

MARYLAND DEPARTMENT OF HEALTH AND MENTAL HYGIENE
PREVENTION AND HEALTH PROMOTION ADMINISTRATION
MATERNAL AND CHILD HEALTH BUREAU

MARYLAND MATERNAL MORTALITY REVIEW 2013 ANNUAL REPORT

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BACKGROUND

Health-General Article, §§13-1203-1207, Annotated Code of Maryland establishes a Maternal Mortality Review Program in Maryland. The statute 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 policymakers, health care providers, health care facilities, and the general public.

The Maryland Department of Health and Mental Hygiene (the Department) conducts maternal mortality reviews in consultation with MedChi, the Maryland State Medical Society. The Department provides funding to MedChi to assist in the maternal mortality review process. MedChi's Maternal and Child Health Subcommittee assists in obtaining medical records, abstracting cases, and convening a committee of clinical experts from across the State, the Maternal Mortality Review Committee (MMR Committee), to provide an in-depth review of maternal deaths to determine pregnancy-relatedness and preventability. The Committee then develops recommendations for the prevention of maternal deaths, and disseminates their findings and recommendations to policy makers, health care providers, health care facilities, and the general public.

Key Definitions

- A **maternal death** is defined by the World Health Organization's International Classification of Diseases Ninth and Tenth Revisions (ICD-9 and ICD-10) to be "the death of a woman while pregnant or within 42 days of conclusion 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." This definition of maternal death is used by the Centers for Disease Control and Prevention's National Center for Health Statistics (NCHS) in calculating state and national maternal mortality rates.
- The **maternal mortality rate (MMR)** is defined as the number of maternal deaths per 100,000 live births in the same time period. MMR is also frequently referred to as the maternal mortality ratio.

In 1986, the Centers for Disease Control and Prevention (CDC) and the American College of Obstetricians and Gynecologists (ACOG) collaborated to issue a statement recommending the use of enhanced surveillance definitions as an approach to more accurately identify deaths among women in which pregnancy was a contributing factor. This collaboration led to the development of the following additional definitions.

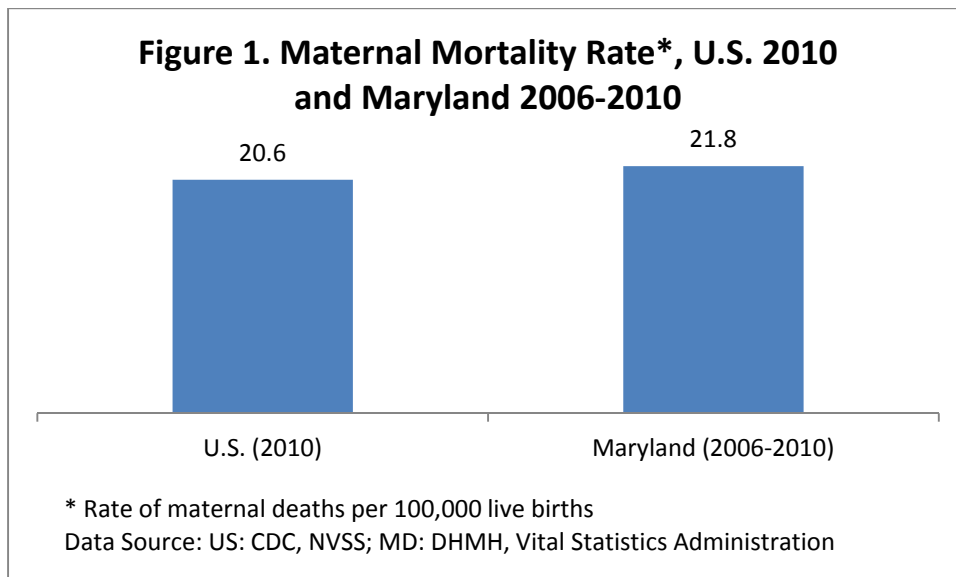
- A **pregnancy-associated death** is defined as "the death of a woman while pregnant or within one year or 365 days of pregnancy conclusion, irrespective of the duration and site of the pregnancy, regardless of the cause of death."
- The **pregnancy-associated mortality rate** is the number of pregnancy-associated deaths per 100,000 live births.
- A **pregnancy-related death** is defined as "the death of a woman while pregnant or within one year of 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 **pregnancy-related mortality rate** is the number of pregnancy-related deaths per 100,000 live births.

The three terms “maternal death,” “pregnancy-associated death,” and “pregnancy-related death” create a challenge when comparing data from different sources and reports for different jurisdictional entities. The NCHS uses strict criteria to define deaths to be included in the MMR based upon information from the death certificates alone. An enhanced surveillance method is necessary to determine pregnancy-associated and pregnancy-related deaths and will be discussed below.

Rising Rates of Maternal Mortality

Nationally, maternal mortality has declined dramatically since the 1930s when the MMR was 670 maternal deaths per 100,000 live births. The MMR was at its lowest level in 1987 at 6.6 maternal deaths per 100,000 live births. However, the MMR has generally risen since that time and was 20.6 maternal deaths per 100,000 live births in 2010, the latest year for which national data are available. Some of the increase in MMR since the mid-1980s could be expected because of the recommendations for enhanced surveillance. Enhanced surveillance using multiple data sources, including case review, will lead to additional cases being identified.

The Healthy People 2020 MMR target is 11.4 maternal deaths per 100,000 live births (MICH-5). Maryland’s MMR for 2006-2010 was slightly higher than the national rate in 2010 (see Figure 1). (A five-year average is used to stabilize the Maryland rate because maternal deaths are relatively infrequent events that may vary considerably year-to-year, particularly in a small state like Maryland).

