

MARYLAND DEPARTMENT OF HEALTH AND MENTAL HYGIENE  
FAMILY HEALTH ADMINISTRATION  
CENTER FOR MATERNAL AND CHILD HEALTH

**MARYLAND MATERNAL  
MORTALITY REVIEW  
2011 ANNUAL REPORT**

Martin O'Malley  
Governor

Anthony G. Brown  
Lieutenant Governor

Joshua M. Sharfstein, M.D.  
Secretary  
Department of Health & Mental Hygiene

Frances B. Phillips, R.N., M.H.A.  
Deputy Secretary, Public Health Services  
Department of Health & Mental Hygiene



## TABLE OF CONTENTS

ACKNOWLEDGEMENTS .....	4
BACKGROUND .....	5
METHODOLOGY .....	8
CASE FINDINGS.....	10
CLASSIFICATION OF DEATH	
TIMING OF DEATH IN RELATION TO PREGNANCY	
OUTCOME OF PREGNANCY	
MATERNAL RACE AND ETHNICITY	
MATERNAL AGE	
JURISDICTION OF MATERNAL RESIDENCE	
RECOMMENDATIONS.....	19
SUMMARY.....	20
REFERENCES .....	20
APPENDIX 1 .....	21
CASE DISCUSSION GUIDE	
APPENDIX 2 .....	23
ISSUES AND DISCUSSION 2008 AND 2009 PREGNANCY-RELATED DEATHS	



## ACKNOWLEDGEMENTS

This review of deaths would not be possible without the data, cooperation, and expertise of the Department's Vital Statistics Administration and the Office of the Chief Medical Examiner. The Maternal Mortality Review Program (the Program) would like to thank the volunteer participants for the hours spent in discussion and the serious attention given to this important public health project. The Program is also grateful for the diligent work of the case abstractors for their careful and thorough abstraction of the cases. Special thanks to all those who participated in this year's case review and policy meetings:

		<b>Hospital/ Affiliation</b>
Lillian	Blackmon, MD	MMR Meeting Chair, MedChi MCH Subcommittee
Joseph	Morris, MD	Anne Arundel Medical Center
Henry	Sobel, MD	Anne Arundel Medical Center
S. Patrick	Donegan, MD	Baltimore Washington Medical Center
Meena	Abraham, DrPH	Consultant
Sayeedha	Uddin, MD	Consultant
Diana	Cheng, MD	DHMH
Isabelle	Horon, DrPH	DHMH
Lee	Hurt, MS, MPH	DHMH
Marsha	Smith, MD, MPH	DHMH
S. Lee	Woods, MD, PhD	DHMH
Donovan	Dietrick, MD	Franklin Square Hospital Center
Fernando	Mena, MD	Franklin Square Hospital Center
Samuel	Smith, MD	Franklin Square Hospital Center
Katherine	Murray, MSN, RN	Frederick Memorial Hospital
James	Dorsey, MD	Greater Baltimore Medical Center, St. Agnes Hospital
Anne	Burke, MD	Holy Cross Hospital
Cynthia	Argani, MD	Johns Hopkins Bayview Medical Center
Lorraine	Milio, MD	Johns Hopkins Bayview Medical Center
Robert	Atlas, MD	Mercy Medical Center
Stephen	Schenkel, MD	Mercy Medical Center
Carla	Bailey, PhD, RN	MIEMSS
David	Fowler, MD	Office of the Chief Medical Examiner
Regina	Kundell, NEA-BC, FNP-BC	Peninsula Regional Medical Center
Ernest	Adadevoh, MD	Prince George's Hospital Center
Kathleen	Dallas, RN, BSN, MS	Shady Grove Adventist Hospital
Monica	Quin, RN	Shady Grove Adventist Hospital
Pedro	Arrabal, MD	Sinai Hospital
Stephen	Contag, MD	Sinai Hospital
Chelsea	Crabtree, MD	Sinai Hospital
David	Schwartz, MD	Sinai Hospital
Jacquelyn	Pelham, MD	St. Agnes Hospital
Judith	Rossiter, MD	St. Joseph Medical Center
Shafonya	Turner, MD	University of Maryland Medical Center
Stacey	Fisher, MD	University of Maryland Medical Center
Christopher	Harman, MD	University of Maryland Medical Center
Jan	Kriebs, CNM	University of Maryland Medical Center
Michelle	Kush, MD	University of Maryland Medical Center
Mishka	Terplan, MD	University of Maryland Medical Center



## BACKGROUND

During the 2000 Maryland General Assembly, Senate Bill 459 was enacted (Health-General Article, §§13-1201-1207, Annotated Code of Maryland) to establish 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 public. The three-year sunset provision was removed during the 2003 legislative session.

The Maryland Department of Health and Mental Hygiene (the Department) conducts maternal mortality reviews in consultation with MedChi, the Maryland State Medical Society. Funding has been made available from the Department's Center for Maternal and Child Health to MedChi since June 2001 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 (WHO) 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 ratios.
- The **maternal mortality ratio (MMR)** is defined as the number of maternal deaths per 100,000 live births in the same time period. MMR is also referred to as the "maternal mortality rate" by Healthy People 2020, WHO, and NCHS, but it is technically a ratio because the denominator only includes live births. This ratio is utilized for national and international comparisons.

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, regardless of the cause of death."
- The **pregnancy-associated mortality ratio (PAMR)** 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 ratio (PRMR)** is the number of pregnancy-related deaths per 100,000 live births.

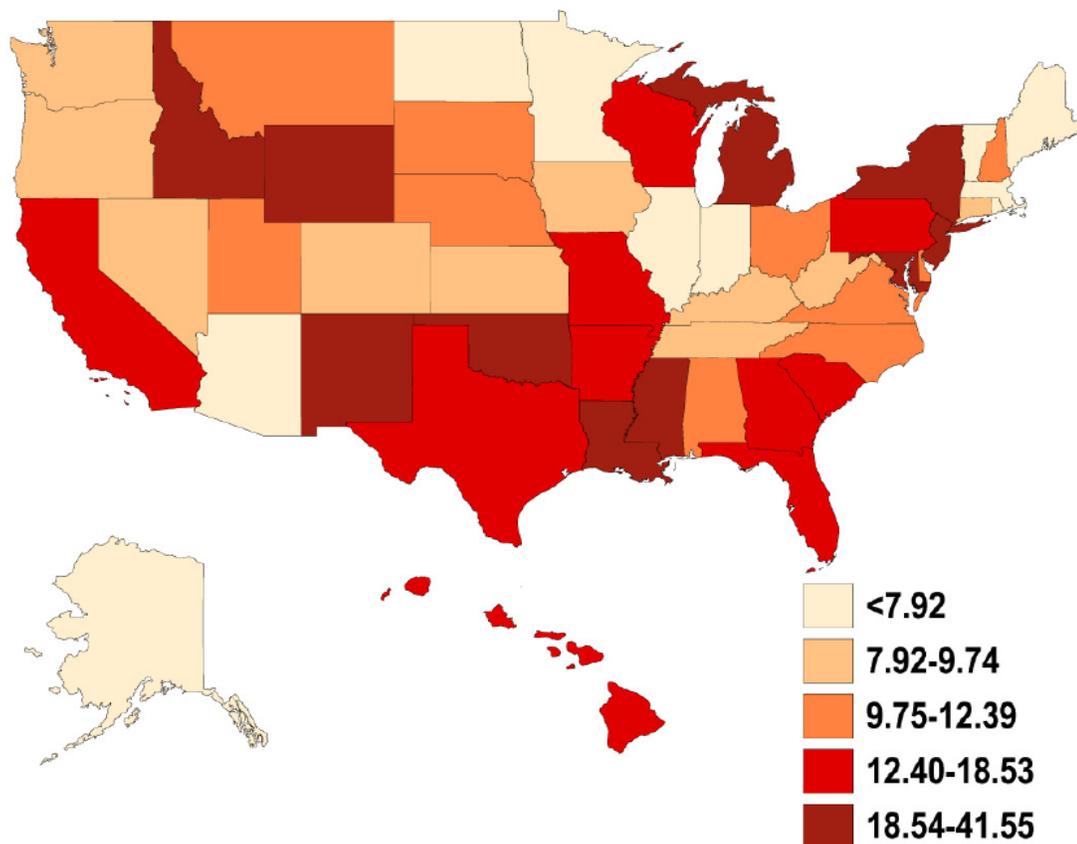
The three terms "maternal death," "pregnancy-associated death," and "pregnancy-related death" create a challenge when comparing data from different sources and reports for different jurisdictional entities. The NCHS uses strict criteria to define deaths to be included in the MMR based upon information 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 achieved its lowest levels in the early 1980s. However, the MMR rose in the 1990s, and has continued to rise since 2000. During the last two decades, maternal deaths from hemorrhage and hypertensive disorders have decreased. However, there appears to be an increase in deaths from other medical conditions, including cardiovascular and neurological problems. Some of the increase in MMR since the mid 1980s can be expected because of the recommended enhanced surveillance. Enhanced surveillance using multiple data sources, including case review, will lead to additional cases being identified at the State level. It is expected that as Maryland and other states enhance surveillance, the MMR will increase because of this improved identification process.

