
Maternal Mortality

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Abstract: This case—maternal mortality—is one of a series of teaching cases in the Case-Based Series in Population-Oriented Prevention (C-POP). It has been developed for use in medical school and residency prevention curricula. The complete set of cases is presented in this supplement to the *American Journal of Preventive Medicine*.

Maternal mortality remains an important public health concern, even though it is a rare event. This teaching module introduces five case reports of maternal death to provide a clinical lead into discussions about data sources such as death certificates and their limitations. The students will also calculate maternal mortality rates and explore racial disparities in this health indicator. Finally, the students will develop intervention strategies to identify and prevent maternal mortality. (Am J Prev Med 2003;24(4S):157–160) © 2003 American Journal of Preventive Medicine

Recommended Reading:

- Maine D, Chavkin W. Maternal mortality: global similarities and differences. *J Am Med Womens Assoc* 2002;57:127–30.
- Callaghan WM, Berg CJ. Maternal mortality surveillance in the United States: moving into the Twenty-First century. *J Am Med Womens Assoc* 2002;57:131–4.

Objectives: At the end of the case, the student will be able to:

- define maternal death (pregnancy-related and pregnancy-associated death);
- accurately report “cause of death” using International Classification of Diseases, 10th edition (ICD-10) codes;
- describe limitations in data sources, using death certificates as an example;
- calculate maternal mortality rates to determine racial disparities;
- describe the health status of a population using these rates; and
- develop intervention strategies to identify and prevent maternal deaths.

Maternal mortality—the death of a woman because of pregnancy-related causes during or within 1 year after a pregnancy—is an extremely rare outcome of pregnancy in the United States today, with an incidence of only 12 deaths per 100,000 live births. Because it represents the worst outcome of pregnancy and be-

cause there are significant racial disparities in maternal mortality rates, it remains an important public health concern. It also serves as a sentinel event: a rare adverse health outcome that can serve as a marker of a population’s overall health status and that can be studied to provide insights about factors that contribute to poor health. In resource-poor countries, maternal mortality is much more common than in the United States, with rates of more than 1000 per 100,000 live births in some countries.

Section A Cases of Maternal Death

The New York State Department of Health from 1996 to 1999 conducted a 3-year review of maternal deaths in collaboration with the Centers for Disease Control and Prevention, the New York State chapter of the American College of Obstetricians and Gynecologists, and the New York City Health Department. Following are five composite case summaries based on the cases reviewed.

(Note: Gravidity [G] indicates the order of a woman’s current pregnancy, i.e., G 2 indicates she is pregnant for the second time; parity [P] summarizes the outcome of past pregnancies, indicating the number of full-term deliveries, preterm deliveries, abortions [spontaneous and induced], and currently living children.)

Patient A was a 23-year-old single, black, Haitian-born woman, G 3, P 1-0-1-1, with systemic lupus erythematosus (SLE), which had led to significant complications: hypertension and lupus nephritis. She was obese (5 feet 5 inches tall and 285 pounds) and had a history of asthma. She was insured by Medicaid but did not have a regular doctor and had received only sporadic care for her SLE and asthma. During her final pregnancy, she received care at a city clinic. She took her sister to appointments whenever possible to help translate be-

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tween English and Creole. The pregnancy was complicated by fetal demise at 21 weeks, requiring prostaglandin induction for delivery. After delivery at a community hospital, she developed respiratory distress, pulmonary edema, and salmonella sepsis. Despite antibiotic therapy, her status deteriorated, and she died.

Patient B was a 36-year-old, married, white woman, G 1, P 0, with severe mitral valve disease secondary to rheumatic fever during childhood. She was enrolled in a managed care plan, in which her primary care provider was an internist. She received prenatal care from a private obstetrician, starting at 10 weeks' gestation. She had a long history of frequent shortness of breath attributed to asthma, and she was unable to sleep without several pillows. Her symptoms became worse during the pregnancy. Her obstetrician referred her to a prenatal diagnostic center for assessment of fetal status, with no mention on the referral form of her cardiac disease. At the diagnostic center, she was told to lie down on an examining table. She soon became severely short of breath, self-administered her asthma medication, and went into cardiac arrest. Resuscitation efforts were unsuccessful.