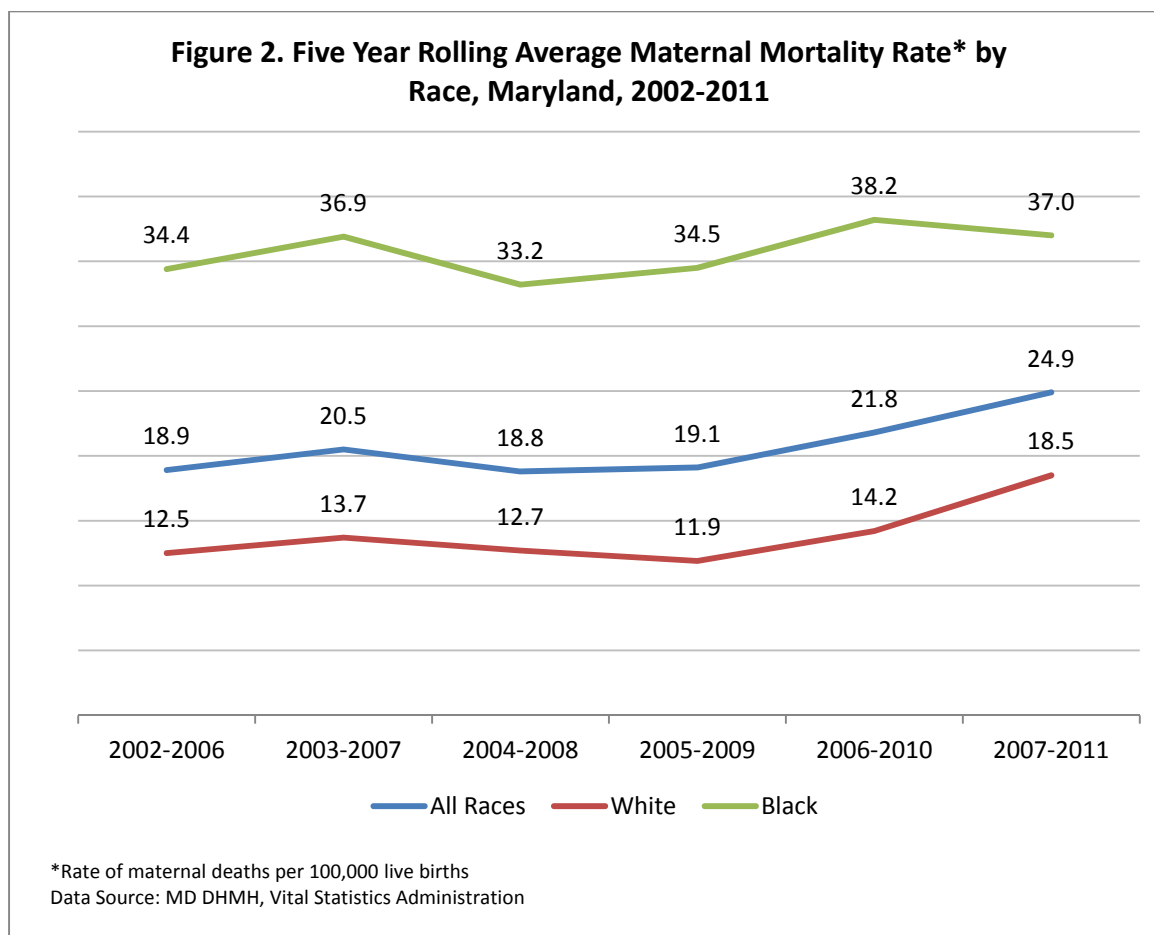


Although Maryland’s high MMR is concerning, it is also a reflection of the State’s intense efforts to more accurately identify maternal deaths since the mid-1990s. To facilitate identification of maternal deaths, the Maryland death certificate was revised in January 2001 to include questions about pregnancy within the year prior to death. These enhanced surveillance methods resulted in a more than doubling of the number of maternal deaths identified in Maryland compared with data from the 1980s and early 1990s.

Racial Disparity

In the U.S., Black women have a MMR more than two and a half times greater than that for White women, a disparity that has persisted since the 1940s. In Maryland there is a similarly large disparity between the rates among Black and White women.

Figure 2 shows the MMR by race in Maryland for six overlapping 5-year periods over the past decade. Compared to 2002-2006, the 2007-2011 White MMR in Maryland increased 48 percent and the Black MMR increased 8 percent. The 2007-2011 Black MMR was twice as high as the White MMR.



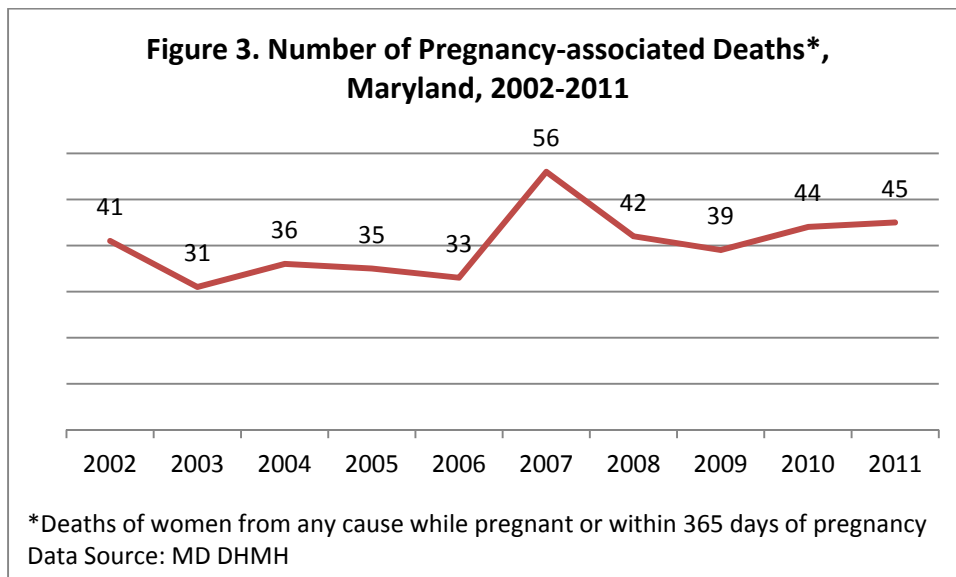
METHODOLOGY

Case Identification

Cases for review are limited to women of childbearing age who were residents of Maryland at the time of their death. Maryland residents who died in other states 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 states. These out-of-state deaths account for a maximum of two to four cases per year, or approximately 5-10 percent of the total pregnancy-associated deaths.

Maternal deaths are determined by information on the death certificates alone. The Maryland death certificate was revised in January 2001 to include questions about pregnancy status, pregnancy outcome, and date of delivery for the 12 months preceding death. Maryland is one of 42 states plus the District of Columbia that now include questions specifically designed to improve identification of maternal deaths on the death certificate. The pregnancy checkbox has significantly increased identification of maternal deaths beyond those recognized by cause of death alone. Only 62 percent of Maryland maternal deaths in the years 1993-2000 were identified by cause of death information alone (Horon, 2005). With the addition of the pregnancy checkbox, 98 percent of maternal deaths are now identified (Horon and Cheng, 2011).

Pregnancy-associated deaths are identified in one of three ways in Maryland. Individual death certificates are the first method of identifying pregnancy-associated deaths through the use of checkbox questions on the death certificate, or because the cause of death is clearly related to pregnancy, such as in the case of ruptured ectopic pregnancy. The second method of determining pregnancy-associated deaths comes from linking death certificates for women aged 10-50 years with birth certificates and fetal death certificates to identify additional cases that were not found through examination of death certificates alone. Thirdly, cases reported to the Office of the Chief Medical Examiner (OCME) are subject to a manual review process to identify evidence of pregnancy in deceased women. All deaths occurring within 365 days of pregnancy conclusion are subsequently designated as pregnancy-associated and further investigated. Using these three methods, 45 pregnancy-associated deaths were identified in 2011. Figure 3 shows the numbers of pregnancy-associated deaths in Maryland from 2002 to 2011. There was an average of 40 pregnancy-associated deaths per year during this period.



Case Review

Pregnancy-associated deaths undergo several stages of review. Once cases are identified, medical records are obtained from the hospitals of death and delivery, when applicable. Physician consultants review death certificates, hospital records, and OCME records for all cases and prepare summaries on those cases that will go to workgroups of the Committee for review of pregnancy-relatedness. All 2011 cases involving death from medical causes, substance abuse, homicide, or suicide were reviewed for pregnancy-relatedness.

