is associated with pregnancy-related deaths by suicide and with developmental delays in children.

Most studies ascertain depression through screening questionnaires for psychological distress; the most popular tool is the Edinburgh Postnatal Depression Scale, which has been translated into many languages and used in many different cultures. These screening questionnaires are not equivalent to clinical diagnoses by medical providers; rather, they indicate a high probability of depression among those who score highly.

In contrast with most other maternal morbidities, depression is a well-studied area, with a number of systematic reviews and meta-analyses, supported by large numbers of papers, although only a small proportion of these articles is from developing countries. The most recent of these reviews calculated that in low-and-middle-income countries (LMICs), the prevalence of depression and anxiety was 16 percent (CI:15-17 percent) during pregnancy, and 20 percent (CI:19-21 percent) during the postpartum period (Fisher and others 2012). Halbreich and Karkun (2006), who conducted the most comprehensive systematic review to date from a geographical perspective, found a broader range of prevalence of depression (0 percent to 60 percent). They attribute this wide range to cultural differences in the reporting and in the understanding of depression, as well as differences in tools and other methodological approaches. However, they also conclude, in view of the wide ranges in the estimates, that the prevalence of depression is high and that the widely cited prevalence of 10 percent 15 percent is not representative of the actual global prevalence.

## Incontinence

Incontinence is any involuntary loss of urine. The most common form of urinary incontinence during and after childbirth is stress urinary incontinence, which consists of involuntary leakages on exertion or effort.

Little information is available on the incidence of incontinence in the postpartum period in LMICs. However, Walker and Gunasekera (2011) found four studies of reproductive-age women published between 1985-2010, in which the prevalence ranged from 5 percent to 32 percent. Another systematic review calculated the following mean pooled estimates for all types of incontinence during the first three months postpartum to be 33 percent for parous women and 29 percent for primiparous women (Thom and Rortveit 2010). In addition, they found that the risk was higher for vaginal birth (31 percent) than for the caesarean births (15 percent), as reported in several case controls studies. Although the authors attempted to obtain information for all countries, no papers from LICs were included.

## Obstetric Fistula

Obstetric fistula results in the continuous loss of urine or fecal matter, occurring both day and night. It has been described as a condition worse than death in view of its medical manifestation, treatment difficulties, and social consequences (Lewis Wall 2006). It occurs when labor is obstructed, and contractions continue with the baby's head stuck in the pelvis or vagina; caesarean section is usually required to deliver the baby (Lewis Wall 2012). As a result of the severe delay in delivery and continuous pressure of the fetal head on maternal tissues, blood flow is blocked resulting in necrosis. This leaves abnormal gaps (or communications) between the vagina and bladder or rectum, allowing urine or stool to pass continuously through the vagina. The meta-analysis by Alder and others of the incidence of fistula in LMICs found a pooled incidence was 0.09 (95 percent CI 0.01, 0.25) per 1,000 recently pregnant women. The condition is extremely rare in HICs, where there are few delays in obtaining good quality maternity care.

## Postpartum Vaginal or Uterine Prolapse

Pelvic organ prolapse is defined as the symptomatic "descent of one or more of: the anterior vaginal wall, the posterior vaginal wall, and the apex of the vagina or vault." (Haylen and others 2010) (page 8). In lay terms, it is when a "descent of the pelvic organs result in the protrusion of the vagina, uterus, or both" (Jelovsek and others 2007) (page 1027). Incidence increases with age, parity, and body mass index (BMI). Hard physical labor is also a risk factor. Prolapse is among the global burden of disease's most common sequelae, with a prevalence of about 9.28 percent. Few population-based incidence studies measured prolapse after childbirth; there is a lack of agreement as to what constitutes a significant prolapse; a grading system exists, but it requires clinical interpretation. In Burkina Faso, 26 percent of women with uncomplicated facility-based deliveries received a diagnosis of prolapse in the postpartum period (Filippi and others 2007). In Gambia, a population-based study with physical examinations found that 46 percent of women ages 15 to 54 years had prolapse, and 14 percent had moderate or severe prolapse (Scherf and others 2002). Severe prolapse affects quality of life and is associated with depression (Zekele and others 2013).