Patient C was a 34-year-old, married, black woman, G 8, P 0-2-5-2. Her obstetric history included four spontaneous abortions (one at 20 weeks as a result of incompetent cervix), two preterm pregnancies complicated by pre-eclampsia, and one hydatidiform mole, which required dilatation and curettage and chemotherapy. She lived with her two children, her husband, and his mother and sister. She and her husband had both abused crack cocaine in the past, but she reported no use in more than 2 years. She had no regular health insurance, but, when she was pregnant, she was able to enroll in Medicaid. She received prenatal care at a hospital clinic, starting at 15 weeks' gestation. During the current pregnancy, at 28 weeks' gestation (with cervical suture in place to prevent late spontaneous abortion), she developed pre-eclampsia and HELLP syndrome (hemolysis, elevated liver enzymes, and low platelets). The cervical suture was removed, and labor was induced with prostaglandin gel and intravenous oxytocin. Fetal bradycardia led to a vacuum-assisted delivery. Her postpartum course was complicated by hypertension, encephalopathy, and death as a result of brainstem herniation. Patient was cared for at a level-II hospital, and her obstetrician did not consult with a maternal-fetal medicine specialist.

Patient D was a 24-year-old, married, white female, G 2, P 1-0-0-1, with poorly controlled type 1 diabetes mellitus, complicated by hypertension, nephropathy, and neuropathy. Before this pregnancy, she had been hospitalized five times for ketoacidosis. She had sporadic health insurance, and her primary source of care was a community health center, where the providers reported poor compliance with medications and with recommendations for diet and exercise. Her diabetes

worsened during the pregnancy, and, at 19 weeks, her condition became life threatening. There was no practitioner readily available with significant experience in second-trimester abortions. Her obstetrician had done saline abortions in the distant past and attempted one in this case. Hypertonic saline entered the patient's circulation, and she became comatose after the abortion and died.

Patient E was a 15-year-old, black primigravida (G 1, P 0) who started prenatal care at 22 weeks, when her mother confronted her about the pregnancy. She lived with her mother and two younger siblings. During prenatal care she reported a long history of verbal abuse by her mother. The pregnancy was medically uncomplicated, and she presented to the hospital at 35 weeks in active labor. She developed severe fetal bradycardia and was delivered by cesarean section. During the operation, she developed pulseless electrical activity (electro-mechanical dissociation) and was resuscitated. Over the course of the next 3 days, two additional operations were necessary because of a ruptured uterine wall that was not identified during the delivery. The uterine rupture led to significant intraperitoneal hemorrhage. Her postoperative course was complicated by tachyarrhythmias, cardiomyopathy, and multiple organ system failure.

Teaching Note: Divide the class into small groups. Have each group choose one of the cases above and discuss the following questions.

Question 1. Was this death preventable?

Question 2. If so, what could have been done differently to prevent it?

Question 3. When the class reconvenes, have each group present prevention opportunities they identified.

Question 4. Discuss recurring issues and strategies for preventing future maternal deaths.

Section B Classifying Maternal Deaths

Maternal deaths are grouped into several categories, based on the relationship between the death and the pregnancy. Deaths that would not have occurred if the woman had not been pregnant are termed *pregnancy-related deaths*. Pregnancy-related deaths are often subdivided into two groups: those that are a result of complications of the pregnancy itself are referred to as *direct maternal deaths* and those that are a result of an underlying illness that was exacerbated by the pregnancy are referred to as *indirect maternal deaths*. Deaths that occur during or within a year after pregnancy, but whose cause is unrelated to the pregnancy itself, are termed *pregnancy-associated deaths*.

Question 1. How would you categorize the following deaths?

- a. 27-year-old female, G 7, P 6-0-1-6, with postpartum hemorrhage unresponsive to medical intervention
- b. 25-year-old female, G 3, P 2-0-0-2, who is 22 weeks pregnant with multiple injuries after a motor vehicle crash
- c. 42-year-old woman with end-stage metastatic breast cancer, found to be 7 weeks pregnant at autopsy
- d. 19-year-old female, G 1, P 1, who is 1 week postpartum with antibiotic-resistant wound infection after cesarean delivery
- e. 33-year-old female, G 2, P 0-0-1-0, with long-standing ulcerative colitis in remission until 38 weeks' gestation who developed fever, abdominal pain, bloody diarrhea, and disseminated intravascular coagulation (DIC)

Question 2. How would you categorize the case you reviewed in Section A?

Question 3. If you were filling out the death certificate for that patient, what would you list as the immediate and underlying causes of death and as other significant conditions? (*Teaching Note: Obtain blank copies of your state's death certificate for this exercise.*)

Question 4. If you were coding the cause of death, which ICD-10 codes would you assign? (Refer to ICD-10 codes listed in Handout.)

Question 5. Discuss how and where death certificates are filled out, the validity of death certificate data for assessing cause-specific mortality rates, and approaches to improving data quality.