Pregnancy-relatedness and opportunities for prevention of deaths are determined through workgroup discussion. The MMR Committee workgroups include general obstetric, perinatology, nurse-midwifery, and nursing specialties, as well as representatives from the Department's Maternal and Child Health Bureau, Vital Statistics Administration (VSA), and the OCME. Representatives from all birthing hospitals in Maryland are encouraged to participate. The workgroup discussions incorporate the CDC framework for case review outlined in "Strategies to Reduce Pregnancy-Related Deaths: From Identification to Action." This approach takes into account medical and non-medical factors contributing to maternal death, and examines quality and content of medical care (see Appendix A, *Maryland Maternal Mortality Review Case Discussion Guide*). Cases discussed by the MMR Committee workgroups are de-identified and members sign confidentiality agreements. The full MMR Committee meets to review issues identified through case reviews and to develop recommendations.

CASE FINDINGS

A total of 45 pregnancy-associated deaths were identified in 2011 for a pregnancy-associated mortality rate of 61.6 deaths per 100,000 live births. Of the 45 deaths, 17 were determined to be pregnancy-related, while the remaining 28 were either determined not to be related to pregnancy or the relatedness to pregnancy could not be determined. The resulting pregnancy-related mortality rate was 23.3 deaths per 100,000 live births.

CASES BY CLASSIFICATION OF DEATH

Figure 4 shows the categories of causes of death for pregnancy-associated and pregnancy-related deaths.

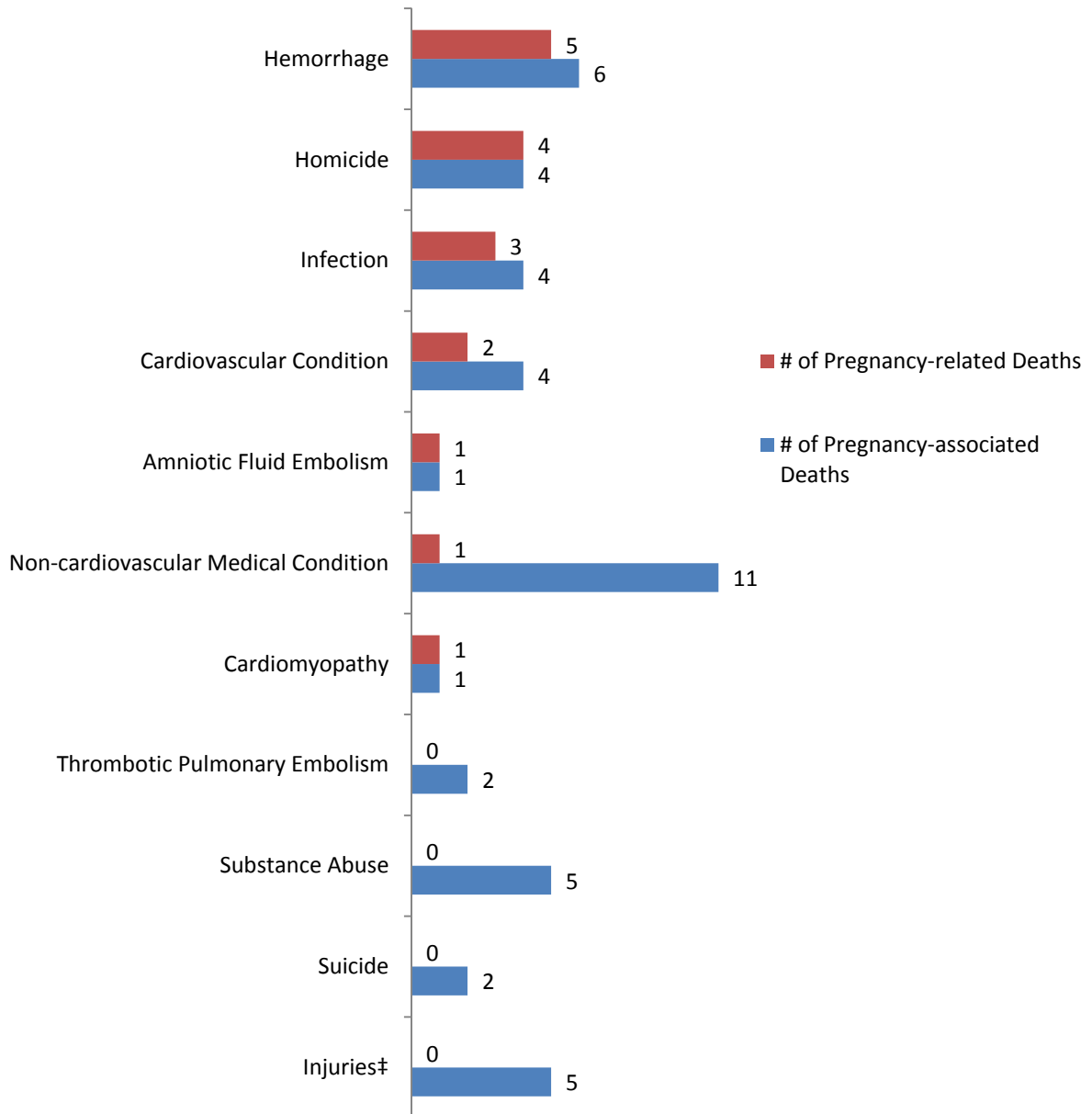
Pregnancy-associated Deaths

The leading causes of pregnancy-associated deaths in 2011 were non-cardiovascular medical conditions and hemorrhage, followed by cardiac disease (including cardiomyopathy), substance abuse, and injuries. Sixty-five percent of pregnancy-associated deaths were due to natural causes (does not include unintentional injury, homicide, substance abuse, and suicide). An additional 11 percent were due to substance abuse, 11 percent to unintentional injury, 9 percent to homicide, and 4 percent to suicide.

Pregnancy-related Deaths

Among the 17 pregnancy-related deaths in 2011, the leading cause of death was hemorrhage, accounting for 29 percent of pregnancy-related deaths. There were 4 homicides that were considered to be pregnancy-related, representing 24 percent of pregnancy-related deaths. Cardiac disease, including cardiomyopathy, accounted for 18 percent, and other medical conditions accounted for the remaining 29 percent of pregnancy-related deaths.