## HIV

A positive HIV status is linked to an increased risk of death in pregnant and non-pregnant women (Zaba and others 2013). A recent systematic review suggests that HIV-infected women had eight



times the risk of a pregnancy-related death, compared with HIV-uninfected women; the excess mortality attributable to HIV among HIV-infected pregnant and postpartum women was close to 1,000 deaths per 100,000 pregnant women. The excess mortality attributable to HIV in pregnant women is much smaller than in non-pregnant women, however, probably because women who become pregnant tend to be healthier. A review that investigated the interaction between HIV status and direct obstetric complications showed that women who are HIV positive are 3.4 times more likely to develop sepsis (Calvert and Ronsmans 2013). The evidence of positive links for hypertensive diseases of pregnancy, dystocia, and hemorrhage was variable.

## **Global Burden of Diseases**

The prevalence of conditions, as well as the prevalence, severity (or “disability weight”), and the duration of their respective sequelae, are key factors in establishing the burden of various conditions in a population and in prioritizing them. Some conditions are noteworthy because they are very severe and are associated with high risk of deaths in the mother or the baby, for example, uterine rupture. A few severe conditions, despite being rare, can last a very long time and have a severe impact on women’s life, for example, fistula.

The GBD 2010 findings suggest that there has been a decrease in the absolute number of DALYS associated with maternal conditions (Lozano 2012; IHM 2013), owing to lower maternal mortality rates, but an overall increase in the number of the global years lived with disabilities. The increase in disabilities is mostly due to obstructed labor, hypertension, and indirect conditions (Vos and others 2012), but it is also due to the high population growth rate, which means that the total number of women in the reproductive age rises over time.

## **Proportion of Major Pregnancy-Related Complications**

A recent longitudinal study has shown that women who had initially survived severe complications were more likely to die within the next five years than other women (Storeng and others 2012). Many of these deaths occur in subsequent pregnancies, indicating that a small number of women, often those with chronic illnesses, cumulate pregnancy-related risks. But what proportion of women suffers a major complication during pregnancy, taking into account various comorbidities? WHO and Columbia University have suggested 15 percent prevalence as a benchmark for their indicators of met need for complication. However, this number has not been validated, except possibly by a study in India (Bang and others 2004). If all of the acute direct complications with non-abortive outcomes mentioned were mutually exclusive, the total prevalence could be as high as 31 percent.

## **Broader Determinants of Maternal Mortality and Morbidity**

This section presents an overview of the broader determinants for maternal mortality and highlights the specificities of maternal health by introducing an established conceptual framework and other classification approaches. As with other health conditions, determinants include characteristics of the social, legal, and economic contexts; individual risk factors, such as women’s age and parity; and the physical environment, for example, water sources and geographical accessibility; some of these have more salience in maternal health.

## **Significant Individual Risk Factors**

Descriptive studies have demonstrated that women face the highest risk of pregnancy-related death and severe morbidity (Hurt and others 2008) when they are very young or older (Graham and Airey, 1987), when they are expecting their first baby or when they have had many pregnancies, when they live far away from health facilities, or when they do not benefit from support from their family and friends (Mbizvo and others 1993). **Table 5.1** illustrates some of maternal mortality main determinants and how they influence women's chances of survival during pregnancy or childbirth.

<<Insert table 5.1 about here>>

We consider two additional important facets of maternal mortality when discussing determinants and interventions to reduce deaths.

- The risk of maternal deaths has two components: the risk of getting pregnant, which is a risk related to fertility and its control or lack of control; and the obstetric risk of developing a complication and dying while pregnant or in labour. The obstetric risk is highest at the time of delivery. The determinants of these risks share many similarities, but also have specificities.
- While the overall risks of maternal death are highest among adolescents and older women of reproductive age the highest number of death is in the middle group of women around 25 years of age. It would be simplistic not to consider the determinants of normal childbearing when women are in their prime reproductive years.