The Healthy People 2020 MMR target is 11.4 maternal deaths per 100,000 live births (MICH-5). This goal ratio is significantly higher than the Healthy People 2010 goal of 3.3 maternal deaths per 100,000 live births, which was not met. Maryland's MMR is higher than the national ratio. The average national MMR for 2003-2007 (the most recent 5-year interval for which U.S. data are available) was 13.3 maternal deaths per 100,000 live births. For the same period, Maryland's MMR was 18.7.

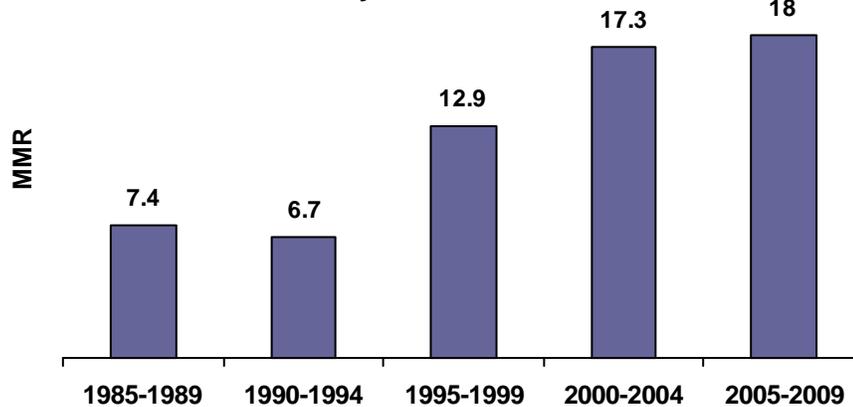
**Figure 1: U.S. Maternal Mortality Rates per 100,000 Live Births by State, 2003-2007.**



Data Source: *Maternal Mortality in the United States, 1935-2007*. US Department of Health and Human Services

Although Maryland's high MMR is concerning, it is also a reflection of Maryland's intense efforts to more accurately identify maternal deaths in the State since the mid-1990s. Maryland was the first state to implement enhanced surveillance methods to identify maternal deaths. These methods include review of medical examiner records, linkage of women's death certificates with birth certificates and fetal death certificates within the previous year, and detailed case review by the Maternal Mortality Review Committee. To further 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 more than doubling of the number of maternal deaths identified in Maryland compared with data from the 1980s and early 1990s (Figure 2).

**Figure 2. Maternal Mortality Ratio, Maryland, 1985-2009**



### ***Racial Disparity***

In the U.S., Black women have an MMR more than three times greater than that for white women, a disparity that has persisted since the 1940s. In Maryland, the MMR for Black women is also over three times the MMR for white women. The State's MMRs for Black and white women are both slightly higher than the U.S. averages. Figure 3 provides a comparison between the maternal mortality ratio for the U.S. and Maryland by race. A five-year average ratio is used because maternal deaths are relatively infrequent events that may vary considerably year-to-year, particularly in a small state like Maryland.

**Figure 3. Maternal Mortality Ratios by Race, Maryland and U.S., 2003-2007**

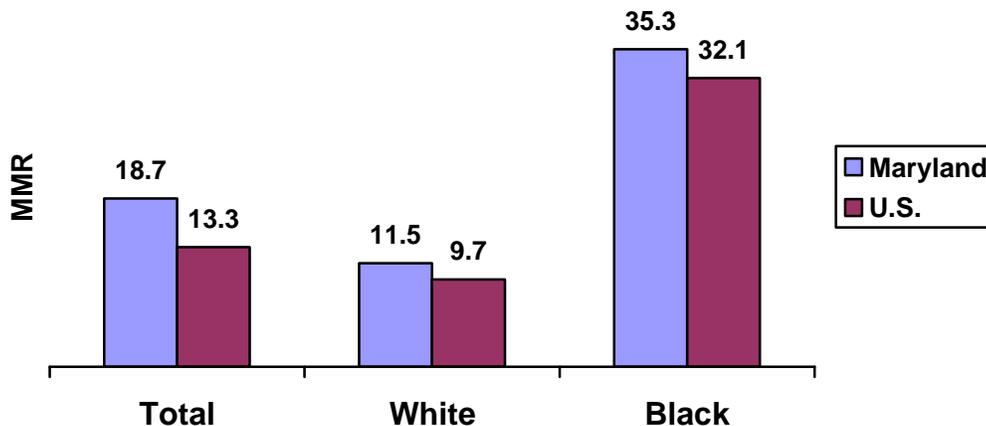
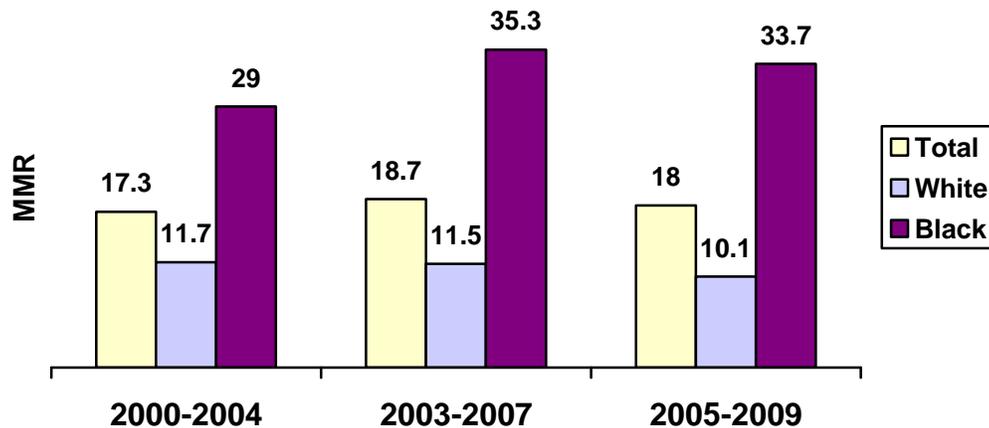


Figure 4 shows the MMR by race in Maryland for three overlapping 5-year periods over the past decade. Compared to 2000-2004, the 2005-2009 white MMR in Maryland decreased 14 percent and the Black MMR increased 16 percent. The 2005-2009 Black MMR remains over three times higher than the white MMR.

**Figure 4. Maternal Mortality Ratios by Race, Maryland, 2000-2009**



## METHODOLOGY

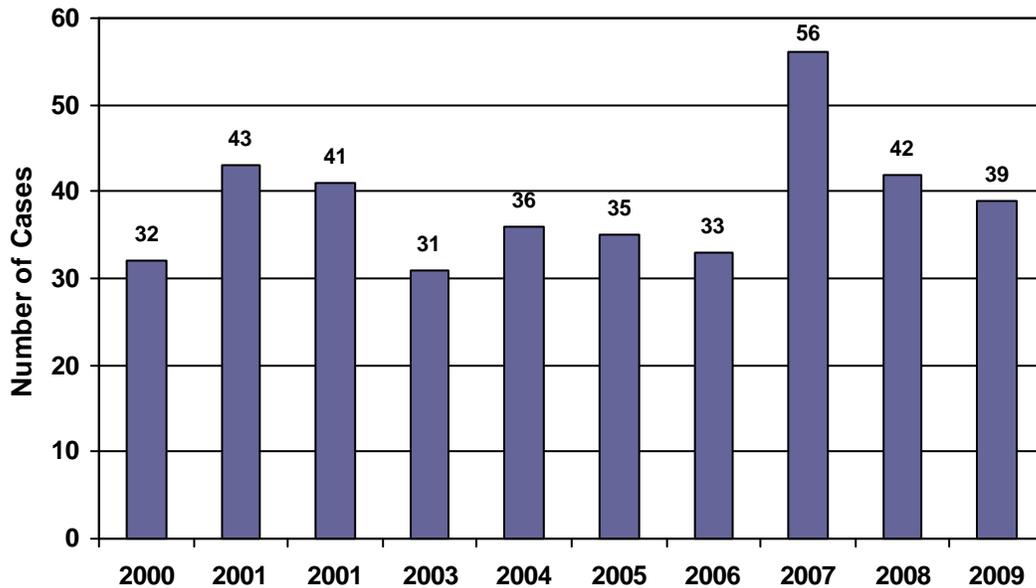
### *Case Identification*

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 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 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 41 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 from 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 by examining death certificates alone. Thirdly, cases are identified through a manual review of files from deaths reported to the Office of the Chief Medical Examiner (OCME), also looking for 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, 42 pregnancy-associated deaths were identified in 2008 and 39 such deaths were identified in 2009. The purpose of this report is to review these 81 deaths. Figure 5 shows the numbers of pregnancy-associated deaths in Maryland from 2000 to 2009. There was an average of 39 pregnancy-associated deaths per year during this period.

**Figure 5. Pregnancy-Associated Deaths, Maryland, 2000-2009**



### **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 case summaries on those cases that will go to workgroups of the Committee for review of pregnancy-relatedness. All 2008 and 2009 cases involving a death from medical causes, substance abuse, 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 Center for Maternal and Child Health, Vital Statistics Administration, and the Office of the Chief Medical Examiner. 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 1, *MMR Case Discussion Guide*).

