Maternal death and near-miss reviews save the lives of mothers and their newborns. This chapter presents an up-to-date overview of maternal mortality in the United States. After reading this chapter you will have a greater understanding of the following:

- Recognize the most frequent causes of maternal mortality in the United States.
- Appreciate patient care practices that can help reduce maternal mortality.
- Identify emerging causes of maternal mortality in the United States.
- Understand the extended impact of a maternal death.
- Know how and why you should be involved in maternal health surveillance.

**Why Should We Be So Concerned?**

Maternal mortality in the United States is infrequent and a relatively small number, but it is an important one. It represents a measure of the overall “effectiveness” of our health care delivery systems through assessment of general medical care and, more specifically, our obstetric health care. Maternal mortality surveillance activities shine a bright light on the “gaps” in those systems. Specifically, the Joint Commission in 2010 classified maternal mortality as a reportable sentinel event.

Additionally, maternal mortality represents an overall societal loss when women are lost to their families—their parents, husbands, partners, and siblings. These women’s productive years of societal contribution are gone, and their surviving children are left motherless.

As reported by the Centers for Disease Control and Prevention, approximately 50% of maternal deaths were deemed to be preventable. This was further characterized by Clark et al., who reviewed deaths over 7 years in the Hospital Corporation of America system and identified approximately 95 maternal deaths occurring in almost 1.5 million births. His top 5 diagnoses mirrored those usually associated with maternal death:

- Pregnancy-induced hypertension
- Pulmonary emboli
- Amniotic fluid embolus
- Hemorrhage
- Cardiac disease

His analysis of these deaths provided the conclusion that approximately 27% were deemed to be preventable.

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**KEYWORDS**

Maternal death, surveillance, etiology, interventions, ascertainment
History of Maternal Mortality

In the early part of the 20th century, maternal mortality in the United States was approximately 1000 deaths per 100,000 live births or about 1%. That rate has dropped progressively over the past century, reaching a nadir in the early 1980s of about 8 per 100,000 live births. This dramatic drop represented a 99% reduction in maternal deaths.

What Led to This Great Improvement in Maternal Health in the United States?

Generally, it has been believed that in-hospital birth was a prominent factor for the reduction in maternal death rate. Additionally, trained and certified attendants (eg, obstetricians, family medicine physicians, certified midwives, or certified nurse midwives) contributed to the declining rate. Finally, blood banking capability became available along with sterile techniques, the discovery of antibiotics, and safe and available anesthesia services, all were contributing factors to this reduction in the maternal mortality ratio.

Initially, we were content, as the maternal mortality ratio remained unchanged from the mid-1980s through the early 1990s. In fact, the Healthy People 2000 goal was to reduce maternal mortality in the United States to less than 3.3 per 100,000 live births. Unfortunately, we missed it. We missed it so badly that we made the Healthy People 2010 goal to again be less then 3.3 per 100,000 live births. Not surprisingly, we missed that target also.

In fact, the reported maternal mortality ratio began to rise in the mid-1990s. A variety of plausible suggestions were made to explain what was happening in the United States:

- There was better ascertainment. Most would agree that whenever an issue comes under scrutiny, general improvement and better case identification follows. However, studies have continued to show that there is still underestimation of maternal death.
- Women are older. Advancing maternal age clearly was seen as a contributing factor. As women delay childbearing, they have a greater chance of developing medical complications or conditions that result in increased risk for maternal death compared with younger women.
- Obesity is a growing national problem. It is a contributing factor to hypertensive disease and diabetes leading to increased death rates.
- Progressively rising cesarean section rate. The increase in abdominal delivery leads to more repeat cesarean deliveries, along with the tragic hemorrhagic conditions associated with placenta accreta.
- Unmasking of additional underlying medical conditions. Advancing maternal age results in women dealing with not only the physiologic demands of pregnancy but also other medical conditions.

In 2003, the U.S. Standard Certificate of Death, recommended by the U.S. Department of Health Statistics, was modified to include a checkbox to indicate whether there had been a recent pregnancy. By 2005, that change resulted in 19 states and reporting agencies that accepted the standard certificate and incorporated checkboxes on their birth certificate. Additionally, in 1999, there was a change from International Classification of Diseases-9 to International Classification of Diseases-10. This change in disease classification resulted in better categorization of deaths during pregnancy and allowed better ascertainment of maternal deaths.