### **The Three Delays Model**

Conceptual models guide research and practice and help decide how best reduce adverse outcomes, by grouping determinants and highlighting their linkages with events in the pathway from health to death. In safe motherhood, the three delays model is the most dominant model and has been extensively quoted in peer-reviewed and research articles (Thaddeus and Maine 1994). Its main attraction is its simplicity and action-oriented presentation. The model is based on the following premises:

- Maternal complications are mostly emergencies.
- Maternal complications cannot be predicted with sufficient accuracy.
- Maternal deaths are largely preventable through tertiary prevention (preventing deaths among women who have been diagnosed with a complication).

At the 1987 launch of the Safe Motherhood Initiative, a group of maternal health experts discussed how long women had for each complication before they would die, if untreated. They agreed that in the case of the most frequent complications, women with postpartum hemorrhage had less than two hours before death; for antepartum haemorrhage, eclampsia, obstructed labor and sepsis, the times would be 12 hours, 2 days, 3 days and 6 days, respectively. This consensus, to some extent has been validated by a case control study in India (Ganatra and others 1998).

The model has three levels of delay:

- The first delay is the time elapsed between the onset of a complication and the recognition of the need to transport the patient to a facility.
- The second delay is the time elapsed between leaving the home and reaching the facility.

- The third delay is the time elapsed from presentation at the facility to the provision of appropriate treatment.

Each of these delays has a distinctive set of determinants. For example, the determinants of the first delay are related to the individual circumstances of the women and their families, who must first recognize that care is needed and then be able to access transport or money to travel to facilities. The determinants of the second delay are concerned with the physical environment, the type of transport, and quality of the road, as well as the performance with the referral system between facilities. The determinants of third delay are related to quality of care, such as the number and training of staff members and the availability of blood supplies and essential equipment. While the action and characteristics of women and families can influence the length of the third delay, for example, by helping to mobilize elements of the surgical kits for cesarean delivery by purchasing missing supplies in pharmacies (Gohou and others 2004), most of the determinants of the third delay are related to service provision.

The three delays model has weaknesses. It does not include the concept of primary prevention (avoid pregnancy) and secondary prevention (avoid a complication once pregnant). Therefore it ignores family planning, noncommunicable chronic diseases, antenatal care and postpartum care. Implicitly, it also assumes that complications arise at home, where women intend to give birth, whereas increasing number of women now delivers in facilities (Filippi and others 2009). In addition, it does not consider the newly identified “fourth delay” which arises when women are discharged unwell or chronically ill from facilities and die at home during the post-pregnancy period or in the next one (Storeng and others, 2012; Pacagnella and others 2012).

## **Rights-based Approaches**

The rights-based approach, which is primarily concerned with the legal, cultural and social context of service accessibility and delivery, is an approach to understanding the determinants of maternal health which has been gaining a higher profile with the introduction of MDG 5b. It began with the observation that most maternal deaths are avoidable, as illustrated by the wide divergence in Life Time Risks of maternal deaths (the probability that a 15 year old woman will die of a pregnancy related causes) between HICs (one in 3700) and LMICs (one in 160) (WHO, 2014), and rich and poor women; that a considerable evidence-based literature exists with respect to effective clinical interventions; and finally that the reduction of maternal mortality is firmly imbedded in women’s ability to control the occurrence and timing of pregnancy (Freedman 2001). Most maternal deaths are not simply a biological phenomenon; many are at least explained by the lack of *freedom and entitlements* experienced by women and service providers, as well as by the lack of accountability of providers, health systems and countries towards women and their families (Freedman 2001; PMNCH 2013). The concept of *freedom* refers for example to the right of women to control their bodies, including their reproductive options, and to have access to acceptable and effective family planning services, including safe abortions. *Entitlements* are concerned with access to good quality services, which must be evidenced-based and respectful, and also emphasises equity in access for all women who need care, whether they are rich or poor, married or single.