Medical, non-medical, and social causes underlying the maternal death include factors such as:

- Intendedness of pregnancy
- Woman's and her family's knowledge about pregnancy
- Timeliness on the part of the woman in recognizing a problem
- Accessibility and acceptability of health care
- Cultural competence and communication skills of health care providers
- Woman's adherence or non-adherence to medical advice and health interventions
- Individual factors such as pre-existing medical conditions, obesity, and substance abuse

Quality and content of medical care on a care-team and institutional level includes factors such as:

- Preventive services
- Community and patient education
- Nutrition, substance abuse and social services
- Preconception services
- Prenatal care
- Labor and delivery services

- Postpartum care and follow-up
- Treatment and management
- Diagnostic procedures
- Medical interventions
- Patient education and follow-up

Cases discussed by the MMR Committee workgroups are de-identified and members sign confidentiality agreements. The full MMR Committee then meets to review issues identified through case reviews and to develop recommendations.

## CASE FINDINGS

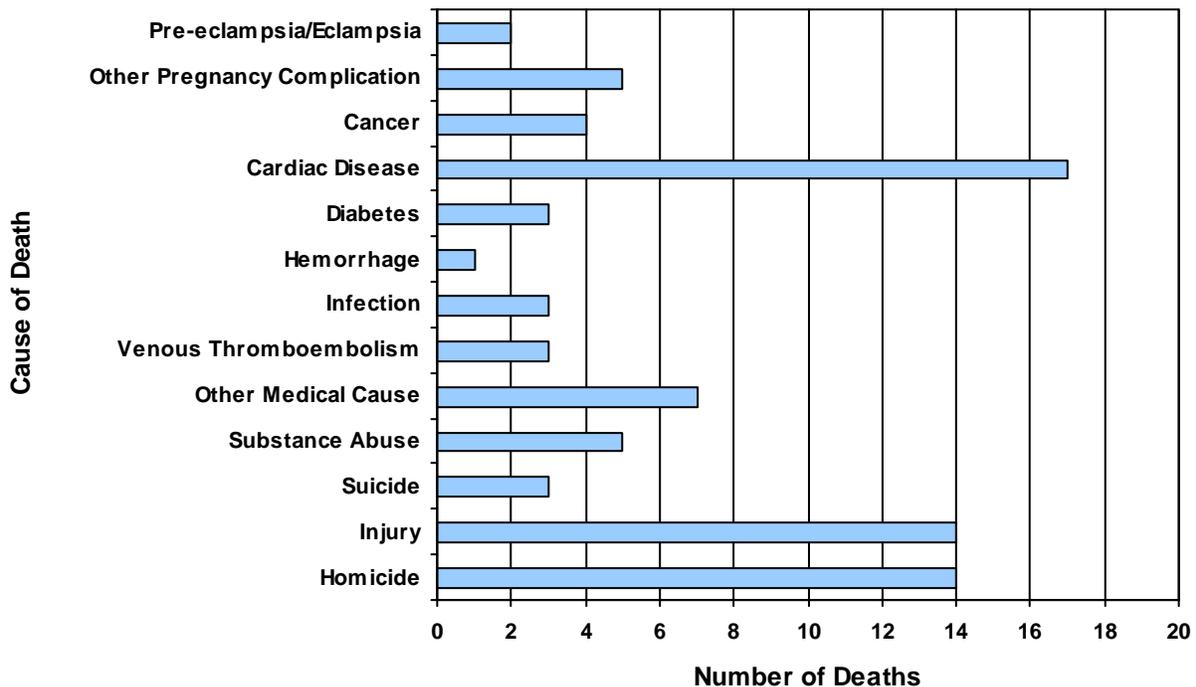
A total of 81 pregnancy-associated deaths were identified in 2008 and 2009 for a pregnancy-associated mortality ratio of 53.2 maternal deaths per 100,000 live births for the two-year period. Of the 81 deaths, 22 were determined to be pregnancy-related, while the remaining 59 were either determined to not be related to pregnancy or the relatedness to pregnancy could not be determined. The resulting pregnancy-related mortality ratio was 14.5 maternal deaths per 100,000 live births for the same period.

## CASES BY CLASSIFICATION OF DEATH

### *Pregnancy-Associated Deaths*

The leading causes of pregnancy-associated deaths in 2008 and 2009 were cardiac disease (including cardiomyopathy), followed by unintentional injury and homicide. Fifty-six percent of pregnancy-associated deaths were due to natural causes (excluding unintentional injury, homicide, substance abuse, and suicide). An additional 17 percent were due to unintentional injury, 17 percent to homicide, 6 percent to substance abuse, and 4 percent to suicide. Figure 6 shows the categories of causes of pregnancy-associated deaths.

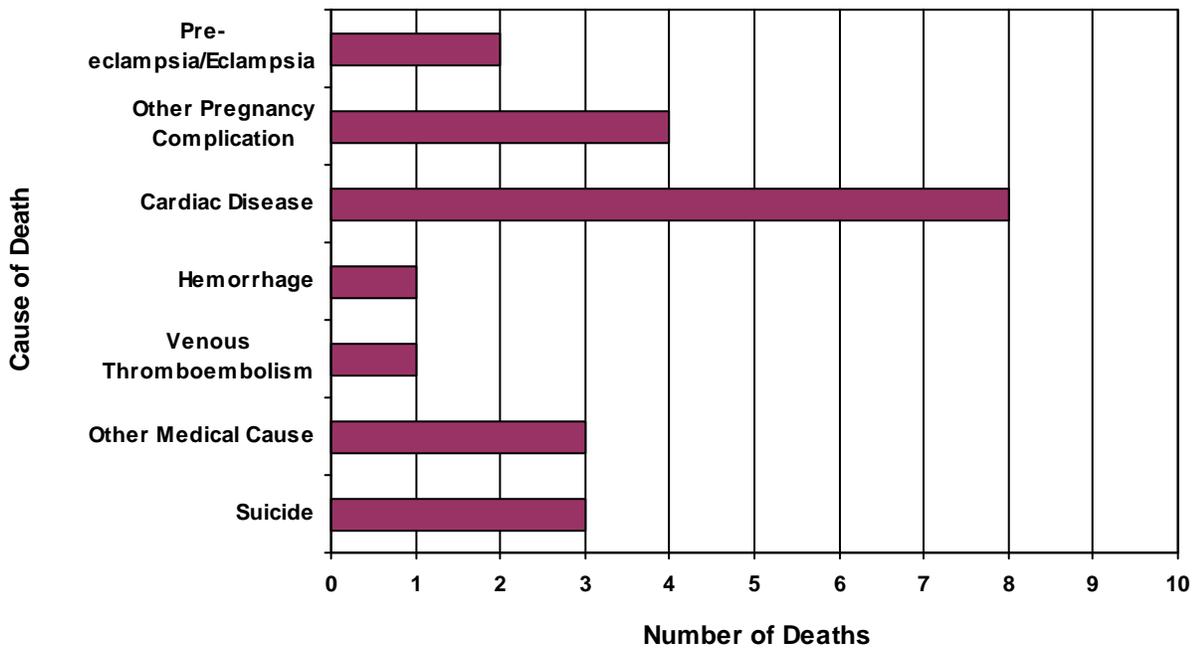
**Figure 6. Categories of Causes of Pregnancy-Associated Death, Maryland, 2008-2009**



### Pregnancy-Related Deaths

Among the 22 pregnancy-related deaths in 2008 and 2009, the leading cause of death was cardiac disease (including cardiomyopathy), accounting for 36 percent of pregnancy-related deaths. Pregnancy complications combined accounted for an additional 27 percent of pregnancy-related deaths. Three suicide deaths were considered to be pregnancy-related. All three women had been on psychiatric medication prior to pregnancy. Their medications were discontinued by psychiatric providers because of their pregnancy, resulting in depression in two cases and psychosis in the third not being managed optimally, contributing to the suicides. Figure 7 shows the categories of causes of pregnancy-related deaths.