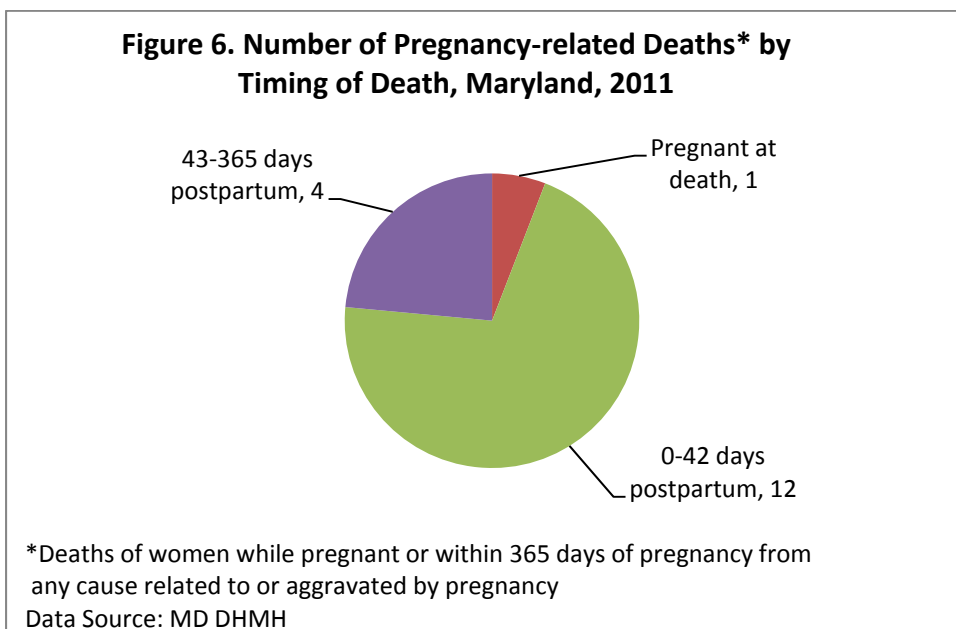
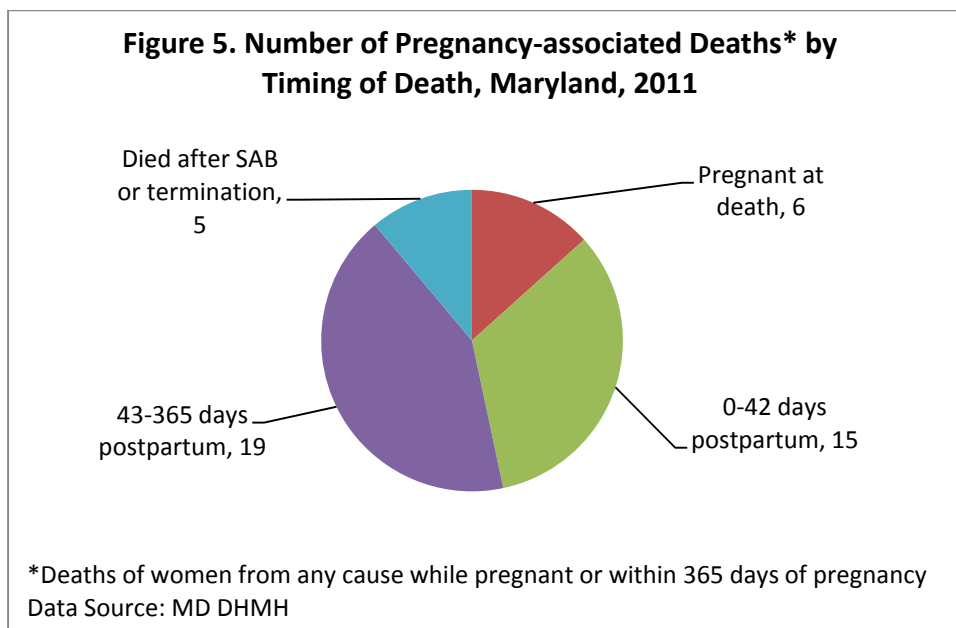
Figure 4. Number of Pregnancy-associated* and Pregnancy-related Deaths by Category of Cause of Death***, Maryland, 2011**



* Number of deaths of women from any cause while pregnant or within 365 days of pregnancy
 ** Number of deaths of women while pregnant or within 365 days of pregnancy from any cause related to or aggravated by pregnancy
 ***Category as determined by Maternal Mortality Review Committee
 ‡Injuries were not included in the review of pregnancy-related deaths
 Data Source: MD DHMH

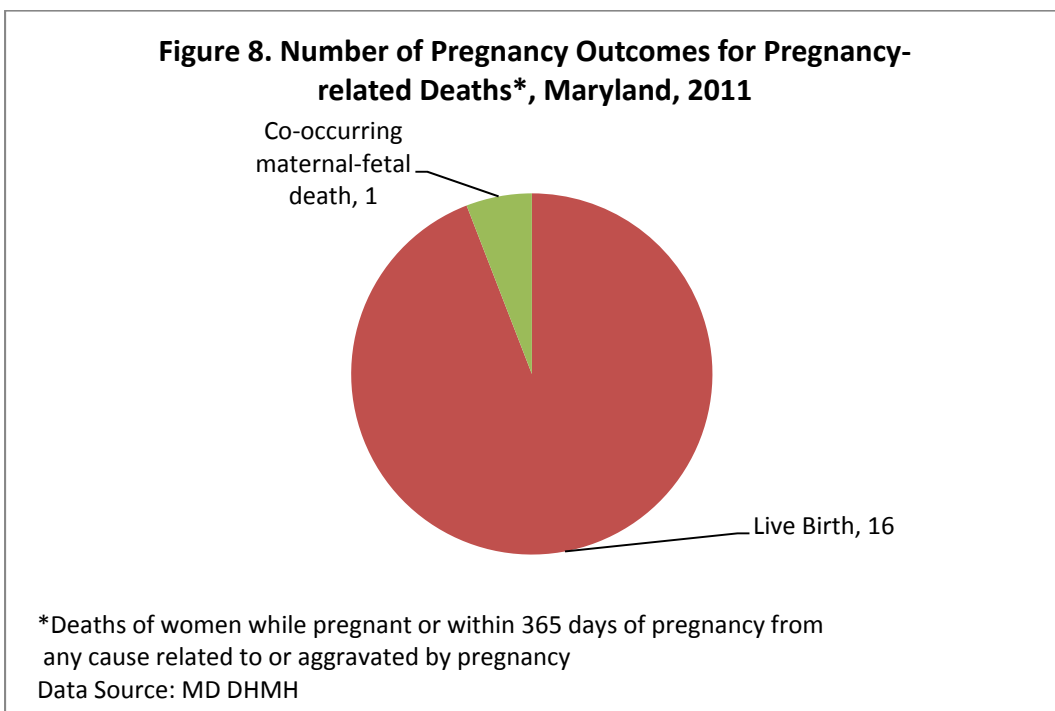
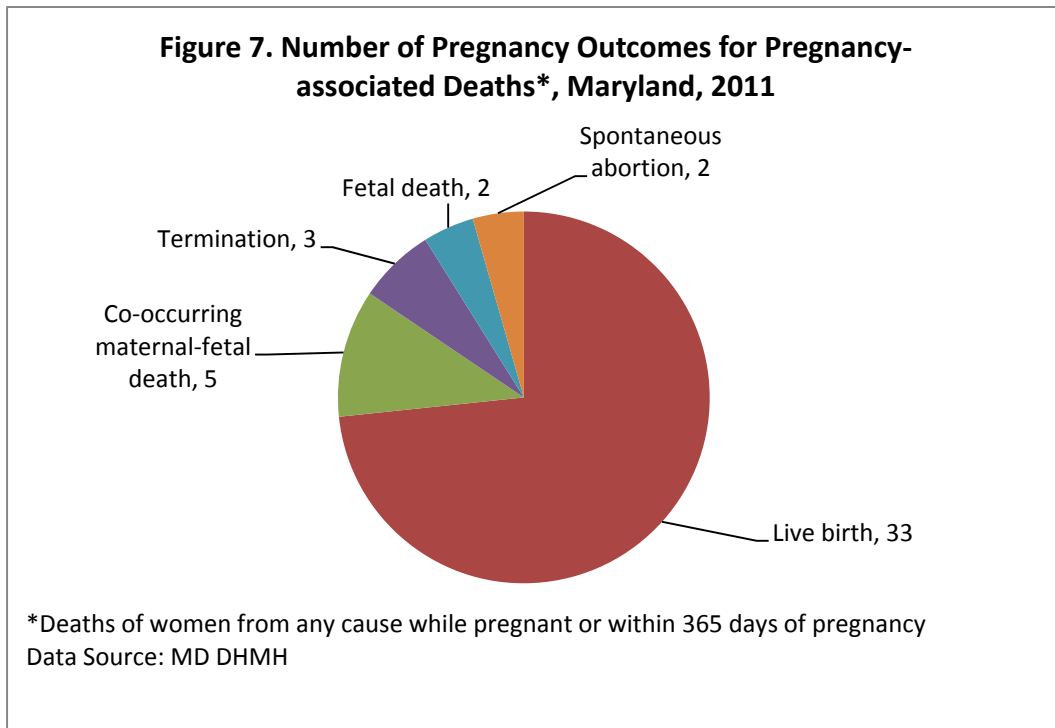
CASES BY TIMING OF DEATH IN RELATION TO PREGNANCY