The accessibility and availability of good quality family planning and legal abortion services are key determinants of maternal mortality in many LICs. Quantitative models suggest that avoiding

pregnancy with contraception has a bigger role to play in the reduction of maternal mortality than inducing an abortion when pregnant with an unintended pregnancy (Singh and Darroch, 2012). However, while access to safe abortion techniques has become easier with the availability of medical abortion, including on the “black market” from drug sellers or the internet in countries where abortion is illegal, there are still many women who die because they could not access safe abortion services (Ganatra and others, 2014). While the distal determinants of fertility and unwanted pregnancy are broadly similar to the distal determinants of maternal health, with their emphasis on culture, poverty and education, their proximate determinants are somewhat different, with a focus on fecundability and marriage patterns (Bongaart 1978) and in the case of unwanted pregnancies an emphasis on the needs of younger and unattached women.

Several studies, mostly qualitative, have highlighted rampant episodes of disrespect and abuse towards pregnant women or women in labour in some maternity units (Silal and others 2012; Hassan-Bitar and Wick 2007). Groundbreaking research is taking place with the TRAction Project in Kenya and Tanzania to delineate the different forms of disrespect and abuse, understand their origins and document quantitatively their frequency (<http://www.urc-chs.com/news?newsItemID=324>). Lack of respectful care could mean that women do not seek care when they need it, or as quickly as they should, and could contribute to deaths of mothers and babies.

Finally, It is also important to be aware that, in HICs and LMICs settings, violence is sometimes one of the most frequent cause of death during pregnancy and childbirth (Ganatra and others 1998; Glazier and others 2006)

## Health System Factors

The level of maternal mortality is one of the best criterion for assessing the relative performance of health systems. Skilled birth attendance is a very good example of a coverage indicator of the “Continuum of Care” which is particularly inequitable because women rely on a functioning health system to access and use professional care (Countdown Report 2012). Health system classifications are helpful in highlighting the barriers or in facilitating the factors that many women meet when they seek care during pregnancy, childbirth, or emergency situations. These classifications complement the three delays model because they go beyond emergency obstetric care. The WHO health system building blocks offer a starting point to classify health system determinants and include the following:

- Quality of service delivery and referral system
- Number, distribution, and training of the types of providers required, including midwives and obstetrician-gynecologists
- Completeness and responsiveness of the health information system
- Ease of access to essential medications, such as magnesium sulphate misoprostol and oxytocin, and the supplies necessary for blood transfusions
- Leadership and financing, a particular relevant issue in several Sub-Saharan African countries, which have ended users’ fees

- Governance, including the capacity of authorities at various levels of the health system to put policies and a management system in place so that women's health can improve

All of these blocks are determinants of the coverage and quality of care that women receive across the continuum of care. Countries case studies have described the relative importance of these blocks or equivalent groupings in understanding the progress in maternal health (McPacker and Koblinsky 2009). The equitable distribution of staff and the adequacy of blood supplies appear to be problematic in most settings in LICs. Coverage of one visit for antenatal care is now very high; the median coverage level is 88 percent among the countdown countries with data (countdown countries include 75 countries where 95% of maternal and child deaths occur). Progress has also been made for skilled birth attendance since 1990 (median coverage 57 percent), emergency obstetric care (as measured by c/s) and postnatal care for mothers (median coverage of 41 percent). However, large urban/rural and wealth inequities, remain, particularly among countries that have made the least progress since the 1990s (Cavallaro and others 2013; Countdown Report 2012).

## **Intersectoral Issues**

The health sector does not exist in isolation; in developing and implementing effective policies, it is essential to consider its interactions with other sectors, such as education, finance, water, and transport. For example, the well-documented decline in maternal mortality in Bangladesh may be related to the availability of emergency obstetric care interventions and fertility decline, but it is also likely to be linked to the increased participation of women in the labor force. Several ecological studies of maternal mortality have shown the relationship between maternal mortality and skilled birth attendance, as well as gross national product (GNP), health care expenditures, female literacy, population density, and access to clean water (Buor and Bream 2003; Montoya and others 2014).