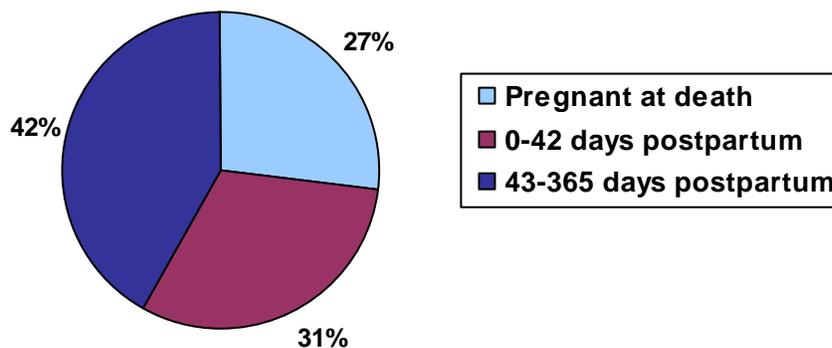
**Figure 7. Categories of Causes of Pregnancy-Related Death, Maryland, 2008-2009**



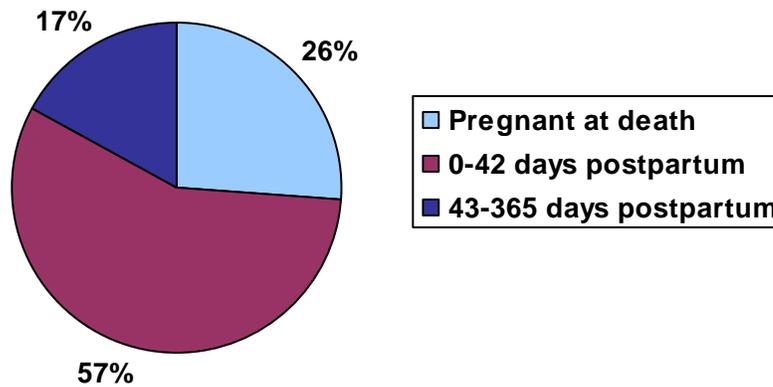
### CASES BY TIMING OF DEATH IN RELATION TO PREGNANCY

Of all pregnancy-associated deaths in 2008 and 2009, 27 percent occurred during pregnancy, 31 percent within 42 days postpartum, and 42 percent occurred between 43-365 days postpartum (Figure 8). Among pregnancy-related deaths in 2008 and 2009, a similar percentage occurred during pregnancy, but a higher percentage (52 percent) occurred within 42 days postpartum (Figure 9).

**Figure 8. Percentage Distribution of Timing of Pregnancy-Associated Deaths, Maryland, 2008-2009**



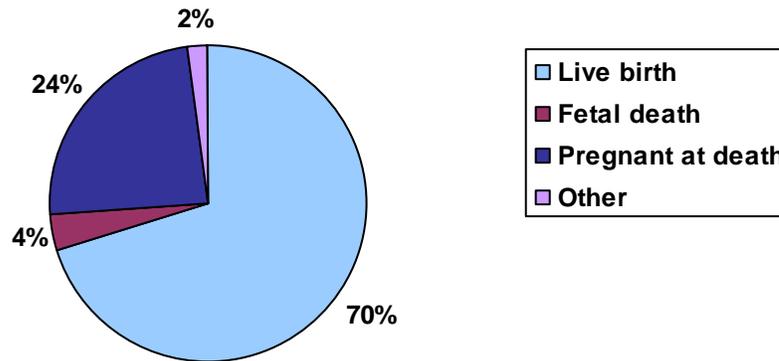
**Figure 9. Percentage Distribution of Timing of Pregnancy-Related Deaths, Maryland, 2008-2009**



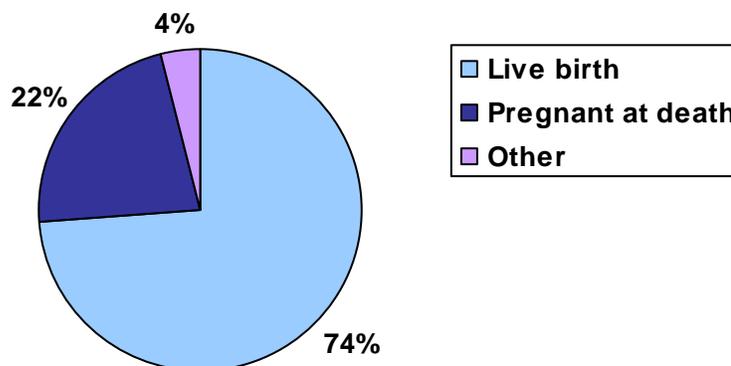
**CASES BY OUTCOME OF PREGNANCY**

In 2008 and 2009, among pregnancy-associated death cases, 70 percent had a live birth and 23 percent were pregnant at time of death, as shown in Figure 10. Among pregnancy-related death cases, the pregnancy outcomes were very similar with 74 percent live births and 22 percent pregnant at time of death (Figure 11).

**Figure 10. Pregnancy Outcome for Pregnancy-Associated Deaths, Maryland, 2008-2009**



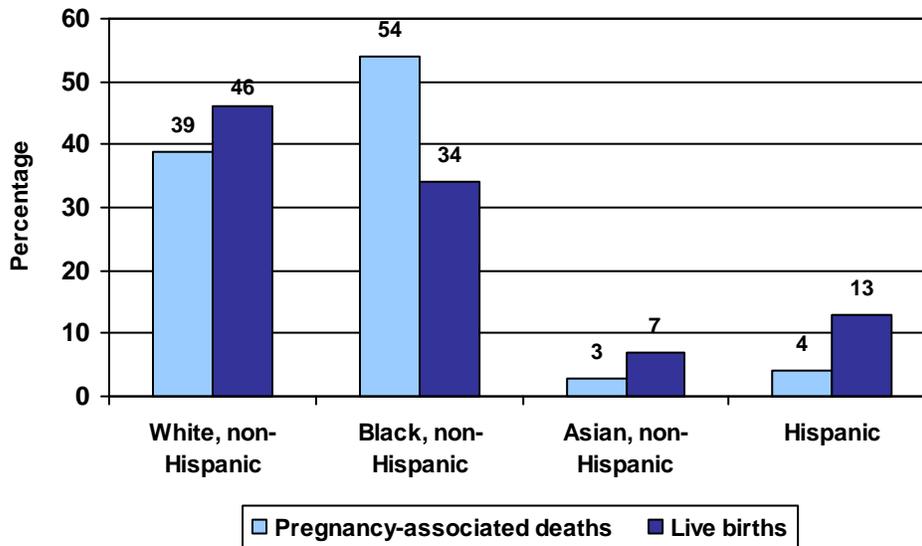
**Figure 11. Pregnancy Outcome for Pregnancy-Related Deaths, Maryland, 2008-2009**



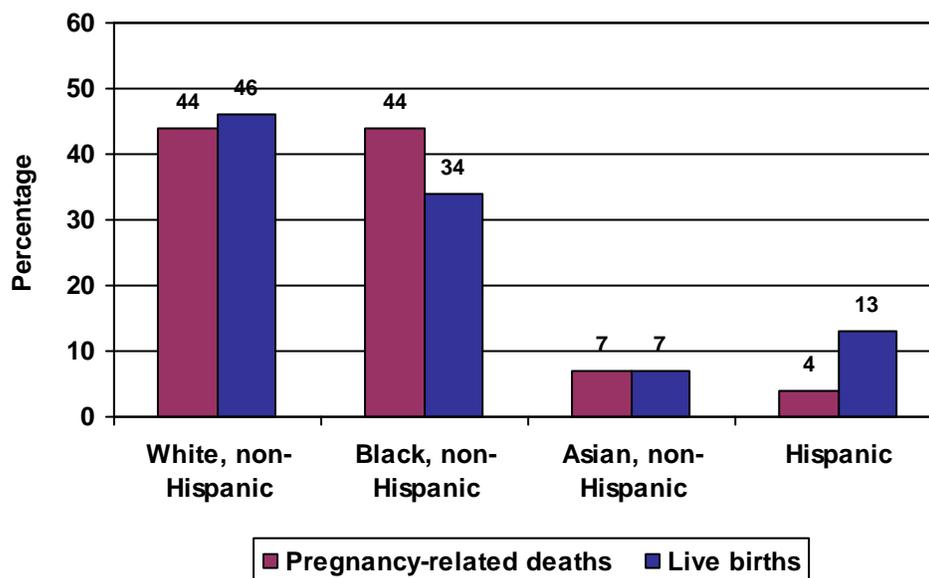
## CASES BY MATERNAL RACE AND ETHNICITY

The racial distributions of pregnancy-associated and pregnancy-related deaths in 2008-2009 are shown in Figures 12 and 13 respectively. Among the 81 pregnancy-associated deaths, the highest percentage occurred among Black women. Compared to the distribution of live births, Black women are over-represented among pregnancy-associated maternal deaths. Black women are similarly over-represented among pregnancy-related deaths for 2008-2009 compared to the distribution of live births, as shown in Figure 13.