Of all pregnancy-associated deaths in 2011, 13 percent occurred during pregnancy, 33 percent within 42 days postpartum, 42 percent occurred between 43-365 days postpartum, and 11 percent died following a spontaneous abortion (SAB) or termination (see Figure 5). Among pregnancy-related deaths in 2011, 6 percent occurred during pregnancy, 71 percent occurred within 42 days postpartum, and 24 percent occurred between 43-365 days postpartum (see Figure 6).



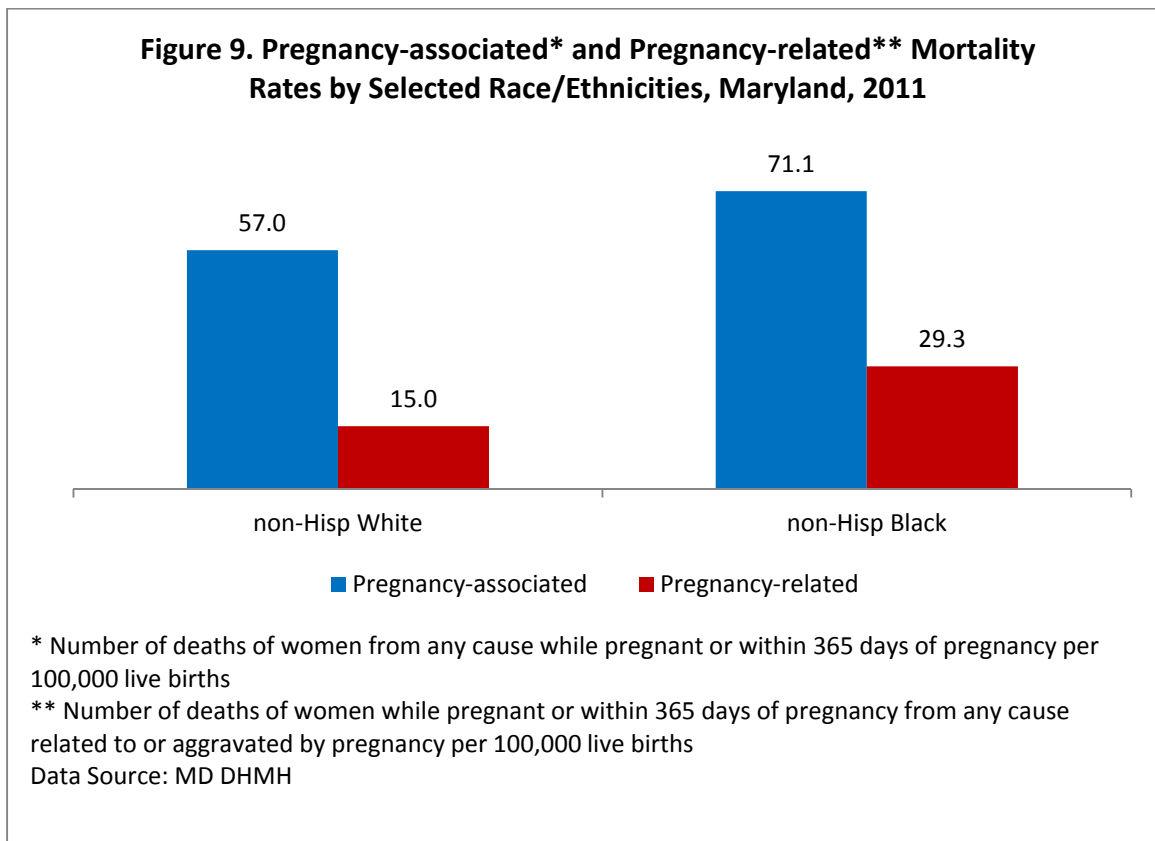
CASES BY OUTCOME OF PREGNANCY

In 2011, among pregnancy-associated death cases, 73 percent had a live birth, 11 percent had co-occurring maternal-fetal deaths, 6 percent had terminations, 4 percent had a fetal death, and 4 percent had spontaneous abortions as shown in Figure 7. Among pregnancy-related death cases, 94 percent had live births and 6 percent were co-occurring maternal-fetal deaths (see Figure 8).



CASES BY MATERNAL RACE AND ETHNICITY

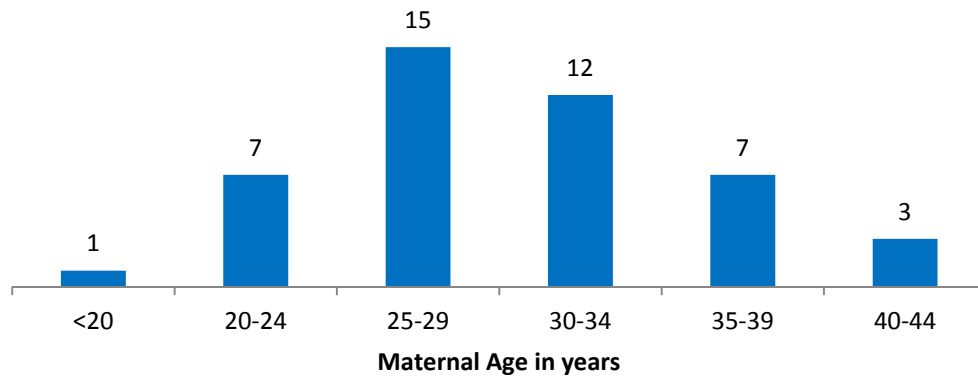
Selected racial distributions of pregnancy-associated and pregnancy-related mortality rates in 2011 are shown in Figure 9. There were 19 pregnancy-associated deaths among non-Hispanic White women, 17 deaths among non-Hispanic Blacks, 4 non-Hispanic Asian deaths, and 1 death each among non-Hispanic other race and Hispanic women (rates for race/ethnicities with fewer than 5 deaths are not displayed). There were 5 pregnancy-related deaths among non-Hispanic White women, 7 deaths among non-Hispanic Blacks, 3 non-Hispanic Asian deaths, and 2 deaths among Hispanic women (rates for race/ethnicities with fewer than 5 deaths are not displayed).