Last but not least, analysis of in vitro fertilization and other artificial reproductive technologies in the United States showed that these procedures, when successful, result in a 3-fold increase in maternal mortality ratio.

In 2000, the United Nations convened a symposium and developed goals for improving international health care. The goal to reduce each country’s maternal mortality by 75% by the year 2015 was identified as number 5 by them. You can only guess where the United States will be in attempting to reduce maternal mortality by 75%. In fact, of developing countries around the world, the United States, as part of North America, is one of few continents with a rising trend.

In the mid-1980s, the American College of Obstetricians and Gynecologists along with the Centers for Disease Control and Prevention established a maternal mortality study group. They redefined the criteria used to categorize maternal deaths, calling them pregnancy-associated deaths to cast a wide net to identify all women who die during pregnancy or within a year of the end pregnancy from whatever cause. These were then separated into following 2 categories: (1) pregnancy-related death in which the death was related to or aggravated by the pregnancy or its management, and (2) not pregnancy-related deaths. Interestingly enough, in 2011, there have been more maternal deaths that are not pregnancy-related deaths than pregnancy-related deaths, because of homicides or motor vehicle accidents.

The analysis of maternal deaths between 1998 and 2005 by Berg et al9 showed that there was a progressive increase in maternal mortality over those years, reaching a peak of almost 17 per 100,000 live births in 2003. When analyzed by race, Caucasians had a significant reduction in maternal mortality compared with the group overall. Additionally, there was a tremendous increase in the risk for maternal mortality among African American women. This resulted in a persisting ratio of 3-4 maternal deaths for African American women compared with Caucasian women. Other ethnic groups, Asians, Hispanics, and other populations, were found to have intermediate ratios throughout this time frame.

The ratio of African American to Caucasian deaths has been studied over the past 50-60 years, and the ratio has remained in the range of 3.5-4 deaths for African American women compared with Caucasians. These deaths occur irrespective of the woman’s education or income level.

Fortunately, maternal deaths in the United States represent a relatively small number of approximately 15 per 100,000 live births. However, this extrapolates to about 500-600 women who die each year in the United States, compared with between 300,000 and 350,000 women who die worldwide each year.
Changes in the Cause of Maternal Mortality Over Time

During the years 1987-1990, the most common cause of maternal death was:

1. Hemorrhage
2. Hypertensive disease
3. Embolic disease, including both pulmonary and amniotic fluid embolism

Between 1991 and 1997, there was a dramatic reduction in hemorrhagic deaths and a small reduction in pregnancy-induced hypertensive deaths, but what emerged were underlying or worsening medical conditions such as:

1. Cardiomyopathy
2. Cardiovascular disease
3. Other medical disease

In the most recent reported time frame between 1998 and 2005, there was a further reduction in deaths due to hemorrhage and a slight reduction in hypertensive deaths, but an escalation in deaths from cardiovascular disease, cardiomyopathy, and other medical conditions affecting our patients.

What Is Being Done to Address These Deaths?

Ascertainment has been improving with the death certificate checkbox now present in 35 states and reporting agencies, with anticipated expansion to almost 48 states by 2013. Maternal mortality review committees are supported and functioning in many states, but clearly not in others. Some states only tabulate maternal deaths, whereas others mandate systematic review, with recommendations being sent to the Governor and the Chairman of their Public Health Department. Multiple recommendations have emerged regarding the management of various pregnancy complications. They may be verbal in the form of Continuing Medical Education (CME) offerings or in print form, such as pamphlets, posters, or publications. The American Congress of Obstetricians and Gynecologists (ACOG) District II’s maternal mortality surveillance group has developed publications and posters on the management of maternal hemorrhage, which were distributed to all hospitals providing maternity services in the State of New York. Other states and review panels have done similar activities. The California Maternal Quality Care Collaborative has also shown a progressive increase in its rate of maternal morality and has begun to publish its findings. ACOG has recommendations on preconception care and publishes Guidelines for Perinatal Care in conjunction with the American Academy of Pediatrics. The State of Florida has had active maternal mortality surveillance for the past 15 years and publishes its results regularly.