Observational studies have shown inadequate levels of hygiene in many maternity facilities (Benova and others 2014), with direct health impacts on mothers, newborns, and care providers (Metha and others 2011). The reasons are multifactorial and include poor infrastructure; inadequate equipment and supplies; and poor practices by care providers and cleaners as a result of weak knowledge, attitudes, motivation, and supervision (Campbell and others 2014). Interventions to address these constraints go beyond the health sector, particularly in the s of water and sanitation (Shordt and Smet 2012). Timely access to care and the difficulties in obtaining motorized transport, as well as challenging topography and inadequate and poorly maintained roads, are important barriers to care. Gabrysch and others (2011) demonstrated that in Zambia, the odds of women being able or choosing to deliver in a health facility decreased by 29 percent with every doubling of distance between their home and the closest facility. They concluded that if all Zambian women lived within 5 km of health facilities, 16 percent of home deliveries could be averted.

## **A Lifecycle Perspective**

Traditionally, safe motherhood programs are designed in such a way that they seem to consider each pregnancy as a separate event. Emerging evidence from cohort studies of near-miss patients suggests that women who have suffered severe obstetric complications have increased mortality risks for several years and have higher risk of a complication in subsequent pregnancies. It is important to be able to identify these women and offer them medical support for an extended postpartum period (Storeng and others 2012).

## **Conclusions**

This chapter summarizes recent data, where available, as well as older data, on the levels and trends of maternal mortality and morbidity and their main determinants. Mathematical modeling implies that maternal mortality is declining in most countries, and that deaths due to direct causes—such as hemorrhage and hypertension—continue to be the main causes in Latin America and the Caribbean and in Sub-Saharan Africa. The high proportion of haemorrhage and hypertension deaths found globally remains the case despite established interventions to prevent and treat direct causes of maternal death (see chapter x), such as active management of the third stage of labor. With the data available, it is not possible to determine if this high proportion is the result of a failure to implement policies and therefore quality of care, if there is a shift toward antepartum hemorrhage, or if misclassifications with regard to abortion and obstructed labor are erroneously increasing the hemorrhage category.

The current distribution of mortality and morbidity burden imply that health program manager and policy makers must continue encourage women deliver in health facilities, where complications can be prevented by appropriate care and where they can receive life saving interventions. At the same time, the gaps in coverage of effective interventions for indirect causes of deaths according to their distribution in various settings have significant implications for the complexity of service delivery in light of the urgent need to accelerate the rate of decline in maternal mortality to reach the MDG 5 target and, ultimately, to stop all preventable deaths. Primary health care for example of women with chronic conditions may have a bigger role in future in improving the health outcomes of pregnant and recently delivered women. In addition, if the post-2015 agenda is to emphasize universal access to essential interventions, then the perceived and technical quality of the health care services provided becomes even more crucial in the fight against maternal mortality and morbidity.

Finally, there is a call for action. Although the global attention to maternal mortality has brought more studies and attempts to measure it, it remains the case that the quality, regularity, and ability of the results to robustly show differentials have not improved dramatically, in particular in terms of routine sources of information such as vital registration. We remain largely dependent on research and mathematical modeling. The paucity of information on maternal morbidity is even more problematic; at the community level, it is almost nonexistent for direct obstetric complications; the burden of ill health associated with some conditions, such as sepsis and ectopic pregnancies, has not been reviewed for a long time. Better population-based local level sources for local level decision-making are essential to achieving improved outcomes.



