



Maternal Mortality: An Enduring Epidemic

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Abstract: Women continue to die from pregnancy-related causes at an alarming rate. Maternal mortality was first called a neglected epidemic in 1985, but to date, no significant improvements have been realized. Great disparity exists as lifetime risk of dying from pregnancy is 1 in 26 in Africa, 1 in 7300 in high-income areas. The UN Millennium Development Goals call for a 75% reduction in maternal mortality by 2015, which will only be realized when priority setting, funding, and program implementation can create conditions for appropriate human resources, infrastructure, and patient education for high-quality obstetric care.

Key words: maternal mortality, safe motherhood, Millennium development goals, human resources for health, reproductive health

For us, obstetricians and midwives who serve the health needs of women in under-served regions, maternal mortality is not statistics. It is not numbers. It is not rates or ratios. Maternal Mortality is people. It is women, women who have names, women who have faces and we have seen these faces in the throes of

agony, distress, and despair. They are faces that continue to live in your memory and haunt your dreams. And this is not simply because these are women who die in the prime of their lives, at a time of great expectation and joy. And it is not simply because a maternal death is one of the most terrible ways to die, be it bleeding to death, the convulsions of toxemia of pregnancy, the unbearable pangs of obstructed labor, or the agony of puerperal sepsis. It is because in almost each and every case, in retrospect, it is an event that could have been prevented. It is an event that should never have been allowed to happen. It is an event that bears and should bear so heavily on our collective conscience.

Dr Mahmoud Fathalla, World Health Day, April 7, 1998.

Maternal mortality, once called a neglected epidemic by Rosenfield and Maine in 1985,¹ continues as an enduring epidemic with very little change in the burden of maternal mortality experienced in the world.² No longer a “neglected epidemic”, widespread knowledge of the high rates of maternal morbidity and mortality, and a 20+ year period of maternal mortality reduction programs

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paradoxically highlight the fact that maternal mortality remains unchanged.³ Increased awareness may be one major outcome of the safe motherhood movement, but incredibly, increase awareness has not led to increases in global support.⁴ Improvements in some countries and among some populations within countries offer a glimpse to the solution. However, the fact that maternal mortality remains relatively unchanged globally speaks to the inability to stop the epidemic with the current level and mix of interventions. Women continue to die at home or present to hospitals and health centers with severe preclampsia, or with eclamptic seizures, in shock from blood loss or sepsis, or prostrate in obstructed labor with possible uterine rupture and obstetric fistula. Once at the hospital, life saving treatment is far from guaranteed.

Neonatal mortality is directly related to maternal mortality and many of its causes are directly related to care of the mother during labor and delivery.⁵ Early neonatal mortality remains unchanged despite gains in under 5 mortality rates for children and infants, mirroring the problem of maternal mortality. As child mortality from infectious diseases, diarrhea, diseases preventable by immunization and malaria decrease, the proportion of infant death from neonatal causes is increasing.⁶ Beyond the newborn and infant period, families who experience a maternal death are more likely to experience the death of other children as well.⁷ The maternal, neonatal, and child suffering that stem from inadequate maternal care is still unacceptably high. As providers of midwifery and obstetric care to women, and/or managers and planners of public health policy and programs, whether working internationally or locally, the challenge remains to facilitate the conditions to reverse this trend.

A standard definition of maternal mortality is important for global comparisons but inconsistency in the definitions exists

TABLE 1. Key Definitions From the World Health Organization⁸

Maternal death	The death of a woman while pregnant or within 42 d of termination 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
Maternal mortality ratio	Number of maternal deaths during a given time period per 100,000 live births during the same time-period
Maternal mortality rate	Number of maternal deaths in a given period per 100,000 women of reproductive age during the same time-period
Adult lifetime risk of maternal death	The probability of dying from a maternal cause during a woman's reproductive lifespan
Pregnancy-related death	The death of a woman while pregnant or within 42 d of termination of pregnancy, irrespective of the cause of death
Late maternal death	The death of a woman from direct or indirect obstetric causes, more than 42 d but less than 1 y after termination of pregnancy

(Table 1). The classic definition of maternal mortality includes obstetric causes but is limited by a 42-day time period, and does not include accidental or incidental causes which may have been owing to circumstances stemming from the pregnancy.⁸ The World Health Organization (WHO) definition of late maternal death includes maternal deaths after 42 days and up to 1 year after delivery and pregnancy-related death accounts for the deaths to any pregnant woman up to 42 days postpartum. The American College of Obstetricians and Gynecologists and the Center for Disease Control and