**Figure 12. Percentage Distribution of Pregnancy-Associated Deaths and Live Births by Race / Ethnicity, Maryland, 2008-2009**



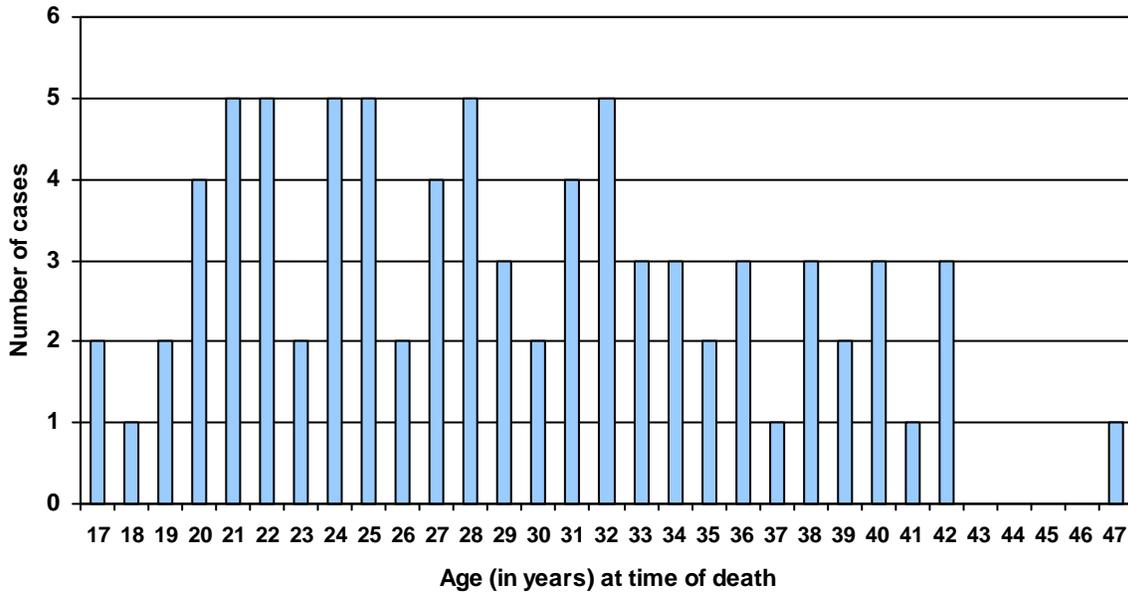
**Figure 13. Percentage Distribution of Pregnancy-Related Deaths and Live Births by Race / Ethnicity, Maryland, 2008-2009**



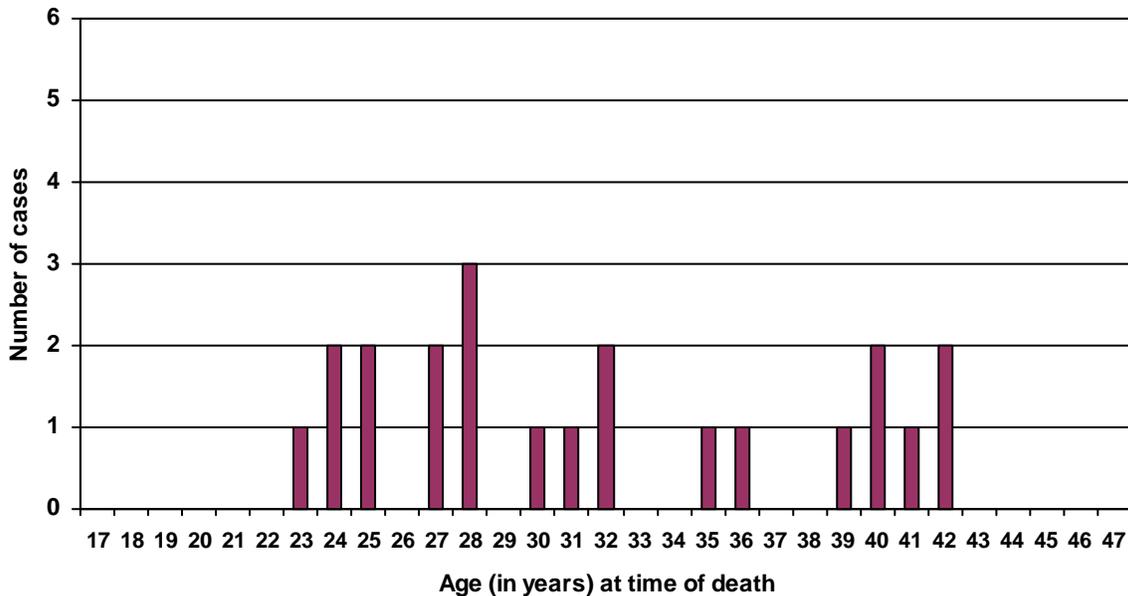
## CASES BY MATERNAL AGE

The ages of decedents for pregnancy-associated deaths in 2008 and 2009 ranged from ages 17 to 47 years, with an average age at death of 29.0 years (Figure 14). Pregnancy-related deaths occurred in women ranging in age from 23 to 42 years, with an average age of 31.8 years (Figure 15).

**Figure 14. Maternal Age, Pregnancy-Associated Deaths, Maryland, 2008-2009**

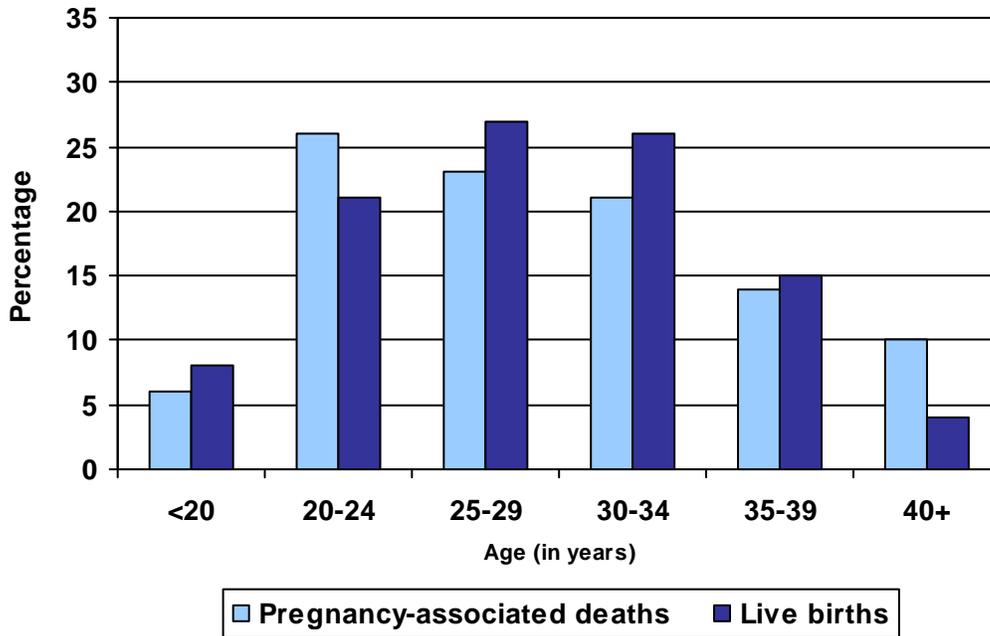


**Figure 15. Maternal Age, Pregnancy-Related Deaths, Maryland, 2008-2009**



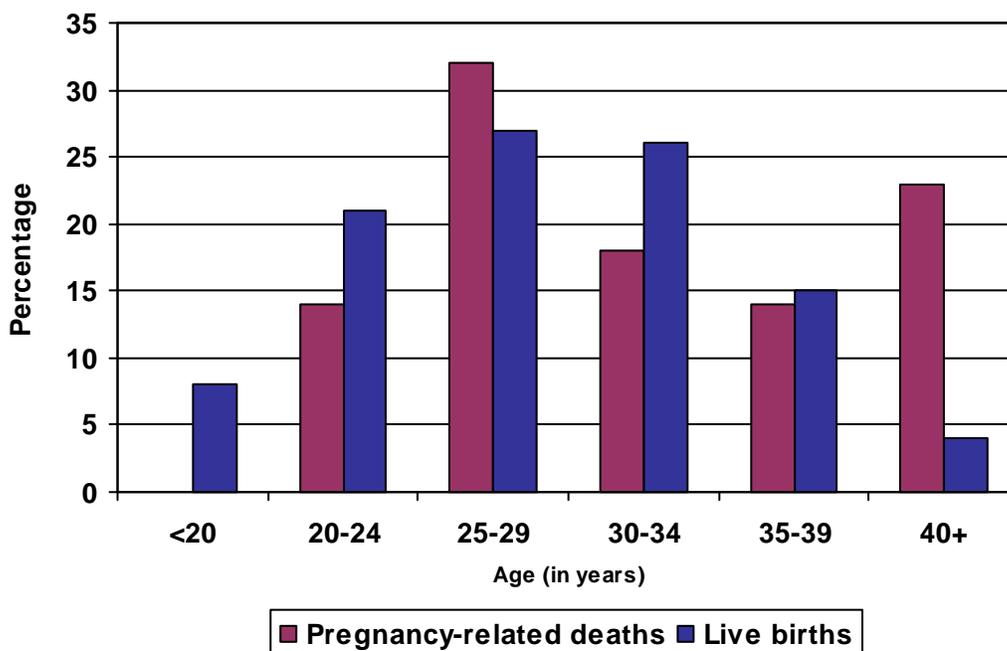
Women ages 20-24 and 40 years or older accounted for a greater proportion of pregnancy-associated deaths compared to live births (Figure 16). The over-representation of 20-24 year old women is largely due to homicide. The majority of decedents 40 years or older died of cardiac disease or complications of pregnancy.

**Figure 16. Pregnancy-Associated Deaths and Live Births by Maternal Age, Maryland, 2008-2009**



Pregnancy-related deaths are most over-represented relative to live births among women 40 years of age and older. All pregnancy-related deaths in this age group were due to cardiac disease and complications of pregnancy.

**Figure 17. Pregnancy-Related Deaths and Live Births by Maternal Age, Maryland, 2008-2009**

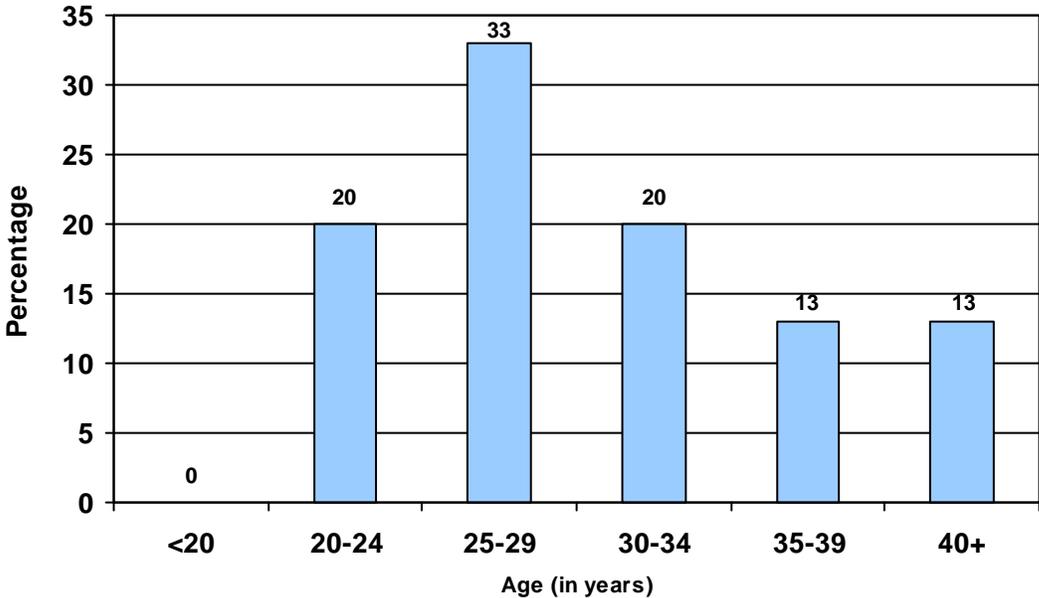


**CAUSES OF DEATH BY AGE**

*CARDIAC DISEASE*

Cardiac disease, including cardiomyopathy, was the leading cause of both pregnancy-associated and pregnancy-related deaths. Among pregnancy-associated deaths, the highest incidence of cardiac death was among women ages 25 to 29 years (Figure 18). Of the 17 pregnancy-associated cardiac deaths, nine were determined to be pregnancy-related. One third of pregnancy-related cardiac deaths were among women ages 25 to 29 years, with another one-third among women 40 or older. Three of the nine pregnancy-related cardiac deaths occurred in women who were overweight or obese, with a Body Mass Index (BMI) >30. In an additional four of these cases, weight status was not known, so obesity may have been a contributing factor for cardiac death in additional cases.

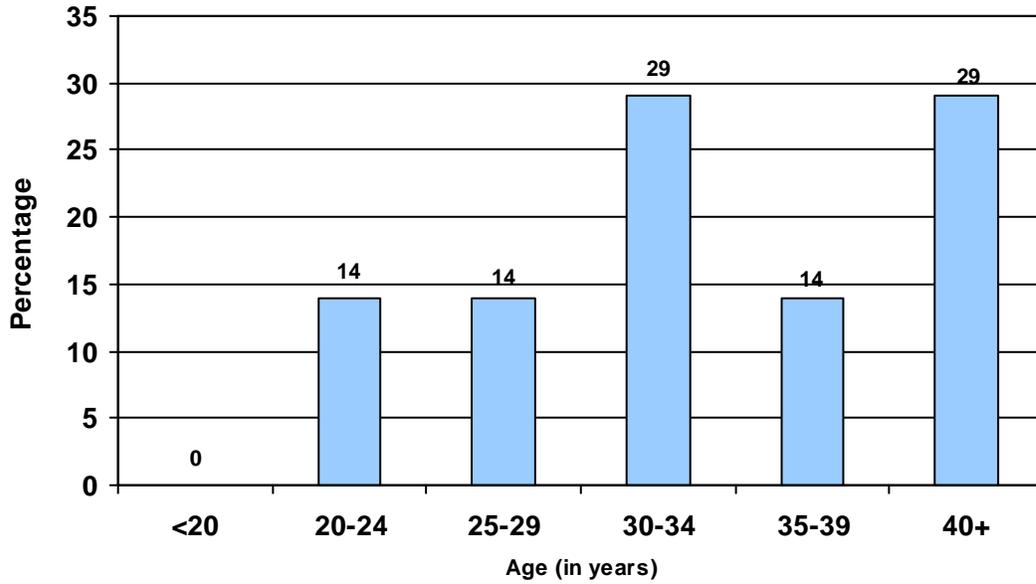
**Figure 18. Pregnancy-Associated Deaths Due to Cardiac Disease by Maternal Age, Maryland, 2008-2009**



*PREGNANCY COMPLICATIONS*

Pre-eclampsia, eclampsia, and other complications of pregnancy accounted for seven pregnancy-associated deaths. All but one were also considered to be pregnancy-related (in one case, it was not clear that the pregnancy complication was the immediate cause of death). Death due to pregnancy complications was more common in older women, with 72 percent of cases occurring among women ages 30 years or older (Figure 19).

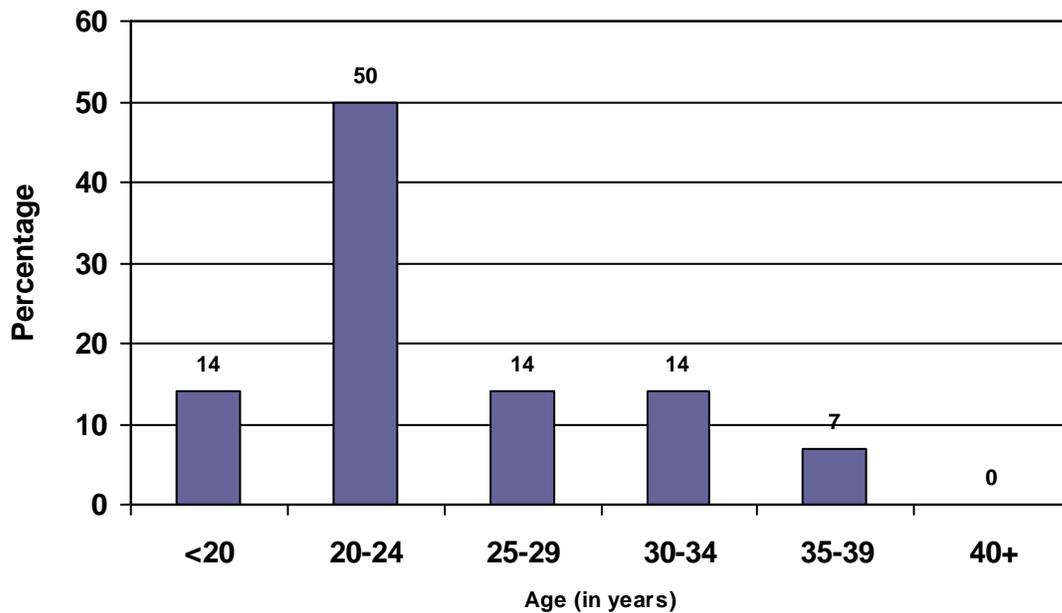
**Figure 19. Pregnancy-Associated Deaths Due to Pregnancy Complications by Maternal Age, Maryland, 2008-2009**



*HOMICIDE*

One-half of the pregnancy-associated homicides occurred among women ages 20 to 24 years, and 78 percent were among those under ages 30 years. Homicide was the leading cause of death among women ages 20 to 24 years, accounting for 35 percent of deaths in that age group.

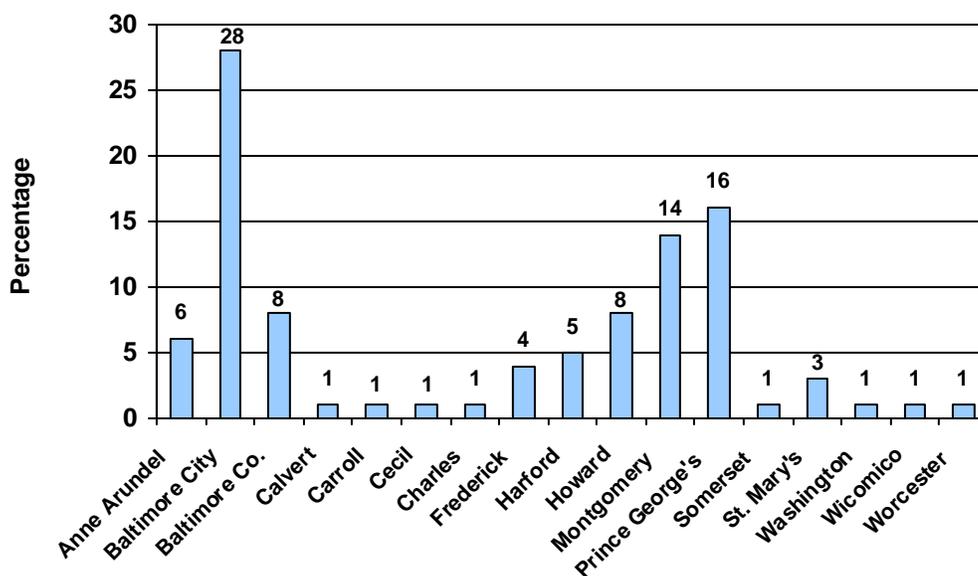
**Figure 20. Percentage Distribution of Homicides by Maternal Age, Pregnancy-Associated Deaths, Maryland, 2008-2009**



## CASES BY JURISDICTION OF MATERNAL RESIDENCE

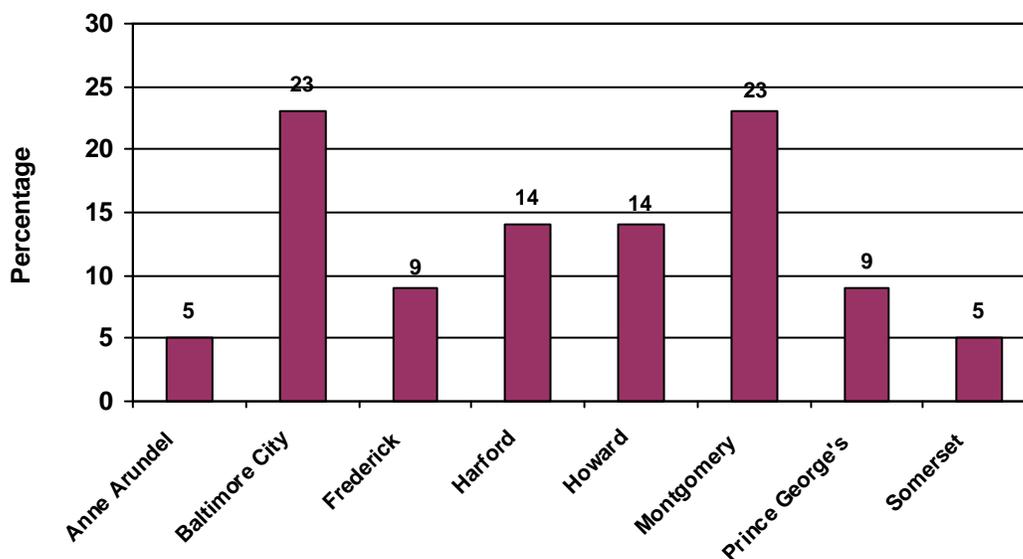
Baltimore City had the highest percentage of pregnancy-associated deaths of any jurisdiction in 2008 and 2009 at 28 percent (Figure 21). The Baltimore Metro Area (comprised of Baltimore City, Anne Arundel, Baltimore, Carroll, Harford and Howard Counties) accounted for 56 percent of pregnancy-associated deaths. During the same period, Baltimore City and the Baltimore Metro Area had 13 percent and 46 percent of live births in the State, respectively. Prince George's and Montgomery Counties ranked second and third in pregnancy-associated deaths. These two counties combined accounted for an additional 30 percent of pregnancy-associated deaths and 34 percent of live births.

**Figure 21. Distribution of Pregnancy-Associated Deaths by Residence of Decedent, Maryland, 2008-2009**



The Baltimore Metro Area also accounted for 56 percent of pregnancy-related deaths, with 23 percent in Baltimore City. Montgomery County also had 23 percent of pregnancy-related deaths but only 18 percent of live births.

**Figure 22. Distribution of Pregnancy-Related Deaths by Residence of Decedent, Maryland, 2008-2009**



## RECOMMENDATIONS

Of the maternal deaths occurring in 2008 and 2009, two groups of deaths stood out and were the main focus of recommendations developed by the full MMR Committee. These groups were deaths due to cardiac disease and those resulting from suicide.

**Cardiac Deaths** - Cardiac disease was the leading cause of both pregnancy-associated and pregnancy-related deaths, accounting for 21 percent of pregnancy-associated and 36 percent of pregnancy-related deaths. Obesity continues to be a contributing factor to cardiac deaths. Early recognition of cardiac dysfunction during pregnancy will allow providers to optimize prenatal and postpartum management.

1. Pre-pregnancy BMI should be recorded for all pregnant patients.
2. Obstetric providers should maintain a high index of suspicion for cardiac complications in obese patients. Echocardiography or measurement of biomarkers, such as N-terminal pro-brain natriuretic peptide (NT-proBNP), should be strongly considered in obese pregnant patients, especially those with co-morbidities, such as hypertension or diabetes. Consultation and/or co-management with cardiology providers should be considered if abnormal cardiac function is present.
3. Careful attention should be paid to fluid balance during labor and delivery and the immediate postpartum period in any patient suspected of or at high risk for cardiac dysfunction.
4. Conduct a multi-year review of pregnancy-related deaths in Maryland due to cardiac disease to better define the population at greatest risk.
5. MMR Committee members have begun discussion about the feasibility of a multicenter study in Maryland to evaluate cardiac testing of obese pregnant patients.
6. Communicate the aforementioned findings and recommendations broadly to the obstetric community through groups such as the Maryland Chapter of ACOG, the Maryland OB Gyn Society, and the Maryland Patient Safety Center Perinatal Learning Network. Findings should also be shared with cardiology providers through similar professional groups and organizations.

In September 2011, the Department launched the Maryland State Health Improvement Process (SHIP). This process provides a framework of accountability, local action, and public engagement for continual progress toward a healthier Maryland. A reduction in deaths from heart disease is one objective included in SHIP (SHIP Objective 25). Although maternal deaths due to heart disease are a small fraction of such deaths in the State, the MMR Committee strives to reduce cardiac deaths among pregnant and postpartum women.

**Suicide Deaths** – Strikingly, the three suicides in the two-year period during 2008 and 2009 were judged to be pregnancy-related because all involved abrupt alteration in medications once the woman's pregnancy status was known. Mental health providers were uncomfortable with medication management during pregnancy. Altered management of psychiatric illness was felt to have contributed to the subsequent suicides.

1. Discuss resources on medication safety and management during pregnancy with Maryland Chapter of ACOG and other obstetric resources. Identify resources in Maryland or online which could be shared with mental health providers to assist with psychiatric medication management during pregnancy.
2. Encourage direct communication between obstetric and mental health providers on patient management.
3. Invite mental health leaders and advocates to a MMR Committee meeting to discuss these findings and possible ways in which obstetric and mental health providers can better collaborate in the management of pregnant patients.

SHIP Objective 8 calls for a reduction in the suicide rate. The postpartum period is well recognized as a time of increased risk of depression and potential suicide. The cases reviewed in this report show that under-treatment during pregnancy can also be a contributing factor. By communicating these findings to mental health providers and supporting collaboration in caring for pregnant patients, the MMR Committee hopes to reduce the risk of suicide among pregnant and postpartum women.

See Appendix 2, *Issues and Recommendations, 2008 and 2009 Pregnancy-Related Deaths*, for other discussion points and recommendations.

## SUMMARY

Maryland continues to have a high maternal mortality ratio compared to the U.S. average and the Healthy People 2020 goal of 11.4 deaths per 100,000 live births. This in part reflects Maryland's intense efforts to accurately identify maternal deaths in the State. Maryland has been at the forefront of efforts to implement enhanced surveillance methods to identify maternal 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. Eighty-one pregnancy-associated deaths were identified in 2008 and 2009. All cases involving a death from medical causes, substance abuse, or suicide were reviewed for pregnancy-relatedness. Twenty-two cases were determined to be pregnancy-related, with the cause of death related to or aggravated by the pregnancy or its management. Cardiac disease was the leading cause of both pregnancy-associated and pregnancy-related deaths, with obesity being a frequent contributing factor. Management of psychiatric medication during pregnancy was also identified as an issue contributing to three suicide deaths. The MMR Program will broaden its dissemination of findings and recommendations in this report, and promote communication and collaboration with providers outside of obstetrics (in fields such as cardiology and mental health) to help in efforts to reduce maternal deaths in Maryland.

## REFERENCES

*Maternal Mortality in the United States, 1935-2007*. US Department of Health and Human Services - <http://www.hrsa.gov/ourstories/mchb75th/mchb75maternalmortality.pdf>

Horon, IL. Underreporting of Maternal Deaths on Death Certificates and the Magnitude of the Problem of Maternal Mortality. *Am J Public Health*. 2005;95:478-482.

Horon, IL, Cheng, D. Effectiveness of Pregnancy Check Boxes on Death Certificates in Identifying Pregnancy-Associated Mortality. *Pub Health Reports*. 2011;126:195-200.

*Strategies to Reduce Pregnancy-Related Deaths: From Identification to Action*. Centers for Disease Control and Prevention - [http://www.cdc.gov/reproductivehealth/ProductsPubs/PDFs/Strategies\\_taged.pdf](http://www.cdc.gov/reproductivehealth/ProductsPubs/PDFs/Strategies_taged.pdf)

**APPENDIX 1**

**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: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

2. 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: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

3. This case was:  
 Preventable ( individual  provider  institutional/systems issues)  
 Potentially Preventable ( individual  provider  institutional/systems issues)  
 Undetermined  
 Not Preventable

4. Resources or services needed but  not used or  not available:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

5. Recommendation(s) to address issues in this case:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## APPENDIX 2

### Maternal Mortality Review Committee Issues and Discussion 2008 and 2009 Pregnancy-Related Deaths

Findings/Issues	Recommendations	Action Items
<p><b>Cardiac Deaths</b></p> <ol style="list-style-type: none"> <li>Cardiac conditions aggravated during pregnancy</li> <li>Obesity is complicating factor in cardiac related deaths</li> <li>Lack of diagnosis of pulmonary edema</li> </ol>	<ol style="list-style-type: none"> <li>Pre-pregnancy BMI for all OB patients</li> <li>Careful attention by obstetrical provider to cardiac function in obese patients; consider echocardiography or biomarkers, especially with co-morbidities.</li> <li>Reinforce the need for careful attention to fluid balance during labor and delivery and immediately postpartum.</li> <li>Improve co-management of patients between OB and cardiology.</li> </ol>	<ol style="list-style-type: none"> <li>Share findings and recommendations with ACOG, hospital Chairs of OB, and Perinatal/Neonatal Learning Network to disseminate to providers.</li> <li>Review multiple year data on cardiac deaths.</li> <li>Consider evaluation of cardiac testing among obese pregnant patients.</li> </ol>
<p><b>Mental Health</b></p> <ol style="list-style-type: none"> <li>Frequent provider misconceptions regarding patient's mental health medications during pregnancy</li> <li>Gun safety/awareness for family and providers of patient's with mental health disorder history, especially suicidal ideation.</li> </ol>	<ol style="list-style-type: none"> <li>Obstetrical consultation for psychiatric providers to clarify medication and treatment during pregnancy.</li> <li>Family planning/pregnancy history needs to be addressed when starting psychiatric medications, especially lithium, Depakote, or other medications associated with fetal risk.</li> <li>Patients with history of mental health disorder or postpartum depression should be referred to mental health services during pregnancy.</li> <li>Facilitate timely consultations for patients requiring care for substance abuse or mood-psychiatric disorders during pregnancy.</li> </ol>	<ol style="list-style-type: none"> <li>Share findings and recommendations with Mental Hygiene Administration and other mental health provider organizations, as well as with obstetric groups.</li> <li>Facilitate care coordination between mental health providers and obstetricians during and after pregnancy.</li> <li>Encourage obstetrician contact with patient's mental health provider during pregnancy.</li> </ol>

Findings/Issues	Recommendations	Action Items
<p><b>Substance Abuse</b></p> <ol style="list-style-type: none"> <li>1. Too many physicians prescribing medications to patient without being aware of other medication prescriptions</li> <li>2. Lack of substance abuse treatment services for women postpartum. Postpartum period known to be associated with higher incidence of relapse because of hormonal shifts, new baby, less intense management; yet often not addressed</li> <li>3. Providers under-screen for alcohol abuse during pregnancy</li> </ol>	<ol style="list-style-type: none"> <li>1. Establish central system for registering controlled substances.</li> <li>2. Consultation between substance abuse treatment providers and obstetrical providers about pregnant patients identified as substance abusers.</li> <li>3. Expand care resources throughout the state for substance abuse treatment during pregnancy and after delivery.</li> <li>4. Re-emphasize use of existing screening tools for alcohol abuse during prenatal care (e.g., ACOG)</li> </ol>	<ol style="list-style-type: none"> <li>1. Share findings and recommendations with DHMH and obstetric groups for further action.</li> <li>2. Evaluate prevalence of substance abuse treatment in Maryland among women of reproductive ages and relationship to pregnancy.</li> <li>3. Contact ADAA about accessibility of treatment slots for women.</li> </ol>
<p><b>Pregnancy Complications</b></p> <ol style="list-style-type: none"> <li>1. Lack of urgency regarding pre-eclampsia</li> <li>2. Lack of magnesium therapy for pre-eclampsia</li> <li>3. Inappropriate management of diabetes in pregnancy</li> </ol>	<ol style="list-style-type: none"> <li>1. Focused response to diagnosis of pre-eclampsia (standard of care response).</li> <li>2. MFM or endocrinology consultation recommended with management of diabetes or hypertension (pre-gestational) during pregnancy.</li> </ol>	<ol style="list-style-type: none"> <li>1. Share findings and recommendations with obstetric groups to disseminate to providers.</li> </ol>
<p><b>Prenatal Care</b></p> <ol style="list-style-type: none"> <li>1. Not enough attention to nutritional care during pregnancy</li> <li>2. Missing HIV testing during prenatal care</li> <li>3. Sleep apnea screen needed during prenatal care</li> </ol>	<ol style="list-style-type: none"> <li>1. Screening and nutritional consultation for patients with history of eating disorders.</li> <li>2. Encourage formal calculation and documentation of BMI as a part of the prenatal assessment and management of anticipated weight gain based on this information.</li> <li>3. Careful attention to nutritional status, especially patients with extremes of BMI (high or low).</li> <li>4. Educate providers about state regulations regarding HIV testing during pregnancy.</li> <li>5. Increase provider awareness of need for sleep apnea assessment.</li> </ol>	<ol style="list-style-type: none"> <li>1. Share findings and recommendations with obstetric groups to disseminate to providers.</li> </ol>
<p><b>Care Coordination/Management</b></p> <ol style="list-style-type: none"> <li>1. Many pregnant women utilizing ED for care during pregnancy, however: <ol style="list-style-type: none"> <li>a. Lack of OB consultation during ED visit</li> <li>b. No indication of ED connecting patients with chronic diseases with follow-up medical care</li> </ol> </li> <li>2. Lack of referral to social services</li> <li>3. Consistency of care needed prenatally</li> <li>4. Not enough attention to drug interactions</li> <li>5. Lack of follow-up post discharge</li> </ol>	<ol style="list-style-type: none"> <li>1. Possibility of obstetrical problem should be considered when a potentially pregnant patient is seen in ED. OB consultation, referral or follow-up as needed is recommended.</li> <li>2. Emergency Departments should establish a mechanism for adequate and appropriate follow-up of pregnant patients, especially those with no provider.</li> <li>3. Each hospital with an ED but not an obstetrical service should establish a policy for the care and/or referral of pregnant patients presenting to ED for care.</li> </ol>	<ol style="list-style-type: none"> <li>1. Share findings and recommendations with DHMH and obstetric groups for further action.</li> </ol>

Findings/Issues	Recommendations	Action Items
<p>6. When multiple complications present postpartum and other disciplines assume primary management of the case important obstetrical concerns are neglected.</p>	<p>4. Primary OB should retain involvement with complex patients postpartum through discharge.            5. Educate providers about social service resources and access to case management through MCOs.            6. Timely referral process to transition the continuation of care for chronic medical problems after delivery.</p>	
<p><b>Documentation</b></p> <ol style="list-style-type: none"> <li>1. Lack of prenatal care information/record in the labor and delivery record</li> <li>2. Poor/lack of medical record documentation</li> <li>3. Poor documentation of height and weight in prenatal and inpatient charts               <ol style="list-style-type: none"> <li>a. Limits analysis of the impact of obesity and overweight on maternal mortality</li> </ol> </li> </ol>	<ol style="list-style-type: none"> <li>1. Establish mechanism for ensuring adequate documentation of diagnosis, management, and course in medical records.</li> <li>2. Encourage state to move forward with universal Health Information Exchanges (HIEs).</li> <li>3. Each hospital with a delivery service should establish policy regarding prenatal care information documentation present in labor and delivery.</li> <li>4. See recommendation for BMI calculation and use listed above.</li> </ol>	<ol style="list-style-type: none"> <li>1. Share findings and recommendations with DHMH and obstetric groups for further action.</li> </ol>
<p><b>OCME</b></p> <ol style="list-style-type: none"> <li>1. No referral or comment about referral to the OCME</li> <li>2. Unclear guidelines regarding OCME protocol</li> </ol>	<ol style="list-style-type: none"> <li>1. Education for OCME investigators about obtaining pregnancy information during investigation.</li> <li>2. Educate MMR Committee about OCME protocol.</li> </ol>	<ol style="list-style-type: none"> <li>1. Share findings and recommendations with OCME.</li> </ol>
<p><b>Medical Assistance</b></p> <ol style="list-style-type: none"> <li>1. MA for women postpartum</li> <li>2. No follow-up on chronic conditions postpartum</li> <li>3. Medicaid eligibility/resources not communicated well to patients particularly pregnant women</li> </ol>	<ol style="list-style-type: none"> <li>1. Provide information sheet to women post delivery about medical assistance eligibility and family planning services available.</li> <li>2. Involvement of MCO case manager during pregnancy/postpartum to link women into needed care.</li> </ol>	<ol style="list-style-type: none"> <li>1. Increase awareness among obstetric providers about new Medicaid expansion for family planning services for women beginning January 2012.            Increase awareness about 5-year family planning waiver postpartum for Medicaid-covered patients during pregnancy.</li> <li>2. Expand women's health services to other Title X Family Planning clinics in Maryland.</li> </ol>