CASES BY MATERNAL AGE

The distribution of pregnancy-associated deaths by maternal age group is shown in Figure 10. The highest pregnancy-associated mortality rate occurred among women ages 25-29 years, at 74.6 deaths per 100,000 live births. The lowest rate occurred among women ages 20-24 years, at 49.6 deaths per 100,000 live births. Intermediate were death rates for women ages 30-34 years at 58.7 deaths per 100,000, and women ages 35-39 years at 65.9 deaths per 100,000 live births. (Death rates for women <20 and >39 years are not reported due to small numbers of deaths leading to unstable rates).

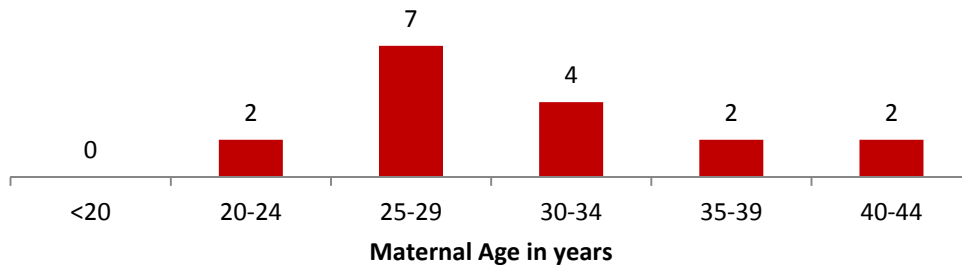
Figure 10. Number of Pregnancy-associated Deaths* by Maternal Age, Maryland, 2011



* Number of deaths of women from any cause while pregnant or within 365 days of pregnancy
 Data Source: MD DHMH

The distribution of pregnancy-related deaths by maternal age group is shown in Figure 11. The pregnancy-related death rate among women ages 25-29 years was 34.8 per 100,000 live births. (Death rates for other age groups are not reported due to small numbers of deaths leading to unstable rates).

Figure 11. Number of Pregnancy-related Deaths* by Maternal Age, Maryland, 2011

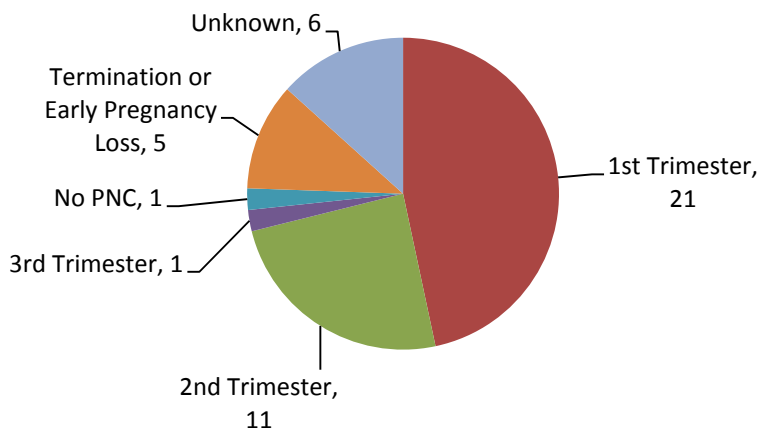


* Number of deaths of women while pregnant or within 365 days of pregnancy from any cause related to or aggravated by pregnancy
 Data Source: MD DHMH

CASES BY TIMING OF PRENATAL CARE INITIATION

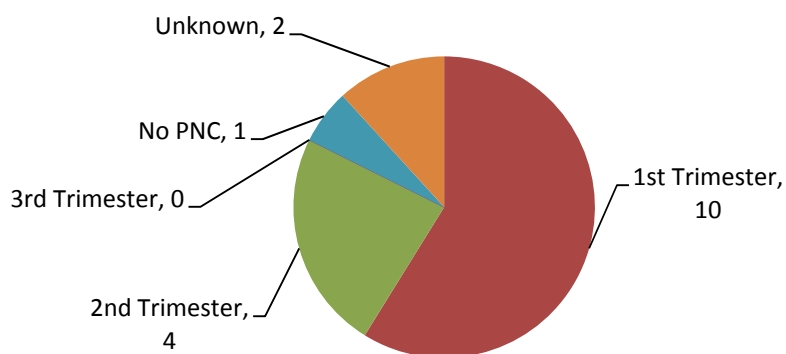
The distribution of pregnancy-associated and pregnancy-related deaths by the trimester when women initiated prenatal care are shown in Figures 12 and 13, respectively. Forty-seven percent of pregnancy-associated deaths were among women who initiated care in the first trimester of pregnancy. Fifty-nine percent of the pregnancy-related deaths were among women who received first trimester prenatal care.

Figure 12. Number of Pregnancy-associated Deaths* by Timing of Prenatal Care Initiation, Maryland, 2011



*Deaths of women from any cause while pregnant or within 365 days of pregnancy
Data Source: MD DHMH