**Table 5.1 Example of Risk Factors and Pathways of Influence**

<b>Individual Nonmedical Risk Factors</b>	
Age	Women at the extremes end of the reproductive age range (below 20 and above 35) have a higher risk of death for both physiological and sociocultural reasons; the largest number of deaths might be in the middle group, because this is when most birth occurs. However, Graham and Airey (1987) have estimated that between a 50 percent and 75 percent of maternal deaths occur between ages 20-35 years.
Parity	First pregnancy and more than three to five pregnancies have a higher risk of complications and death. Women in their first pregnancy have longer duration of labor, while women with multiple pregnancies are more likely to suffer postpartum hemorrhage. While family planning can help to reduce the number of higher order births, first pregnancies can only be delayed but not avoided (Graham and Airey 1987).
Unintended pregnancies	These pregnancies are either mistimed or unwanted. Unwanted pregnancy is a risk factor for unsafe abortion, lack of social support, and domestic violence. Women who continue with their pregnancy are less likely to plan for childbirth and more likely to commit suicide (Ronsmans and Khat 1999).
Marital status	Single women who are pregnant often lack support from their partners or their families and are more likely to try to induce an abortion or to run into financial and other logistic difficulties when seeking care for labor.
Women's education	Women who are educated know where to obtain effective services and are more likely to request these services, when needed.
Husbands' education	Where husbands are the main decisions makers, the educational level of the husbands is often a more important determinant of maternal mortality than the women's education (Ganatra and others 1998).
Ethnicity and religion	In high-income countries, women from black or migrant communities are more likely to die during pregnancy for cultural and medical reasons, including chronic ill-health. Women from certain religious groups may seek medical advice from their religious leaders or deliver in places of worship.
Poverty	Money is often required to travel or to deliver safely. Emergency caesarean section is a very expensive procedure, which can lead to delays in seeking care and in catastrophic expenditures.
Obesity and other nutritional factors	Obese or anemic women are more likely to die in childbirth. Obese women face the increased risk due to comorbid conditions, such as diabetes, hypertension, or cardiac problems; it is also because it is technically more difficult to provide them with clinical care. Severely anemic women cannot tolerate hemorrhage to the same degree as women with higher hemoglobin levels.
Past obstetric history	Past stillbirths and emergency caesarean are predictors of complications and deaths.
<b>Social and economic context</b>	
Women's status	Often measured using education as proxy, women's status indicators help to assess the extent to which women can make decisions on their own and the extent to which women and their decisions are valued. Many proxy variables have been used to measure women's status, including age at marriage, financial decision making power, and women's opinion on domestic violence (Gabrysch and Campbell 2009).
Legality of reproductive health services	Where abortion laws are restrictive, women are more likely to have unsafe abortions. The current focus is on delegating certain procedures to mid-level providers to ensure that more women have access to safe and effective services.



Conflict	Extremely high levels of maternal mortality have been reported where infrastructure and communication systems have been destroyed (Afghanistan, Somalia)
<b>Physical environment and health systems characteristics</b>	
Staff and facilities	The number, quality, and distribution of staff members are important risk factors for mortality; it is difficult to predict which women will have complications, and women are more likely to die in home births. Skilled birth attendance is often the most significant risk factor in maternal mortality models. Women who live at a distance from facilities are much more likely to delay seeking care and to experience multiple referrals.
Transport network	Patient access to transport and problematic topography are risk factors for the long duration of the second tier of delays.
Water and sanitation	The availability and quality of water and sanitation (WATSAN) are key factors at the community level; they influence direct risks of diarrheal diseases and other water-borne infections in pregnant and parturient women, as does personal hygiene before and after delivery (Shordt and others 2012). WATSAN can indirectly pose risks to women's health in terms of carrying heavy water receptacles and violence against women at public water collection points or latrines. In health care facilities, WATSAN impacts the hygiene practices of providers during childbirth, such as hand washing and environmental cleaning, with attendant increased risks of maternal and newborn nosocomial infections (Hussein and others 2011).
Quality of care and accountability	As more women deliver with skilled providers, the quality of care in facilities becomes increasingly important. The accountability of the health sector is a new focus of interventions to improve the quality of care. The availability of blood is one of the most important determinants in the quality of care received by women who are severely ill (Graham and others 2013).

NB: see Gabrysh and Campbell for further examples of risk factors.

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