TABLE 2. Key Definitions From the United States Center for Disease Control and Prevention⁹

Pregnancy-associated death	The death of a woman while pregnant or within 1 y of termination of pregnancy, irrespective of cause
Pregnancy-related death	The death of a woman while pregnant or within 1 y of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by her pregnancy or its management, but not from accidental or incidental causes

Prevention adopted a different definition for pregnancy-related death and added the pregnancy-associated death (Table 2). These definitions extend the time period to 1 year, and capture all deaths to pregnant and postpartum women, both nonobstetric and obstetric.⁹ A commonly used measure of maternal mortality, the maternal mortality ratio, measures the risk of death during pregnancy. The less common (but often misused) maternal mortality rate measures the risk of death of a woman from pregnancy-related causes among all women of reproductive age. By incorporating fertility rates with these measures, a lifetime risk of death owing to pregnancy can be calculated (Table 1).

Maternal mortality is the health indicator with the greatest disparity between developed and developing countries. WHO estimates in 2005 provide the most recent picture, with a global maternal mortality ratio of 400 maternal deaths per 100,000 live births, with 536,000 maternal deaths occurring annually, and a global lifetime risk of death from pregnancy of 1 in 92.⁸ In developed regions,

the maternal mortality ratio (MMR) is 9 and in developing regions the ratio 450 with a lifetime risk of the dying a maternal death of the 1 in 7300 and 1 in 75, respectively (Table 3). Insignificant decreases in the global MMR from 430 to 400, and from 480 to 450 in developing regions between 1990 and 2005 indicate the enduring reality of the epidemic (Table 4). Some progress has been made in Middle Eastern countries but no progress has been made in Africa and, with increasing population, the numbers are increasing. Ratios include 2100 in Sierra Leone, 1800 in Niger, and 1100 in Malawi.

MMRs are useful to estimate the burden of maternal mortality in a country or region or to compare across regions, but reliable and consistent data about the number of maternal deaths, and the number of live births, is difficult to obtain. Various methods used to estimate maternal mortality each have strengths and weaknesses. Registration of births and deaths is the ideal method but requires a health information system infrastructure that collects, stores and retrieves birth and death certificate information that is not present in many countries. In countries with such infrastructure, maternal deaths are still missed and misclassified. In the United States, enhanced maternal mortality surveillance identifies potential maternal deaths by direct query, through key informant interviews, confidential inquiry and by linking birth certificates and fetal death certificates to women who have recently died. Linking a birth or fetal death certificate to a woman who has died within 1 year of birth provides a pool of pregnancy-related deaths (Centers for Disease Control and Prevention definition) that can be further investigated through maternal mortality review committees.⁹ Increased surveillance identified 39% more maternal deaths than birth certificate data alone,¹⁰ and in Maryland discovered homicide as the major cause of death to women within a year of delivery.¹¹

TABLE 3. World Health Organization 2005 Maternal Mortality Estimates⁸

Region	MMR (Maternal Deaths Per-100,000 Live Births)*	No. Maternal Deaths*	Lifetime Risk of Maternal Death*: 1 in	Range of Uncertainty on MMR Estimates	
				Lower Estimate	Upper Estimate
World total	400	536,000	92	220	650
Developed regions†	9	960	7300	8	17
Countries of the commonwealth of Independent states (CIS)‡	51	1800	1200	28	140
Developing regions	450	533,000	75	240	730
Africa	820	276,000	26	410	1400
Northern Africa§	160	5700	210	85	290
Sub-Saharan Africa	900	270,000	22	450	1,500
Asia	330	241,000	120	190	520
Eastern Asia	50	9200	1200	31	80
South Asia	490	188,000	61	290	750
South-Eastern Asia	300	35,000	130	160	550
Western Asia	160	8300	170	62	340
Latin America and the Caribbean	130	15,000	290	81	230
Oceania	430	890	62	120	1200

*The MMR and lifetime risk have been rounded according to the following scheme: < 100, no rounding; 100-999, rounded to nearest 10; and > 1000, rounded to nearest 100. The numbers of maternal deaths have been rounded as follows: < 1000, rounded to nearest 10; 1000-9999, rounded to nearest 100; and > 10,000, rounded to nearest 1000.