Section C Maternal Mortality Statistics

The maternal mortality ratio is the number of pregnancy-related deaths (death certificate cause of death in the ICD10 range O00-O99) divided by the total number of live births. Below are statistics for New York State during the period from 1995 through 1997.

	Total	White	Black	Other
Maternal Deaths	83	32	45	6
Births	791,629	568,947	165,423	57,259

Question 1. Calculate the maternal mortality ratio for the total population and for each subgroup.

Question 2. Discuss the difference among these ratios and the possible reasons for the difference.

Question 3. Would race-specific maternal mortality ratios be good health indicators for a county to use in its community health assessment? Why or why not?

Studies indicate that counting only deaths in which the cause of death on the death certificate is in the

ICD-10 range from O00 to O99 seriously underestimates the maternal mortality ratio. This underestimation is due to problems in reporting and in coding the cause of death. Many maternal causes (e.g., insulin-dependent diabetes mellitus in pregnancy, ICD-10 code O24.0) are miscoded under a similar nonmaternal cause (i.e., insulin-dependent diabetes mellitus, ICD-10 code E10).

Question 4. How could we improve death certificate reporting of maternal deaths?

To improve completeness of maternal mortality counts, statisticians use a variety of data sources. In addition to the cause of death, in many states the death certificate includes a question about whether the person had been pregnant within the past 6 months. This checkbox can help identify additional maternal deaths. The National Center for Health Statistics reviews all death certificates and generates a multiple-causes-of-death file, using all the information available on the certificate, not simply the conditions listed under cause of death. Many maternal deaths are found in the multiple-cause file that were not originally reported as maternal deaths, for example, deaths originally reported as being a result of surgical complications, in which the surgery in question was cesarean section. A third approach to finding potential maternal deaths involves linking death certificates to birth, fetal death, and abortion certificates in the previous year to identify women who died within a year after pregnancy. In addition, many states have hospital discharge databases that can be used to improve completeness of maternal death counts.

Question 5. What are the strengths of each approach?

Question 6. What are their weaknesses?

Question 7. What variables would you use to link birth and death certificates to maximize the number and accuracy of matches?

New York State's hospital discharge database includes the following variables:

- Dates of hospital admission and discharge
- Patient's date of birth, gender, and address
- Discharge status (discharged to home, to long-term care facility, or dead)
- Principal diagnosis and up to 14 other diagnoses
- Procedures performed during hospitalization

Question 8. Using any of these variables, how would you identify potential maternal deaths?

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Appendix. Handout 1: Selected ICD-10 Codes (for Section B, question 4)

Code	Definition
A01	Typhoid and paratyphoid fevers
A02	Other salmonella infections (A02.1=salmonella septicemia)
A42	Other septicemia
B20	HIV disease resulting in infectious and parasitic diseases
B16	Acute hepatitis B
E10	Insulin-dependent diabetes mellitus (<i>excludes</i> diabetes mellitus complicating pregnancy)
E66	Obesity
E87	Disorders of fluid, electrolyte, and acid–base balance
I05	Rheumatic mitral valve disease
I10	Essential (primary) hypertension
I12	Hypertensive renal disease
I21	Acute myocardial infarction
I42	Cardiomyopathy
I45	Cardiac conduction disorders
I50	Heart failure
I61	Intracerebral hemorrhage
J45	Asthma
L93	Lupus erythematosus
N00	Acute nephritic syndrome
O00	Ectopic pregnancy
O01	Hydatidiform mole
O04	Medical abortion (i.e., any legally induced abortion: surgical or medical)
O10	Pre-existing hypertension complicating pregnancy, childbirth, and the puerperium
O14	Gestational hypertension with significant proteinuria (O14.1=severe pre-eclampsia)
O24	Diabetes mellitus in pregnancy (O24.0=pre-existing, insulin-dependent)
O35	Maternal care for known or suspected fetal abnormality and damage
O66	Obstructed labor, unspecified
O70	Perineal laceration during delivery
O71	Other obstetric trauma
O72	Postpartum hemorrhage
O74	Complications of anesthesia during labor and delivery
O75	Other complications of labor and delivery
O85	Puerperal sepsis
O87	Venous complications in the puerperium
O88	Obstetrical embolism (O88.1=amniotic fluid embolism)
O90	Complications of the puerperium, not elsewhere classified
O95	Obstetric death of unspecified cause
O96	Death from any obstetric cause >42 days, but <1 year after delivery
O97	Death from sequelae of direct obstetric causes
O98	Maternal infections and parasitic diseases classifiable elsewhere but complicating pregnancy