Additionally, various statements, management and transfusion protocols, and CME presentations have been helpful in disseminating the information surrounding maternal mortality and its surveillance. As mentioned earlier, even the Joint Commission in 2010 identified maternal death as a sentinel event, requiring each institution to do a detailed review of a maternal death and the clinical issues that led to it. The Ohio Perinatal Quality Collaborative began to look at issues of cesarean sections, aspects of cesarean sections leading to prematurity, and problems associated with cesarean delivery. In Massachusetts, women suffering accidents and accidental injuries were also studied, and their recommendations were published. Last but not least, the California Maternal Quality Care Collaborative published its recommendations on the prevention and management of hemorrhage for the State of California.

The Confidential Enquiries have reviewed maternal deaths in the United Kingdom since the 1950s in partnership with the Royal College of Obstetricians and Gynaecologists. They tabulate the causes and trends in maternal death, publishing a report every 3 years. Moreover, to address maternal care issues, they develop national management protocols aimed at reducing deaths. Beginning with the 2003-2005 report, they recognized their more important duty to save mothers’ lives rather than just tabulate the causes of their death. Therefore, as we investigate maternal deaths in the United States, we have to remember that it is not just data we are reviewing but rather each case signifies the death of a specific woman/mother. It must be our goal to put not only a name but also a face on every maternal death because every maternal death represents a loss. Remembering these women and their contributions
becomes critical to “seeing” the mother’s face in each death.

However, maternal death represents only the tip of the iceberg. In 2008, Callaghan et al.\textsuperscript{14} from the Centers for Disease Control and Prevention reviewed the National Hospital Discharge Survey between 1991 and 2003, covering close to 50 million deliveries. They found that severe morbidity affected 5.1 per 1000 deliveries and more importantly resulted in hysterectomy, transfusions, or eclampsia. Women at the extremes of maternal age were those at greatest risk, as were black women, as compared with white women. Severe morbidity and near-miss was found to be 50 times more common than maternal death. Although the tip of the iceberg is maternal death, 20,000-30,000 women are adversely affected by severe morbidity resulting from near misses each year in the United States.

What Has ACOG Done?

ACOG has kicked off their new “MOMS” program—Making Obstetrics and Maternity Safer. This program can be easily incorporated into our practices. Our lobbying on Capital Hill has resulted in Representative Conyers’ Bill, H.R. 894, Maternal Health Accountability Act of 2011, which requires each state to establish a maternal mortality review committee. ACOG has developed Educational Bulletins and Committee Opinions dealing not only with clinical care but also with quality and safety approaches to protect our patients. Last but not least, ACOG makes the Voluntary Review of Quality Care Task Force available to hospitals attempting to advance their clinical safety standards.

Even President Obama\textsuperscript{15} has endorsed efforts to improve maternal health. In March 2011, a presidential memorandum was released to enhance collection of relevant data and statistics relating to women. He encouraged each of his agencies to cooperate in making data with regard to women’s health issues more relevant and more available.

What Can You Do as a Practicing Obstetrician–Gynecologist?

Greater professional awareness of the issues and improvements in patient care have been shown to reduce the tragedy of maternal death or disability. A coordinated and systematic maternal health review process should be established in every state and reporting agency. The process begins with case identification and data collection, followed by analysis resulting in clinical recommendations or actions, continuing with evaluation and refinement, ultimately leading full circle to additional case identification (Fig. 1).

\begin{itemize}
  \item If asked to participate in maternal health review—just say yes.
  \item If there is not a review process in your community, it becomes your job to make one happen.
  \item Assess every patient who you manage for their risk of hemorrhage and embolism. Establish a preventative strategy for both conditions.
  \item Evaluate every cesarean section preoperatively to ensure it is necessary and postoperatively to determine if your management could have been different.
  \item Encourage your patients to use seatbelts and remove guns from their homes, as there are more deaths from accidents and violence than pregnancy-related deaths.
  \item Optimize the medical condition of your patients with hypertension, diabetes, or other medical conditions. Be aware of mental health issues, as suicides and postpartum depression have a tremendous influence on overall health care.
  \item Finally, when indicated by underlying medical disease, recommend effective contraception or sterilization for your patients. This can completely avoid adverse maternal or perinatal outcomes.
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The Pebble Analogy

I think about maternal mortality as a sentinel event similar to tossing a pebble into a pond of still water. It begins with a maternal event that expands with ever-enlarging ripples impacting the child, her partner and other siblings, her other children, her extended family, then her physicians, nurses, and other health care providers, her employer and coworkers, society at large, and, last but not least, the mother, should she survive, to live a life saddled with the lifelong burdens of medical morbidity (Fig. 2).

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References