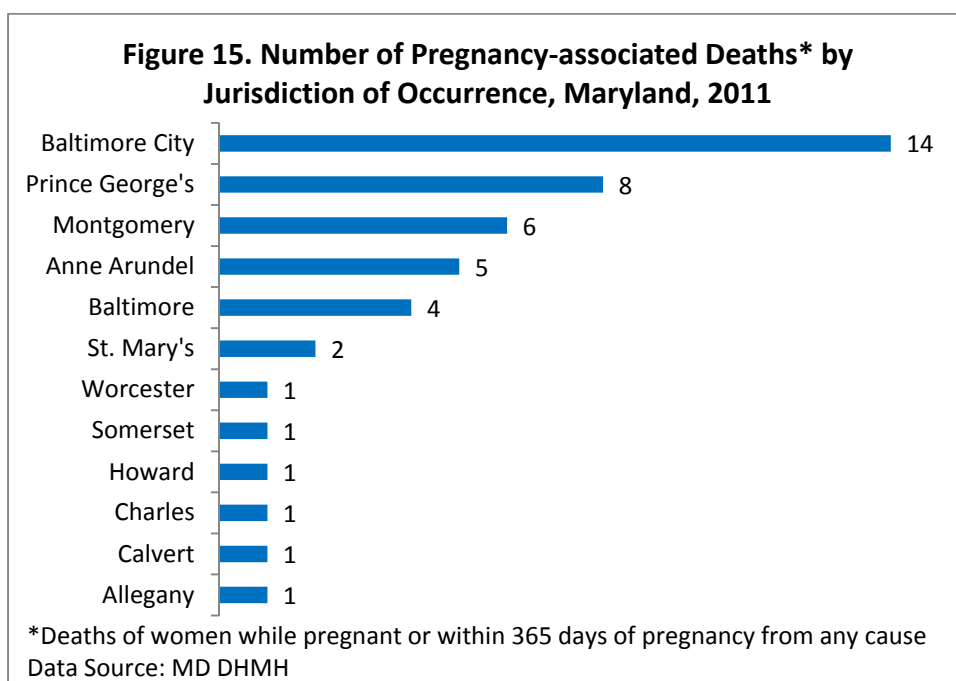
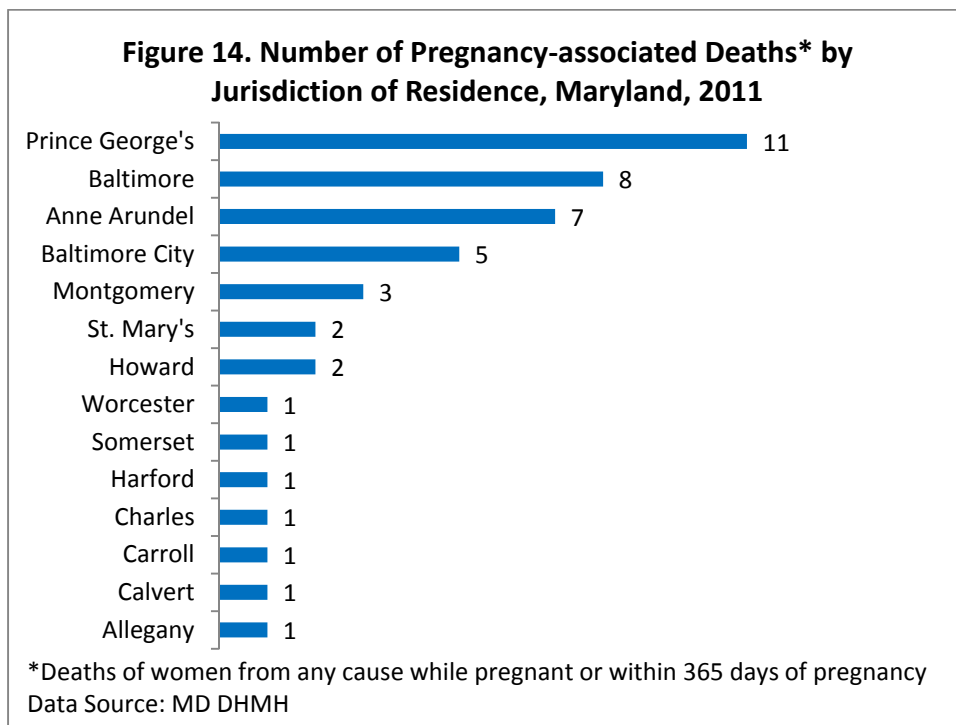
Figure 13. Number of Pregnancy-related Deaths* by Timing of Prenatal Care Initiation, Maryland, 2011



*Deaths of women while pregnant or within 365 days of pregnancy from any cause related to or aggravated by pregnancy
Data Source: MD DHMH

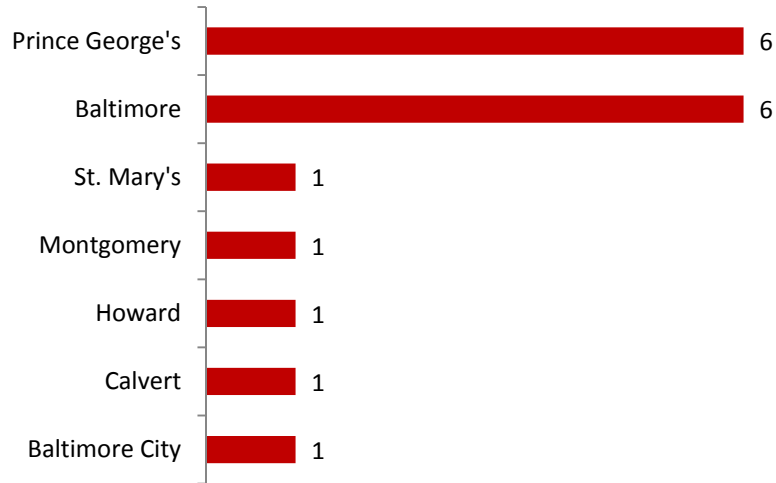
CASES BY JURISDICTION OF RESIDENCE AND OCCURRENCE

Twenty-four percent of the 2011 pregnancy-associated deaths were among residents of Prince George's County (see Figure 14). Thirty-one percent of the pregnancy-associated deaths occurred in Baltimore City (see Figure 15).



In 2011, 70 percent of pregnancy-related deaths were among residents of Prince George's County and Baltimore County (see Figure 16). Twenty-nine percent of the pregnancy-related deaths occurred in Baltimore City (see Figure 17).

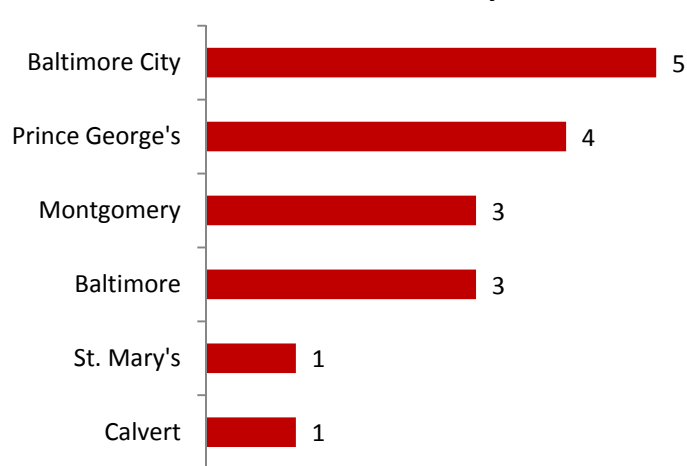
Figure 16. Number of Pregnancy-related Deaths* by Jurisdiction of Residence, Maryland, 2011



*Deaths of women while pregnant or within 365 days of pregnancy from any cause related to or aggravated by pregnancy

Data Source: MD DHMH

Figure 17. Number of Pregnancy-related Deaths* by Jurisdiction of Occurrence, Maryland, 2011



*Deaths of women while pregnant or within 365 days of pregnancy from any cause related to or aggravated by pregnancy

Data Source: MD DHMH

FOCUS ON HEMORRHAGE DEATHS

Obstetric hemorrhage is a major cause of maternal morbidity and one of the leading causes of maternal mortality in both developed and developing countries (Mousa and Alfirevic, 2003; Clark et al., 2008) and is increasing in incidence. Nationwide, postpartum hemorrhage has increased more than 25 percent since the mid-1990s (Callaghan et al., 2010; Bateman et al., 2010). Over the same period, blood transfusions increased 92 percent during delivery hospitalizations (Kuklina et al., 2009). Timely and accurate diagnosis of obstetric hemorrhage is critical to initiate appropriate interventions and to improve outcomes.