†Includes Albania, Australia, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Malta, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Serbia and Montenegro (Serbia and Montenegro became separate independent entities in 2006), Slovakia, Slovenia, Spain, Sweden, Switzerland, The former Yugoslav Republic of Macedonia, The United Kingdom, The United States of America.

‡The CIS countries are Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Tsjikistan, Turkmenistan, Uzbekistan, The Republic of Moldova, The Russian Federation, and Ukraine.

§Excludes Sudan, which is included in sub-Saharan Africa.

In developing regions, deaths can be further investigated through the reproductive age mortality survey, verbal autopsies and maternal death reviews.^{8,12} By using hospital records, interviews with health workers and family members to review the chain of events that lead up to the maternal death, a clearer determination as to the cause of death can be made. Maternal mortality reviews, anonymously identifying, and analyzing the circumstances surrounding a maternal death, have historically been a critical component in the identification of health system issues that contribute to maternal mortality.¹³ The review of a maternal death gives voice to a woman whose death was most likely avoidable, and creates

an unfortunate opportunity to discover weaknesses in the health care system.¹⁴ Conducting the review frames maternal death as a “sentinel event” that is not acceptable. Death reviews provide an opportunity for members of the community, family members, physicians, and health planners to become conscious of the gaps in care that led to the death, and as a result, promote focused action and influence policy.¹²

Household surveys can be performed to estimate maternal mortality, but are expensive, require a large sample size and result in an estimate with large confidence intervals. The “sisterhood methods”, focused surveys of women asking about the survival of their sisters, requires a smaller

TABLE 4. Comparison of Maternal Mortality Estimates 1990 and 2005⁹

	1990*		2005*		Percentage Change in MMR Between 1990 and 2005	Annual % Change in MMR Between 1990 and 2005
	MMR	Maternal Deaths	MMR	Maternal Deaths		
World total	430	576,000	400	536,000	-5.4	-0.4
Developed regions†	11	1300	9	960	-23.6	-1.8
Countries of the commonwealth of independent states (CIS)‡	58	2800	51	1800	-12.5	-0.9
Developing regions	480	572,000	450	533,000	-6.6	-0.5
Africa	830	221,000	820	276,000	0.6	0.0
Northern Africa§	250	8900	160	5700	-36.3	-3.0
Sub-Saharan Africa	920	212,000	900	270,000	-1.8	-0.1
Asia	410	329,000	330	241,000	-19.7	-1.5
Eastern Asia	95	24,000	50	9200	-47.1	-4.2
South Asia	620	241,000	490	188,000	-21.1	-1.6
South-Eastern Asia	450	56,000	300	35,000	-32.8	-2.6
Western Asia	190	8500	160	8300	-16.2	-1.2
Latin America and the Caribbean	180	21,000	130	15,000	-26.3	-2.0
Oceania	550	1000	430	890	-22.2	-1.7

* The 1990 estimates have been revised using the same methodology used for 2005, which makes them comparable. The MMRs have been rounded according to the following schemes < 100, no rounding; 100-999, rounded to nearest 10; and > 1000, rounded to nearest 100. The numbers of maternal deaths have been rounded as follows: < 1000, rounded to nearest 10, 1000-9999, rounded to nearest 100; and > 10,000, rounded to nearest 1000.

† Includes Albania, Australia, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Malta, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Serbia and Montenegro (Serbia and Montenegro became separate independent entities in 2008), Slovakia, Slovenia, Spain, Sweden, Switzerland, The former Yugoslav Republic of Macedonia, The United Kingdom, The United States of America.

‡ The CIS countries are Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Tadjikistan, Turkmenistan, Uzbekistan, The Republic of Moldova, The Russian Federation, and Ukraine.

§ Excludes Sudan, which is included in sub-Saharan Africa.

sample size but provides an estimate of the maternal mortality ratio years before the survey. Simple surveys cannot determine the cause of death, and may underestimate the maternal death when deaths from ectopic pregnancy, elective abortion, and other less obvious causes of maternal death are not included. Maternal mortality may also be overestimated by these methods if the deaths were not owing to the pregnancy.

Maternal mortality is statistically a rare event; the ratios tend to have large confidence intervals and are subject to many variables. Because the denominator is so large and the numerator so low, 1 or

2 deaths more or less from year to year can significantly change the ratio. Even moderate changes may not be statistically significant and cannot be attributable to any particular intervention or necessarily signify a trend. Because of the weakness inherent in the use of this variable, other indicators have been investigated as measures for maternal health and indirect indicators of maternal mortality. Proxy measures, such as neonatal mortality or process indicators such as institutional deliveries where emergency obstetric care is available, quality of care measures such as case fatality rate, proportion of deliveries that are cesarean

sections¹⁵ have not been successful in capturing the picture of maternal health globally.^{16,17}

Currently, the internationally accepted proxy for the availability of maternal care is percentage of births with a skilled attendant.¹⁸

A skilled attendant is an accredited health professional—such as a midwife, doctor or nurse—who has been educated and trained to proficiency in the skills needed to manage normal (uncomplicated) pregnancies, childbirth, and the immediate postnatal period, and in the identification, management and referral of complications in women and newborns.¹⁸

For this measure to be meaningful, several assumptions must be made: a common skill level for all “skilled attendants”, a skilled attendant can handle basic obstetric emergencies, he or she works in an enabling environment and can facilitate timely referral and effective treatment for more complicated cases. Because this is not always the case, measuring skilled attendance at birth alone cannot provide assurance that pregnancy complications can be adequately handled.¹⁹ This indicator is measured by survey and through hospital record review. Current rates of skilled attendance at birth are variable, and a clear relationship to maternal mortality is difficult to determine.²⁰ Despite the weakness of the indicator itself, it draws attention to the need for skilled providers and enabling environments.²⁰

Traditional Birth Attendants (TBAs) whether formally trained or untrained are not classified as skilled attendants. TBAs are usually nongovernmental “private providers” who attend pregnancies and deliveries in many rural areas. TBAs are usually local community members, usually women, who were from family ties, apprenticeship or spiritual anointing assuming a role in home childbirth. Their

traditional role may vary and include conducting prenatal visits, providing physical assistance with the delivery of an infant and placenta, and assisting with neonatal care. Current estimates suggest that TBAs, relatives, and others assist at 43% of all live births, ranging from less than 1% to 89% of live births.²¹ Up to 12% of births are unassisted in some settings. TBAs occupy a special place as healers in communities, and often are the first people pregnant women seek for pregnancy care. Early in the safe motherhood initiative, an emphasis was placed on the training of TBAs as an intervention to reduce maternal mortality. This stemmed in part from the Bamako Initiative, whose emphasis on community based care for infant and child survival was extended to maternal care.

The term “trained TBA” is often used to describe someone who has undergone a program of education, and skills acquisition who is then connected to the health care system for support. The content of the training is specific to the national and regional policies. Early TBA training was limited and emphasized in many instances the 3 clean practices: clean hands, clean delivery surface, and clean cord cutting. The materials needed to accomplish this are packaged in a “safe birth kit” or “clean birth kit”. These kits are then provided to the TBA or the pregnant woman herself. The contents of a birth kit usually include a sheet of plastic as a delivery surface, soap, clean or sterile razor blade, and string for cord clamping and cutting, and may also include antibiotic ophthalmic antibiotic to prevent conjunctivitis and other materials as training and supplies permit. Replenishment of materials is accomplished through government or private programs. More recently, training programs have been developed that provide training in “obstetric first aid”.

There is little evidence to support a role for TBAs in reducing maternal mortality.

A meta analysis of TBAs, which included 4 studies, involving over 2000 TBAs and nearly 27,000 women found significantly lower rates of stillbirths, perinatal death and neonatal death rate, and higher referral rates. "Maternal death rate" was not significant (adjusted odds ratio 0.74, 95% confidence interval 0.45-1.22, $P = 0.24$). In other studies, perinatal deaths and number of monthly referrals did not differ between groups. Another RCT found no significant differences in frequency of postpartum hemorrhage (odds ratio 0.94, 95% confidence interval 0.76-1.17, $P = 0.60$) among women cared for by trained versus untrained TBAs.²¹

It is generally accepted that pregnancy complications occur in 40% of all pregnancies, and severe complications occur in 15%.²² Of 210 million pregnant women annually around the world, an estimated 30 million develop complications. Pregnancy complication that continue untreated in the absence of medical care, or receive inadequate or inappropriate medical care may either resolve spontaneously or evolve into irreversible or difficult to reverse clinical situations with high risk of death. Pregnancy complications related to pregnancy and childbirth are the leading cause of death and disability for women aged from 15 to 49.⁸ In Matlab, Bangladesh, out of 542 deaths of women of childbearing age from 1976 to 1985, 30% of those deaths were due to direct obstetric complications.²³ In rural areas, where pregnancy complications cannot be readily addressed, reversible complications quickly become irreversible and lead to a clinical scenario of maternal and neonatal death.

Hemorrhage, hypertensive diseases of pregnancy, obstructed labor, postpartum infection, and complications of illegal abortion remain the major causes of maternal mortality in most countries.²⁴ Ectopic pregnancy, another potential major cause of maternal mortality, is difficult to diagnose and recognize, especially at

the community level through the use of surveys. Risk factors for pregnancy complications and obstetric emergencies are not predictive. In terms of numbers, most women with risk factors deliver without complications, and most women with complications do not have risk factors.

The risk of dying in pregnancy is directly related to access to emergency obstetric care. There are 3 delays for women with obstetrical complications. Deciding to seek appropriate medical help for an obstetric emergency, reaching an appropriate obstetric facility, and receiving adequate care when a facility is reached.²⁵ This model assumes that treatment cannot begin until a woman arrives at a tertiary center where quality services will be rendered. In rural and remote settings, however, access to care may be difficult. Because of the difficulty in obtaining community based data for pregnancy complications, and the lack of ultrasound in rural areas, these complications go largely unnoticed unless women present to a facility. As a result, most of the data and information about the contribution of pregnancy complications to maternal mortality are from hospital based studies. In a study of pregnancy complications at the community level, which was nested in a neonatal care trial in India, 772 women were followed prospectively from the seventh month of pregnancy to 28 days postpartum. The incidence of maternal morbidity was 52.6%, 17.7% during labor and 42.9% during puerperium. The most common intrapartum morbidities were prolonged labor, prolonged rupture of membranes, abnormal presentation and primary postpartum hemorrhage; the most common postpartum morbidities included breast problems, secondary postpartum hemorrhage, puerperal genital infections, and insomnia.²⁶ In a retrospective study of pregnancy complications in rural Haiti, 450 women self identified as pregnant during a census and 388 were interviewed

postpartum. Complications were reported by 58.6%. Bleeding postdelivery was the most frequent complication (42.5%), followed by great pain (33.8%), bleeding during pregnancy (20.1%), and fever postdelivery (11.6%).²⁷ Community level identification and initial stabilization of pregnancy emergencies may prevent the progression of the complication to an untreatable, fatal state. Tertiary preventative efforts, or efforts to delay progression of the complication must be implemented early in the course of a pregnancy complication to be effective. Obstetric complications will become more severe and difficult if not impossible to treat when left untreated at the time of identification, especially in areas where obstetric services are underutilized and access is poor.

Maternal and neonatal care, and maternal mortality prevention is under prioritized and under funded globally. Many factors including data and evidenced based considerations, political realities and funding priorities influence the international community of funders, program planners, policy makers, and implementors of public health programs. Historically, programs are often “disease-based”. The United States President’s Emergency Plan for AIDS Relief and WHO’s Roll Back Malaria are examples of vertical programs that may or may not include provisions for maternal care. Maternal mortality will decrease only when a system is in place that assures a woman access to prevention, diagnosis, treatment, and timely referral and effective treatment of pregnancy complications and emergencies. A system in place for this could easily accommodate malaria prevention, prevention of maternal to child transmission of human immunodeficiency virus, nutrition, and child survival, instead of the other way around.

Creating the environment to adequately address the maternal health is the hard part and will require attention

to both brick and mortar infrastructure, and human resource needs—carried out in a way not to replicate the history of medicalization of childbirth and the resultant cultural backlash that has occurred in many developed countries. Culturally appropriate yet medically safe places to give birth with partners and family members present,²⁸ are essential, as are adequate numbers of trained midwives and nurses, and a commitment to training a cadre of physicians, including obstetricians and midwives who will stay in country and eventually take responsibility for the maternal care climate in their own country. The loss of physicians and nurses from the south to the north has created a health care crisis.²⁹ In Ghana, however, the establishment of an in country obstetrics and gynecology post graduate training program has resulted in retention of more than 98% of physicians trained. Many have continued to work as faculty, and some are now moving into rural areas.³⁰

The solution to maternal mortality will come from priority setting in country and will result from governmental and private initiatives supported by a group informed by public health and clinical considerations, human resource and human capacity needs, effective management structures, culturally informed architectural ideas for birthing at rural and urban centers, innovations in simple and sustainable technology for diagnosis and treatment, and financial and technical support from global funders and experts in the field.

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