

**State of Maryland
Maternal Mortality Review Program**

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I. Introduction

During the 2000 Maryland General Assembly, Senate Bill 459 was enacted to establish maternal mortality review in Maryland. The bill requires: (1) identification of maternal death cases; (2) review of medical records and other relevant data; (3) determination of preventability of death; (4) development of recommendations for the prevention of maternal deaths; and (5) dissemination of findings and recommendations to policy makers, health care providers, health care facilities, and the general public. The three year sunset provision was removed during the 2003 session by Senate Bill 688. Maternal mortality review is conducted by the Maryland Department of Health and Mental Hygiene in consultation with MedChi, The Maryland State Medical Society. Funding has been made available from the Center for Maternal and Child Health, Maryland Department of Health and Mental Hygiene to MedChi since June 2001 to investigate pregnancy-associated deaths in Maryland and identify opportunities for reduced maternal morbidity and mortality. MedChi's Maternal and Child Health Committee provides consultation to maternal mortality review activities, conducts case reviews and develops recommendations to the Department.

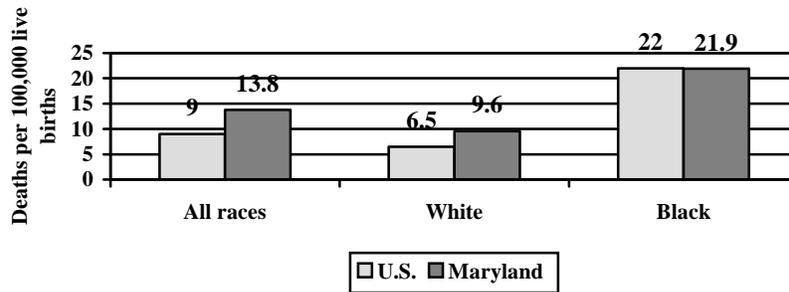
II. Background

A maternal death is defined by the World Health Organization's (WHO) International Classification of Diseases Ninth Revision (ICD-9) and Tenth Revision (ICD-10) to be "the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by pregnancy or its management but not from accidental or incidental causes."¹ This definition is used by the Centers for Disease Control and Prevention's National Center for Health Statistics in calculating maternal mortality in the United States.

In 1986, a joint maternal mortality collaboration from Centers for Disease Control and Prevention (CDC) and the American College of Obstetricians and Gynecologists (ACOG) issued a statement recommending the use of an enhanced surveillance definition and approach to more accurately identify deaths among women in which pregnancy was a contributing factor. This group also defined a pregnancy-associated death as the death of a woman while pregnant or within 1 year or 365 days of pregnancy termination (conclusion), regardless of the cause of death. A pregnancy-related death was further defined as the death of a woman while pregnant or within 1 year of termination (conclusion) 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.

The Healthy People 2010 maternal mortality ratio (MMR) target is 3.3 deaths per 100,000 live births, the same goal as Healthy People 2000, which was not met. Nationally, maternal mortality has declined dramatically since the 1930's when the maternal mortality ratio (MMR) was as high as 670 maternal deaths per 100,000 live births. However, there has been no significant change in maternal deaths since 1982; the five-year national maternal mortality ratio for 1997-2001 was 9.0 maternal deaths per 100,000 live births.

**Maternal Mortality Ratio by Race
U.S. and Maryland, 1997-2001**



The maternal mortality ratio for Maryland has also shown no improvement in recent years. The MMR for 1997-2001 was 13.8 per 100,000 live births, higher than that for the U.S., and significantly higher than the Healthy People goal of 3.3.

In the US, black women have a maternal mortality ratio three-to-four times greater than that for white women; a disparity that has persisted since the 1940s. For 1997-2001, Maryland’s MMR was 21.9 per 100,000 live births for black women compared to 9.6 among white women. The US MMR for black women was 22 per 100,000 and 6.5 per 100,000 for white women.

The criteria used by the National Center for Health Statistics to define deaths included in the maternal mortality ratio from information included on death certificates are very strict. Enhanced surveillance using multiple sources and including case review will identify additional cases at the State level, which are believed to meet the WHO definition. It is expected that as Maryland and other states enhance surveillance the MMR will be influenced by this improved case finding.

III. Maternal Mortality Review Process in Maryland

Case Identification

Cases for review were limited to women of childbearing age who were residents of Maryland at the time of their death. Maryland residents who died in other jurisdictions are counted in the official Vital Statistics reports, but they are not included in the case reviews because of the difficulty in obtaining records across jurisdictions. These deaths account for 2-4 per year or approximately 10-15% of the total.

Using the recommended enhanced surveillance approach, pregnancy-associated deaths were identified in one of three ways. First, death certificates indicating the cause of death or contributing factor to be a condition related to pregnancy are identified. Maryland is one of at least 18 jurisdictions that include questions specifically designed to improve identification of maternal deaths on the death certificate. The Maryland death certificate was revised in January 2001 to include questions about pregnancy status and date of delivery for the 12 months preceding death. Second, death certificates for women aged 10-50 were linked with birth certificates and fetal death certificates to identify cases in which a condition related to pregnancy was not identified on the death certificate. And, lastly, cases were identified through a manual

review of files from deaths reported to the Office of the Chief Medical Examiner. All deaths occurring within 365 days of pregnancy termination (conclusion) were subsequently designated as pregnancy-associated and further investigated.

Case Classification

Death certificates were reviewed for 2000 and 2001 to identify potential cases. Case identification for deaths occurring in 2002 is underway but has not yet completed the full process of enhanced surveillance. In addition, deaths due to suicide were identified for the years 1993 to 2001, to ensure an adequate representation for this focus. Once the cases were identified, medical records were obtained from the hospitals of delivery and death. Case summaries were prepared using available information from death certificates, medical records and Medical Examiner's records by an Ob/Gyn Physician Consultant. The cases were then grouped by category (e. g. cardiac causes, suicides, homicides) and presented to the MedChi Maternal and Child Health Committee for review.

Category classification was done according to broad subject areas: homicide, suicide, substance abuse, injury, cardiac disease, cancer, ectopic pregnancy, vascular accidents, pregnancy-associated hypertension, amniotic fluid embolism, hemorrhage, pulmonary embolism and infection. Cases were classified as homicide or suicide if the manner of death was indicated as such on the death certificate. Cases were classified as substance abuse if the drug or alcohol intoxication contributed to the death and the manner of death was undetermined and if the decedent had a history of substance abuse. Other cases of intoxication in which the decedent had no substance abuse history were included in the injury category as poisonings. The injury category included all deaths from motor vehicle crashes, bicycle and pedestrian injury, and injuries from fire and poisoning.

Classification of medical causes of death was also done in broad categories based on similarities of etiology and/or management. Cardiac disease included deaths from diseases of the heart and aorta. Cancer included deaths in which the underlying cause was malignancy. Ectopic pregnancy was separated from the traditional category of hemorrhage, because of the difference in etiology and management of this condition from other obstetrical hemorrhage. Vascular accidents included deaths from rupture of peripheral vessels (i.e. rupture of cerebral aneurysm). Deaths from pregnancy-induced hypertension were separately classified. Deaths from amniotic fluid embolism were separated from pulmonary embolism.

Case Review

The Maternal and Child Health Committee membership includes the following specialties: obstetrics, pediatrics, nurse-midwifery, emergency medicine and public health. The Office of the Chief Medical Examiner is also represented. Other specialists are brought in as needed for case reviews (e.g., cardiology, psychiatry). The Committee discusses whether the death is pregnancy-related, whether it was preventable, how the death might have been prevented and other patient care issues illustrated by the case.

Confidentiality is maintained in two ways: the case summaries are de-identified, i.e. without patient, provider, or institutional identifiers, and Committee members and guest specialists are required to sign a confidentiality agreement prior to reviewing cases.

Reviews of 2000 and 2001 pregnancy-associated deaths were conducted to determine pregnancy-relatedness and preventability, develop recommendations and highlight patient care issues. Case reviews occurred in one of three ways. Cases reviewed in aggregate by the Maternal and Child Health Committee were: six suicides, three substance abuse, eight homicides and nine cardiac disease. Nineteen individual cases were reviewed by the Maternal and Child Health Committee: four suicides, two homicides, two substance abuse, three cardiac, and eight with other medical causes of death. Additional cases with a medical cause of death were reviewed by the OB/Gyn physician consultant and at least one committee member to determine whether cases were pregnancy-related and/or preventable.

IV. Case Findings in Maryland

Case Identification

There were 32 pregnancy-associated cases identified in 2000 and 43 cases in 2001 for a total of 75 pregnancy-associated cases available for analysis. For 2002, preliminary investigation reveals a minimum of 32 pregnancy-associated deaths. Pregnancy-related deaths are a subset of pregnancy-associated deaths. One-third of the pregnancy-associated deaths identified for 2000-2001 were determined to be pregnancy-related. Examining deaths to women up to one year postpartum increased ascertainment of pregnancy-related cases by 12 percent, validating the enhanced surveillance approach for more complete identification of maternal deaths.

Pregnancy outcome, 2000-2001 cases

The most common outcomes for both pregnancy-associated and pregnancy-related deaths were a live birth (68% and 48% respectively) and an undelivered pregnancy (19% and 32% respectively). Ectopic pregnancy, fetal death and unknown outcomes accounted for the remainder.

Cause of Death Classification

Cardiac disease is the leading cause (20%) of the 75 pregnancy-associated deaths followed by homicide (16%). The substance abuse category (11%) includes women who have narcotic, cocaine or alcohol intoxication or abuse listed on the death certificate as the underlying or contributing cause of death and who have a history of substance abuse. Although intoxications are often included in the injury category, substance abuse cases were separated out from injury cases here in this analysis.

Considering only the 25 pregnancy-related deaths, the leading causes were cardiac disease (44%) and ectopic pregnancy (16%). The “cardiac disease” category includes cases of cardiomyopathy, hypertensive cardiac disease, coronary artery disease, coronary artery dissection and aortic

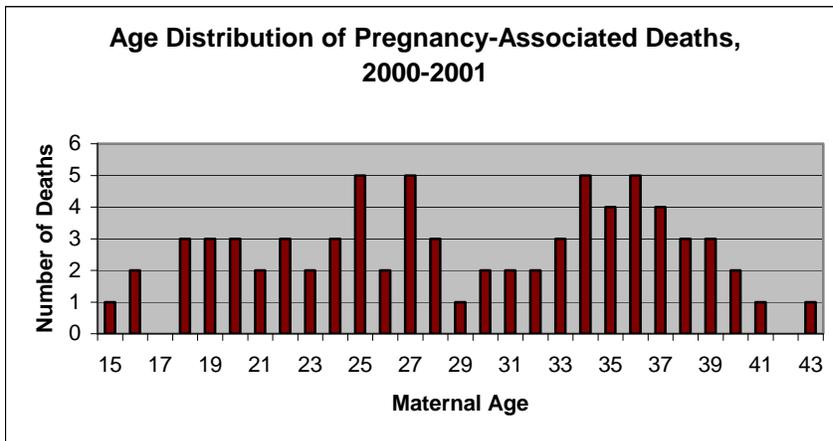
aneurysm rupture. Ectopic pregnancies are often included in the deaths from hemorrhage. However, since the etiologies and management of ectopic pregnancy and obstetrical hemorrhage are very different, they were considered separately. There were no cases of pregnancy-related death from infection.

Cases by Maternal Race and Ethnicity

Forty-eight percent of pregnancy-associated deaths occurred in non-hispanic black women, 41% in non-hispanic white women, 6.7% in Hispanic women and 4 % among Asians. The pregnancy-associated mortality ratio for black women is 1.9 times higher than that for white women while pregnancy-related mortality ratio is 2.2 times greater for black women. The ratio for Hispanic women in Maryland appears high, but may be misleading as it is based on only 3 deaths, all of which occurred among foreign-born women. The distribution of causes of death also varied in race/ethnic categories, with non-hispanic black women having a relatively higher proportion of deaths related to medical causes as defined above.

Cases by Maternal Age

The ages of decedents ranged from 15 to 43 years as seen below.



Preventability

A case was classified as preventable if the death might have been avoided by a change in patient factors, provider practice or institutional systems. Preventability was determined by two methods. The Maternal and Child Health Committee determined the preventability for the 19 cases that were discussed in depth. In addition, it was decided by Committee consensus that homicide, suicide and unintentional injury cases would all be classified as preventable. It is recognized that the determination of preventability does not follow rigid criteria and that this determination is open to interpretation. These considerations make comparisons in different venues impossible.

The distribution of cases and preventability for pregnancy-associated and pregnancy-related deaths as determined by the MCH Committee is provided in the Table below. Among the pregnancy-related deaths deemed preventable, provider practice or institutional practice issues

were identified for three cases and individual practice and possibly provider practice issues were identified for the fourth case.

Preventability of Deaths, 2000-2001

Classification	Pregnancy-associated Deaths N=75 (%)	Pregnancy-related Deaths n=25 (%)
Preventable	37 (49)	4 (16)
Not preventable	32 (43)	19 (76)
Not Determinable	6 (8)	2 (8)

Summary of Additional Findings

1. Prenatal care

Among the 75 pregnancy-associated deaths, 61% had prenatal care, 7% did not have prenatal care, and prenatal care status was unknown for 35% of cases. Of the women who had prenatal care, 57% began care in the first trimester, 20% in the second trimester and 4% in the third trimester. Timing of prenatal care initiation was unknown for 20% of these cases.

Of the 25 pregnancy-related cases, 56% had prenatal care: eight women began care in the first trimester, two in the second trimester and trimester of prenatal care initiation was unknown for four women. Twelve percent had no prenatal care and prenatal care status was unknown for 32% of women. For comparison, only 3.7% of women experiencing a live-birth in Maryland in 2001 had late or no prenatal care.

2. Chronic conditions

Depression, hypertension and cardiac disease were the most frequent pre-pregnancy conditions identified in case reviews. Thirteen women (17%) had a history of depression, ten (13%) had a history of chronic hypertension and eight (11%) had a history of cardiac disease. Additionally, three women had pre-existing diabetes.

3. Obesity

Maternal weight also appears to be a significant factor in deaths from medical causes (59%) compared to non-medical causes (27%). Maternal BMI was compared in postpartum women only. Among women who died while pregnant, 50% of those who died of medical causes weighed over 200 lbs at the time of death, whereas none of the women who died of non-medical causes weighed over 200 lbs. Thirty-three percent of women who died of medical causes weighed over 250 lbs.

V. Findings and Recommendations from Maternal and Child Health Committee

A. Cardiac disease

Cardiac disease was the leading cause of deaths, contributing to 20% of pregnancy-associated and 44% of pregnancy-related deaths for 2000 to 2001. In contrast, diseases of the heart account for 10% of the deaths in females in the 15-44 age group overall.

Issues identified:

- 1) Difficult to perform cardiac evaluation on morbidly obese patients. Imaging technology such as echocardiography is also challenging for obese patients.
- 2) X-rays are often avoided in pregnant women although may be necessary for cardiac work-up.
- 3) Difficulties in separating causes of erratic behavior (psychosis vs. hypoxia) among psychiatric patients may result in incomplete medical evaluation.

Committee Recommendations:

- 1) Consider a one-week postpartum visit for women with pre-eclampsia.
- 2) Increase provider awareness of peripartum cardiomyopathy and its symptoms.
- 3) Educate patients regarding difference in expected postpartum symptoms from those that may be warning signs of medical problems.
- 4) Educate patients with hypertension regarding the risks of becoming pregnant.

B. Homicide and Substance Abuse

Homicide contributed 16% of pregnancy-associated deaths and substance abuse 11% of deaths. In all cases, the influence of the woman's pregnancy on her homicide could not be determined. Homicide accounts for only 5.5% of deaths among 15-44 year old females in the general population.

Most homicides (67%) were secondary to firearm use, one-third perpetrated by someone known to the decedent, and one-fourth had a documented history of domestic violence. Additionally, the decedent had been using drugs or alcohol in 42% of cases.

Among the substance abuse cases, there was limited information available about the resources and services that had been offered to, or accepted by, the women. Much of the discussion revolved around the availability and adequacy of social service systems for women and their families.

Committee Recommendations regarding substance abuse:

- 1) Explore feasibility of reimbursement for additional services provided through Healthy Start and other case-management providers.
- 2) Examine support services available to family members of incarcerated individuals.
- 3) Improve medical records documentation of which services related to substance abuse and counseling are offered and available to patients and whether the patients used these resources in order to establish an approach to interventions.
- 4) Examine resources available to women exposed to domestic violence.

C. Suicide

Ten cases of suicide occurred among pregnant and postpartum women between 1993 and 2001.

Issues identified:

- 1) Insufficient availability of mental health providers in Maryland to manage these cases.
- 2) Opportunity for obstetrical providers to identify women with depression during prenatal and postpartum care.
- 3) Shortened duration of psychiatric care due to reimbursement issues.
- 4) “Curbside” consultations among physician colleagues.
- 5) Opportunity for pediatricians to identify mothers “at risk” for depression at well-baby visits.
- 6) Psychiatric evaluation in emergency departments.
- 7) Acceptability of diagnosis and treatment for depression during pregnancy and postpartum by clients and family.
- 8) Need to further examine issue of depression among Hispanic women. (Twenty-seven percent of suicides occurred among Hispanic women while Hispanic women make up 7.3% of women giving birth.

Committee recommendations regarding suicide:

- 1) Evaluate primary care providers current practices regarding depression screening prenatally and postpartum.
- 2) Develop resource guide for providers.
- 3) Develop a plan for provider education regarding maternal depression and suicide prevention.

The Maternal Depression Project emerged as a result of the determination by the Committee that suicides are preventable maternal deaths. The goal of the intervention is to assist providers for improved diagnosis and treatment of women with depression during and after pregnancy. Subsequently, a Maternal Depression Team was formed with local, state and national participants representing public agencies, institutions, private organizations and the managed care sector. A survey of clinical practice was conducted over the last six months to identify barriers to diagnosis and treatment of women with depression. Efforts will be focused primarily on provider education regarding the issue of maternal depression and its impact on the mother, infant and family.

VI. Accomplishments of Maryland’s Maternal Mortality Review Program

There has been significant progress in establishing the maternal mortality review process for the State by the Department working with MedChi and its Maternal and Child Health Committee. A format for case review has been created including a guide for data abstraction and case summarization. Also, a case review process has been established for grouping cases by category and presenting cases for committee discussion.

All pregnancy-associated cases for 2000 and 2001 have been reviewed. A Microsoft Access database has been created and data from the 2000 and 2001 cases entered. Identification and review is underway for 2002 cases.

The following issues regarding maternal mortality were identified in Maryland:

- 1) The enhanced surveillance methodology has improved ascertainment of maternal deaths..
- 2) Women over 35 were disproportionately affected, making up 31% of the pregnancy-associated deaths but only 18% of women giving birth.
- 3) Racial disparity persists: black women comprise approximately one-half of pregnancy-associated deaths but only 33% of women giving birth in Maryland.
- 4) Hispanic mothers in Maryland account for 6.7% of pregnancy-associated deaths and 7.3% of births. However, one-third (3 cases) of the suicide cases from 1993-2001 occurred among Hispanic women.
- 5) The leading causes of pregnancy-related death identified vary from those traditionally recognized such as infection, hemorrhage and pregnancy-induced hypertension. Cardiac disease was observed to be the number one cause of death in this review. However, pregnancy-induced hypertension and hemorrhage from ectopic pregnancies still account for a significant number of deaths.
- 6) Women had no prenatal care in twelve percent of pregnancy-related deaths which includes the deaths in which prenatal care would be most likely to have a positive impact. This is contrasted to the 3.7% of late/no prenatal care in the overall population.
- 7) Maternal obesity appears to be a complicating factor in pregnancy-related deaths.
- 8) A need for resources and training for improved diagnosis and treatment of maternal depression was identified through case review and the provider survey.

VII. Summary and Future Plans

Maryland continues to experience high maternal mortality compared to the U.S average and the Healthy People 2010 goal of 3.3 deaths per 100,000 live births. The use of multiple sources for identifying pregnancy-associated deaths has resulted in more complete detection of cases. Seventy-five pregnancy-associated deaths were reviewed for 2000 to 2001. Despite the small absolute numbers to date, a series of key factors contributing to maternal mortality in Maryland have been identified. In the next year, all pregnancy-associated cases will be reviewed in detail by a maternal mortality workgroup, which will then refer selected cases to the Maternal and Child Health Committee for discussion and development of recommendations to the Department.

At present, a new intervention to prevent maternal deaths and reduce maternal morbidity, Maternal Depression Project, has been initiated. Maternal depression impacts the mother, infant and family unit. The formation of a Maternal Depression Team by the MedChi through partnerships with ACOG and other public and private agencies will benefit providers and women by identifying ways to improve diagnosis and treatment for this treatable condition. Plans include

developing a resource toolkit and training for providers to assist them in managing maternal depression.

In addition, information identified in the maternal mortality review process will continue to be incorporated into a variety of provider education activities throughout the State by members of the Department and the Maternal and Child Health Committee.