Between 2001 and 2011, there were 19 pregnancy-related deaths due to hemorrhage identified in Maryland. Of these 19 deaths due to hemorrhage, 10 occurred in 2010 and 2011, five in each year. Hemorrhage was the leading cause of pregnancy-related death in both years. Among the 2010 and 2011 hemorrhage deaths, maternal age at death ranged widely from 22 to 41 years. When disaggregated by race, six deaths were among Black women, three deaths among White women, and one among Asian women. The numbers of deaths by race were too small to compute stable rates; however, the number of births to White women in 2010 and 2011 was substantially higher than births to Black women, indicating a racial disparity among hemorrhage deaths.

Multiple risk factors for obstetric hemorrhage have been identified (Lockwood et al., 2013; Lyndon et al., 2010). Strong risk factors for obstetric hemorrhage include placenta previa, placenta accreta, preeclampsia, clotting factor abnormality, anemia, prolonged labor, induced or augmented labor, ruptured uterus, and general anesthesia. Moderate risk factors include prior cesarean birth(s) or uterine surgery, grand multiparity, large fetus or multiple gestation, chorioamnionitis, prior deliveries with hemorrhage, large uterine fibroids, and morbid obesity. The presence of multiple risk factors may increase the risk of hemorrhage (Lyndon et al., 2010; ACOG, 2006).

Of the 10 pregnancy-related hemorrhage deaths in Maryland in 2010 and 2011, all had at least two risk factors associated with hemorrhage; one death had five risk factors present. Preeclampsia was the most common risk factor, present in five of the deaths. Induced labor was present in four of the deaths. Prior cesarean section, morbid obesity, and placenta previa were each present in three of the hemorrhage deaths. Other risk factors present in one or two deaths included prior postpartum hemorrhage, chorioamnionitis, placenta accreta, clotting abnormalities, anemia, ruptured uterus, and general anesthesia. Eight of the 10 hemorrhage deaths were felt to be preventable or potentially preventable.

Several issues were identified in review of the hemorrhage death cases. These included poor quantification of blood loss, underestimation of blood loss, delayed or inadequate replacement with blood products, and lack of a protocol for response to massive hemorrhage.

The following recommendations were developed by the MMR Committee in response to the review of obstetric hemorrhage deaths:

1. Blood loss during pregnancy, delivery, and early postpartum periods should be assessed routinely and accurately. Every delivery hospital should develop a plan to maximize accuracy in determining blood loss.
2. Every delivery hospital should have a written protocol to respond to massive obstetric hemorrhage. This should include coordination among physicians, nurses, anesthesiologists, and the blood bank. It should indicate which personnel may activate the protocol, address the number of units of various blood products to be made available in an emergency situation, and emphasize the rapid pace at which blood products must be made available.

3. Every delivery hospital should provide hospital staff regular and ongoing trainings or simulations to ensure effective management of obstetric hemorrhage.

The MMR Committee has shared its findings and recommendations on obstetric hemorrhage with the Department's Perinatal Clinical Advisory Committee, which is currently updating the Maryland Perinatal System Standards for all delivery hospitals in the State. The Advisory Committee has voted to add a standard requiring all Maryland delivery hospitals to have a protocol in place to respond to obstetric hemorrhage, and a plan to improve quantitative measurement of blood loss.

The MMR Committee will help provide resources to Maryland delivery hospitals to develop a hemorrhage response protocol and disseminate these resources through the Maryland Patient Safety Center Perinatal-Neonatal Learning Network, the Maryland Hospital Association, and professional organizations, such as ACOG. One excellent resource is the California Maternal Quality Care Collaborative Obstetrical Hemorrhage Toolkit, available at http://www.cmqcc.org/ob_hemorrhage. The Toolkit includes a compendium of best practices; care guidelines; sample forms for policy and procedure, risk assessment, quantitative measurement of blood loss, and quality improvement implementation; a hospital implementation guide; and a slide set for professional education. The MMR Committee looks forward to working with Maryland delivery hospitals to reduce future deaths from obstetric hemorrhage.

SUMMARY

Maryland continues to have a slightly higher maternal mortality rate compared to the U.S. average, and substantially higher than the Healthy People 2020 goal of 11.4 deaths per 100,000 live births. This in part reflects Maryland's increased surveillance efforts to accurately identify maternal deaths in the State. Maryland has been at the forefront of states working to implement enhanced surveillance methods to identify pregnancy-associated deaths. These methods include revision of the death certificate to include questions about pregnancy within the year prior to death, review of medical examiner records, linkage of women's death certificates with birth certificates and fetal death certificates from the previous year, and detailed case review by the MMR Committee. Forty-five pregnancy-associated deaths were identified in 2011.

Non-cardiovascular medical conditions were the leading cause of pregnancy-associated deaths. All cases involving a death from medical causes, substance abuse, homicide, or suicide were reviewed for pregnancy-relatedness. Seventeen cases, including the four homicide deaths, were determined to be pregnancy-related, with the cause of death related to or aggravated by the pregnancy or its management. Hemorrhage was the leading cause of pregnancy-related deaths.

Moving forward, the Maternal Mortality Review Program will broaden its dissemination of findings and recommendations in this report, and promote communication and collaboration with providers outside of obstetrics (including substance abuse treatment and mental health) to support efforts to reduce pregnancy-related deaths in Maryland.

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http://www.cdc.gov/reproductivehealth/ProductsPubs/PDFs/Strategies_taged.pdf.

Appendix A

**Maryland Maternal Mortality Review
Case Discussion Guide**

Date: _____ Case # _____

Purpose: To review pregnancy-associated deaths in order to classify cases, identify trends in mortality, and develop recommendations for systems change.

Case Definition: Death of a woman while pregnant or within 365 days of pregnancy conclusion

1. Medical Care and Non-medical Causes Underlying the Death

Quality/content of medical care

- | | |
|--|--|
| <input type="checkbox"/> Preventive services | <input type="checkbox"/> Postpartum care and follow-up |
| <input type="checkbox"/> Community and patient education | <input type="checkbox"/> Management & treatment |
| <input type="checkbox"/> Nutrition, substance abuse, and social services | <input type="checkbox"/> Diagnostic procedures |
| <input type="checkbox"/> Preconception services | <input type="checkbox"/> Medical interventions |
| <input type="checkbox"/> Prenatal care | <input type="checkbox"/> Patient education and follow-up |
| <input type="checkbox"/> Labor and delivery services | |

Non-medical (social) causes underlying the death

- Intendedness of pregnancy
- Woman's and her family's knowledge about pregnancy & its possible complications
- Timeliness on the part of the woman in recognizing a problem & taking action
- Accessibility/acceptability of healthcare (cultural/experience/financial/geographic/transportation/logistic)
- Cultural competence and communication skills of health care providers
- Woman's adherence or non-adherence to medical advice and health interventions

2. Issues specific to this case

Individual Behavior: _____

Provider Practice: _____

Institutional/ Systems Issues: _____

Additional issues: _____

Sources of Information: _____

Information Missing: _____

1. Type of Case:

Pregnancy-related (causes related to or aggravated by pregnancy or its management)

Not Pregnancy-related (cause unrelated to pregnancy)

Undetermined

Due to: _____

2. This case was:

Preventable (individual provider institutional/systems issues)

Potentially Preventable (individual provider institutional/systems issues)

Undetermined

Not Preventable

3. Resources or services needed but not used or not available:

4. Recommendation(s) to address issues in this case:

