

Florida's Pregnancy-Associated Mortality Review 2010 Update



Prepared by:

Leticia Hernandez, Ph.D.

Training and Research Consultant
Maternal and Child Health Practice and Analysis Unit
Florida Department of Health

Deborah Burch, R.N., M.S.N., C.P.C.E.

PAMR Coordinator/RN Consultant
Infant, Maternal, and Reproductive Health Unit
Florida Department of Health

Cheryl Clark, Dr.PH., R.H.I.A

Training and Research Manager
Maternal and Child Health Practice and Analysis Unit
Florida Department of Health



Summary

Reduction of maternal death is a national and state priority. Florida's Pregnancy-Associated Mortality Review (PAMR) is an ongoing system of surveillance that collects and analyzes information related to maternal deaths in order to promote system improvements through evidenced-based actions aimed at preventing future untimely deaths.

In 2011, the PAMR case selection process identified 153 pregnancy-associated deaths occurring to residents of Florida from January 1, 2010 to December 31, 2010. The PAMR case selection committee identified that 49 of these pregnancy-associated deaths that occurred in 2010 were most likely to be pregnancy-related. Upon full team review of the 49 death cases, the PAMR committee found 44 (89.8%) of these deaths to actually be pregnancy-related.

The pregnancy-related mortality ratio (PRMR) in Florida in 2010 was 20.5 per 100,000 live births. Although the 2010 PRMR is lower than the 2009 ratio of 26.2 per 100,000 live births, the decrease was not statistically significant.

Notable for 2010:

- The leading pregnancy-related causes of death in 2010 were hemorrhage (20.5%), infection (15.9%), and cardiomyopathy (13.6%).
- In 2010, 71% of the pregnancy-related deaths occurred during the postpartum period, of which 39% of all deaths occurred postpartum prior to discharge and 32% occurred after hospital discharge.
- Almost 64% of the pregnancy-related deaths occurred after a live birth delivery, 11.4% occurred after a spontaneous or elective abortion, 9.1% after an ectopic pregnancy, 9.1% died while still pregnant (prior to a delivery), and 6.8% occurred after a stillbirth.
- Of women who died during or after delivery, 67% had cesarean as a delivery method. Of these women 30% were planned cesarean deliveries and 70% were unplanned cesarean deliveries.
- In 2010, more than half (57%) of women experiencing a pregnancy-related death fell into the overweight and obese categories.

Introduction

Case Selection for Team Review

Every year, the PAMR process begins with collecting data for all reported deaths that are associated with pregnancy. The Florida Department of Health has implemented a process of data linkages to maximize the identification of pregnancy-associated deaths. This enhanced surveillance system fosters improved case identification when compared with a more limited process utilized by Vital Statistics alone.

A pregnancy-associated death (PAD) is defined as a death to a woman during pregnancy or up to one year after the pregnancy ends, regardless of the cause of death. Cases are included in the listing of pregnancy-associated deaths if any of the following four criteria are met:

- 1) The response on the death certificate is “yes” to the question: “If female, was she pregnant in the past year?”
- 2) The cause of death diagnosis code (International Classification of Diseases or ICD-10 code) indicates a death classified as being due to “Pregnancy, Childbirth, and the Puerperium (Chapter XV O00-O09).”
- 3) There is a matching birth or fetal death record within 365 days prior to the woman’s death.
- 4) There is a matching Healthy Start Prenatal Screen (Florida’s universal prenatal screening tool used to identify and assess pregnant women at risk for adverse birth outcomes) within 365 days prior to the woman’s death.

The PAMR case selection committee is comprised of an obstetrician, nurse, and epidemiologist. All death certificates identified as pregnancy-associated deaths are

reviewed by the case selection team who assign a preliminary category to each case. Cases are reviewed primarily for cause and timing of death and categorized as pregnancy-related, possibly pregnancy-related, or not pregnancy-related.

A pregnancy-related death (PRD) is a pregnancy-associated death which resulted from 1) complications of the pregnancy itself, 2) the chain of events initiated by the pregnancy that led to death or 3) aggravation of an unrelated condition by the physiologic or pharmacologic effects of the pregnancy that subsequently caused death. A possible pregnancy-related death is a pregnancy-associated death where determination of the death could not be conclusively classified as either related or not related to the pregnancy. Pregnancy-associated deaths due to a cause deemed unrelated to pregnancy are classified as not pregnancy-related.

Approximately 15 cases are chosen each quarter for record abstraction and team review. Abstraction preference is given to deaths categorized as pregnancy-related. A random selection of the possibly pregnancy-related and the not pregnancy-related cases is conducted until a total of 15 cases have been reached. Table 1 depicts the characteristics of cases which were not selected for team review by the committee.

**Table 1. 2010 PAMR Data on Non-Selected Cases
(n = 102)**

Classification at Selection

Pregnancy-Related = 0
Possibly Pregnancy-Related = 2
Not Related = 100

PAMR Selection

ICD-10 codes = 34
Prenatal screen = 23
Pregnancy check box = 43
Birth/Fetal death certificate = 72

Age

< 16 = 1
16 – 19 = 10
20 – 24 = 29
25 – 29 = 30
30 – 34 = 17
35 – 39 = 7
> 39 = 8

Race / Ethnicity

White Non-Hispanic = 59
Black Non-Hispanic = 25
Hispanic = 13
Other (specify) = 5

Marital Status

Married = 48
Separated = 4
Divorced = 7
Widowed = 1
Never married = 42

Place of Birth

Florida = 62
Other U.S. = 32
Outside U.S. = 8

Education Level

8th or less = 1
HS, no diploma = 21
HS diploma or GED = 53
College, no diploma = 12
College with degree = 15

Leading Causes of Death:

Accidental drug overdose = 26
Motor vehicle accident = 19
Homicide = 12
Cancer = 21
Suicide = 6
Other miscellaneous = 18

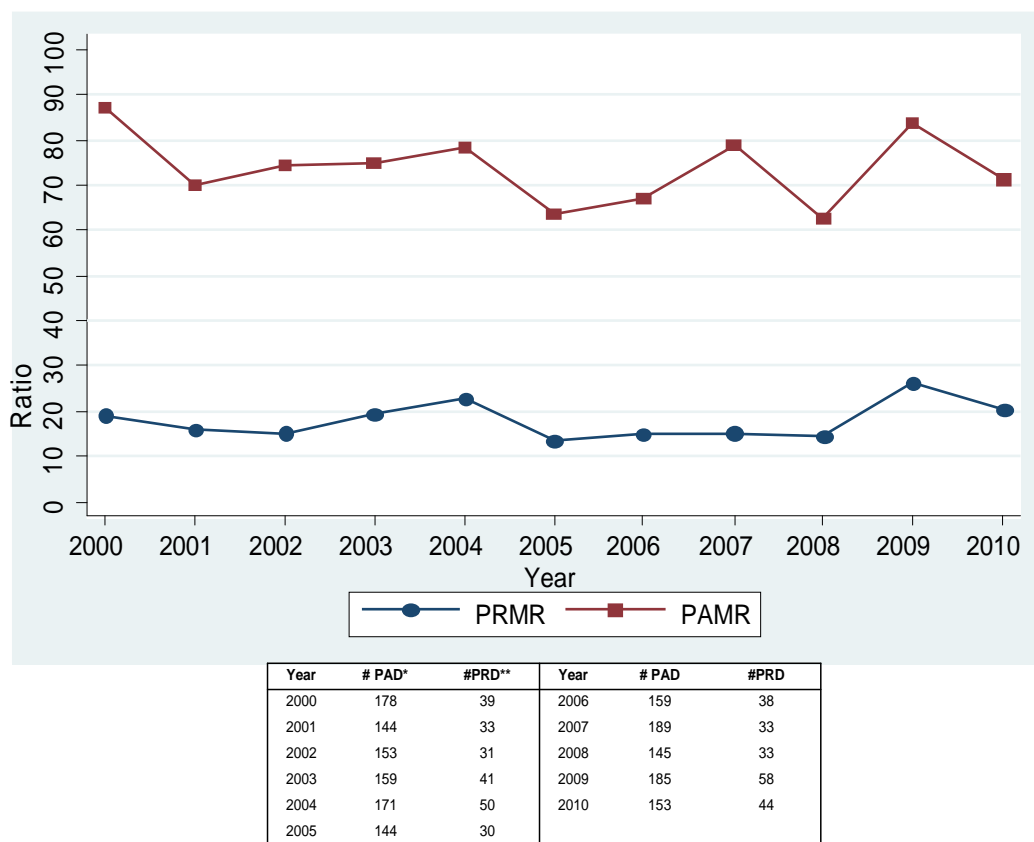
ME Referred = 68

Autopsy = 68

Pregnancy-Related Mortality Findings — Florida, 2010

Florida's pregnancy-associated mortality ratios and pregnancy-related mortality ratios are shown in Figure 1. Pregnancy-related deaths are a subset of pregnancy-associated deaths. Although there was a decrease in the pregnancy-associated and pregnancy-related mortality ratios in 2010 compared with 2009, the decrease was not statistically significant.

Figure 1. Pregnancy-Associated Mortality Ratios and Pregnancy-Related Mortality Ratios — Florida 2000-2010

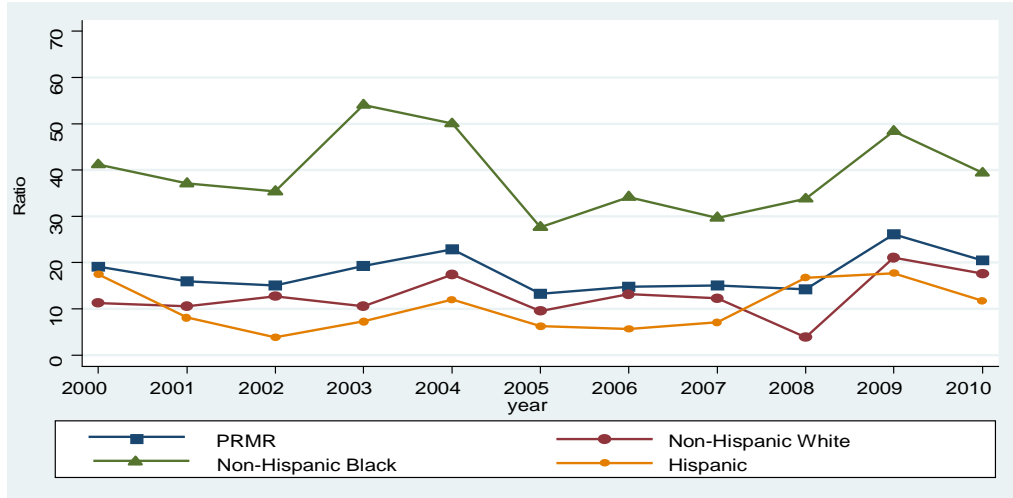


Between 2000 and 2010, the pregnancy-related mortality ratio (PRMR) fluctuated from 19.1 deaths per 100,000 live births in 2000 to a low of 13.3 deaths per 100,000 live

births in 2005, increased to a high of 26.2 in 2009, and declined to 20.5 deaths per 100,000 live births in 2010 (Figure 2).

Racial and ethnic disparities continue to exist with pregnancy-related mortality in Florida. In 2010, the PRMR for non-Hispanic Black women was 39.4 per 100,000 live births compared with 17.6 for non-Hispanic White women and 11.7 for Hispanic women (Figure 2).

Figure 2. Pregnancy-Related Mortality Ratios — Florida, 2000-2010

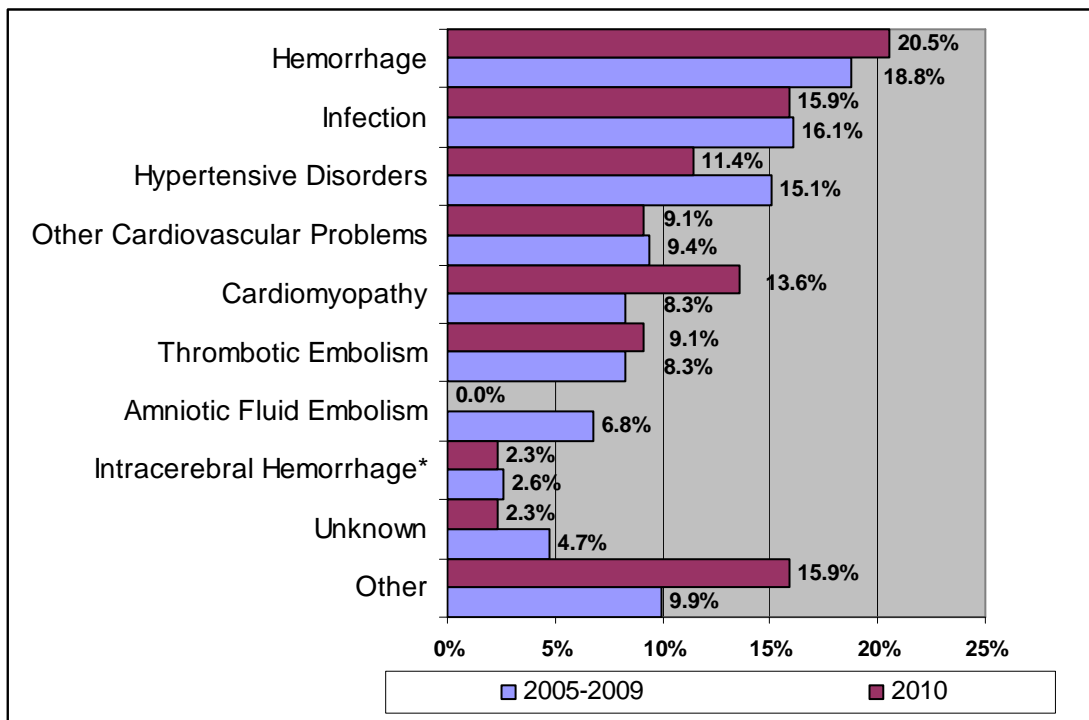


Cause of Death

The leading causes of pregnancy-related death in 2010 were hemorrhage (20.5%), infection (15.9%), and cardiomyopathy (13.6%) (Figure 3 and Table 2). The category, “other remaining causes,” tied for the second leading cause and accounted for 15.9% of pregnancy-related deaths. These “other remaining causes” of death included: hematopoietic disorders (4.5%), collagen vascular diseases (2.3%), injury (2.3%), cancer (2.3%), pulmonary problems (2.3%), and neurologic/neurovascular problems (2.3%). Comparing the pregnancy-related mortality ratios for the period covering 2005-

2009 with 2010, there were differences in the causes of death percentages; however, due to the small number of cases, statistical significance couldn't be determined. Figure 3 and Table 2 show how the percentages of deaths for hemorrhage, other remaining causes, cardiomyopathy, and thrombotic embolism were higher in 2010 than compared with the 5-year period of 2005-2009. Also shown in Figure 3 and Table 2 are decreases in the percentage of deaths during the period of 2005-2009 and 2010 due to infection, hypertensive disorders, other cardiovascular problems, intracerebral hemorrhage, and unknown cause of death. There were no deaths due to amniotic fluid embolism in 2010.

Figure 3. Distribution of Pregnancy-Related Causes of Death Florida, 2005-2009 (n=192) and 2010 (n=44)



*Intracerebral hemorrhage (no known hypertensive disorder)

**Table 2. Distribution of Causes of Pregnancy-Related Death
Florida, 2005-2009 and 2010**

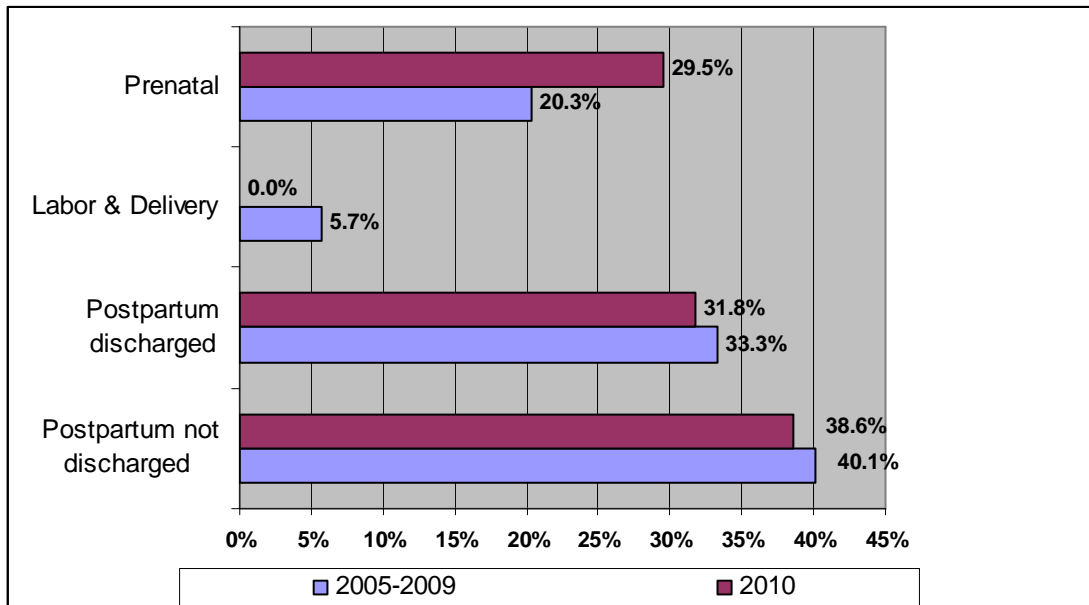
Causes	2005-2009 N (%)	2010 N (%)	Change in Percentage
Hemorrhage	36 (18.8)	9 (20.5)	9.0
Infection	31 (16.1)	7 (15.9)	-1.2
Hypertensive Disorders	29 (15.1)	5 (11.4)	-24.5
Other Cardiovascular Problems	18 (9.4)	4 (9.1)	-3.2
Thrombotic Embolism	16 (8.3)	4 (9.1)	9.6
Cardiomyopathy	16 (8.3)	6 (13.6)	63.9
Amniotic Fluid Embolism	13 (6.8)	0 (0.0)	-
Intracerebral Hemorrhage (no known hypertensive disorder)	5 (2.6)	1 (2.3)	-11.5
Other	19 (9.9)	7 (15.9)	60.6
Unknown	9 (4.7)	1 (2.3)	-51.1
Total	192	44	

Timing of Death

Figure 4 presents pregnancy-related deaths by timing of death: prenatal, labor and delivery, or postpartum for the 5-year period of 2005-2009 compared with single-year data from 2010. In 2010, 70.5% of the deaths occurred during the postpartum period, which for this analysis is the period after delivery up to one year. Nearly 39% of all deaths occurred postpartum prior to discharge from the delivery hospital and 32% occurred postpartum after hospital discharge. Among women who were discharged from the hospital after delivery in 2010, the most common causes of death occurring

during the first 6-weeks were infection (27.3%), hypertensive disorders (18.2%), and thrombotic embolism (18.2%). For those women who were not discharged, the most common causes of death were hemorrhage (22.2%), infection (16.7%), hypertensive disorders (16.7%), other cardiovascular problems (16.7%) and other causes (16.7%).

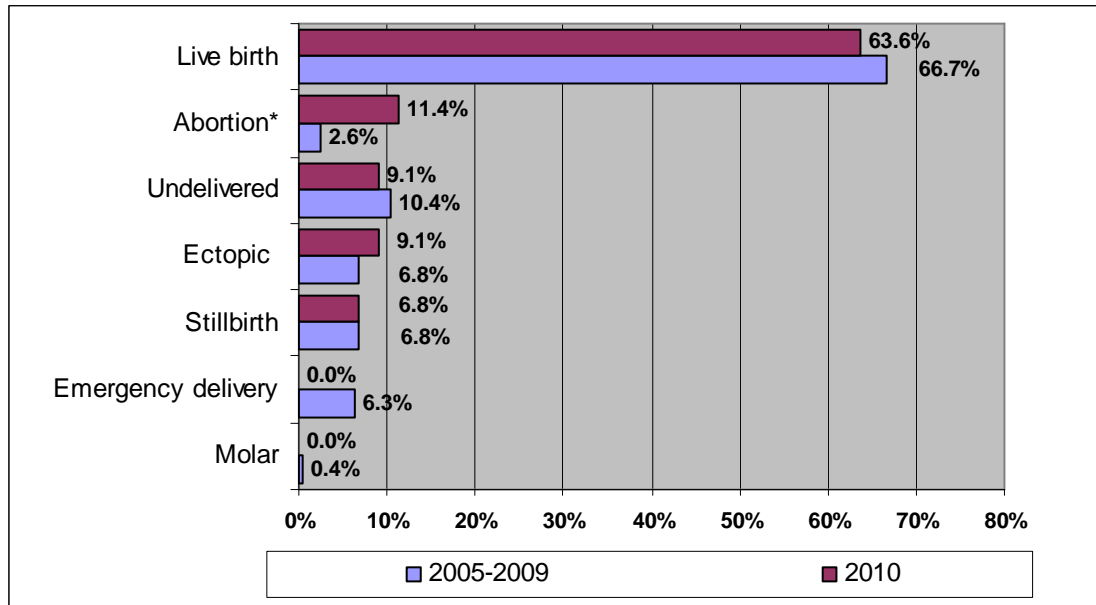
Figure 4. Percent Pregnancy-Related Deaths by Timing of Death — Florida, 2005-2009 (n=192) and 2010 (n=44)



Pregnancy Outcome

Figure 5 shows the pregnancy-related deaths by outcome of pregnancy. In 2010, 9.1% of deaths occurred before delivering the baby, 63.6% occurred after a live birth, 11.4% occurred after a spontaneous or elective abortion, 9.1% occurred after an ectopic pregnancy, and 6.8% occurred after a stillbirth. In 2010, there were 81 surviving children of mothers who died from pregnancy-related deaths.

**Figure 5. Percent Pregnancy-Related Deaths by Pregnancy Outcome
Florida, 2005-2009 (n=192) and 2010 (n=44)**



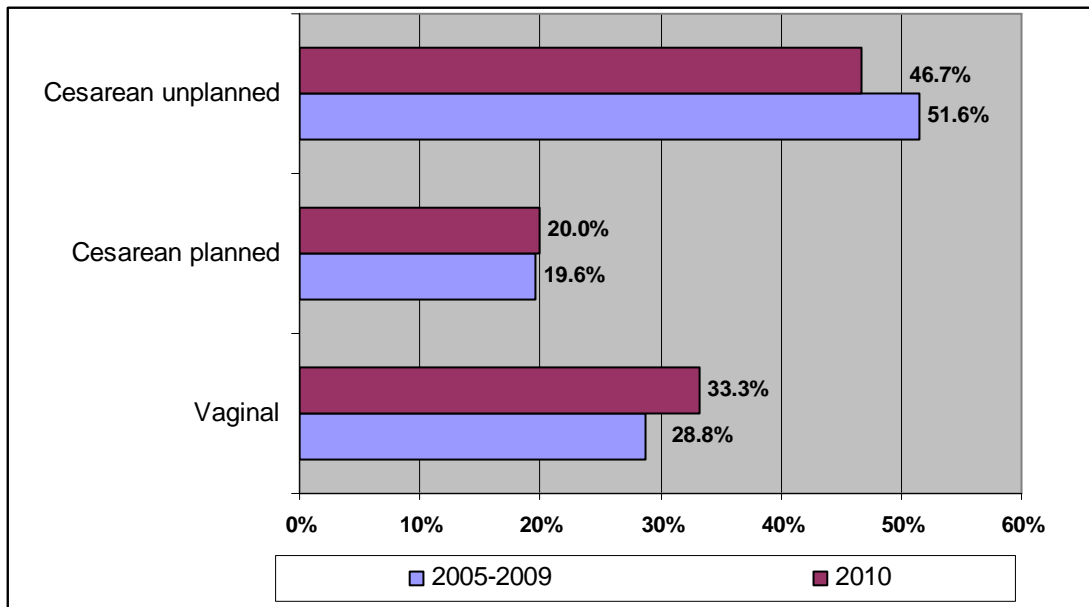
* Abortion includes spontaneous and elective abortions.

Type of Delivery

Figure 6 shows the percentage of women in 2010 who died during labor and delivery or postpartum by type of delivery. During 2010, the majority (66.7%) of these deliveries were cesarean deliveries. Of the 20 women who died after cesarean delivery, six (30.0%) were planned cesarean deliveries and the remaining 14 (70.0%) were unplanned cesarean deliveries. The PAMR review team recognizes that cesarean delivery may be performed in order to save maternal and/or fetal life.

There was a decrease in the percentage of deaths in women who had a cesarean delivery in 2010 (66.7%) when compared with 2005-2009 (71.2%). A decrease in percentage of women having cesareans was also observed when compared to all live births by type of delivery, 36.8% of live births whose mother had cesarean during 2005-2009 compared with 32.9% that had cesarean in 2010 [1].

**Figure 6. Percent Pregnancy-Related Deaths by Type of Delivery
Florida, 2005-2009 (n=153), 2010 (n=30)**

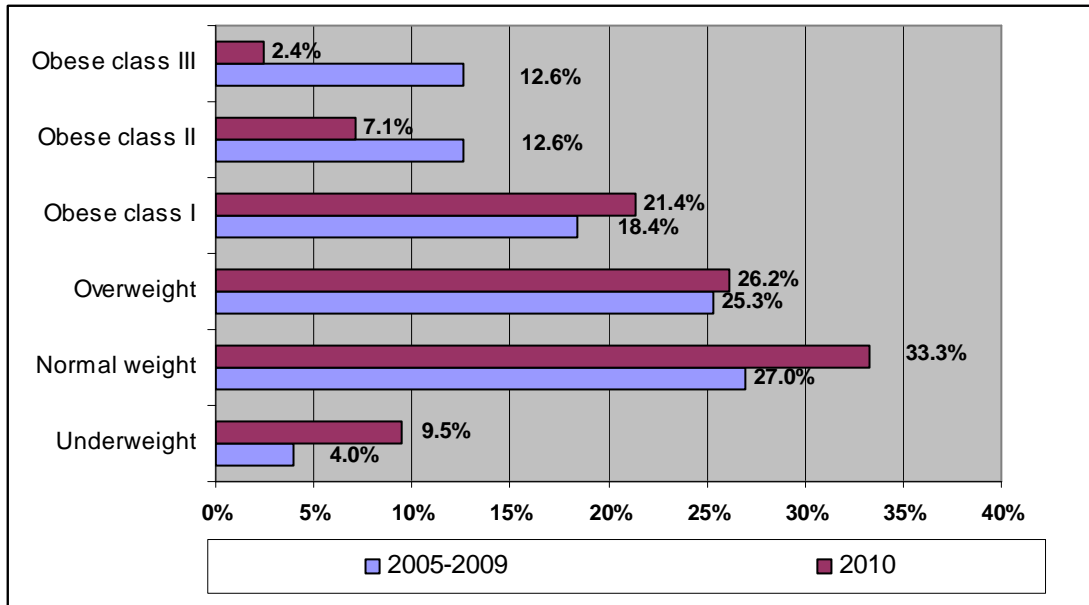


Maternal Body Mass Index (BMI)

In 2010, more than half (57.1%) of women who experienced a pregnancy-related death fell into the overweight (BMI 25-29.9) and obese class I (BMI 30-34.9), obese class II (BMI 35-39.9), or obese class III (BMI of 40 or more) categories (Figure 7). In comparison, 46.3% of all Florida women having a live birth in 2010 were classified to be overweight or obese [1].

Figure 7 presents BMI for 2010 compared with 2005-2009. A decrease was observed in women who died and who were in the obese class III category from 12.6% during 2005-2009 to 2.4% in 2010. However, there was no reduction observed in the obese class III category for all women giving births in 2010 according to birth certificate data. In 2010, 3.2% of women who gave birth were classified as obese class III and the same percentage was observed during the period 2005-2009 for obese class III women (3.2%) [1].

**Figure 7. Percent of Pregnancy-Related Deaths by BMI
Florida, 2005-2009 (n= 174) and 2010 (n= 42)**



PAMR Identified Issues and Recommendations for 44 Pregnancy-Related Deaths

After reviewing pregnancy-related deaths the PAMR committee identifies relevant issues related to the death and makes recommendations in an effort to promote system improvements. The issues and recommendations are placed into the following four prevention categories: Clinical Factors, System Factors, Individual and Community Factors, and Death Review Factors. Recommendations are listed under the specific cause of death categories.

Clinical Factors

Relates to services provided by the entire health care system.

Issues

1. Incomplete assessment

- Lack of thorough assessment of the cardiac, pulmonary, and vascular systems during pregnancy and/or after delivery
 - Lack of vigilance in monitoring vital sign trends and lack of appreciation for significance of abnormal values
2. Inadequate documentation
 3. Lack of coordination and follow-up, particularly of high-risk women
 4. Deficient communication between staff and patients
 5. Lack of association between a change in mental status and deteriorating medical condition
 6. Prevention-Patient Education (Preconception/Pregnancy/Postpartum)

Clinical Recommendations

- Providers should perform cardiac and respiratory assessment at the initial prenatal visit to establish a baseline and identify women at risk for potential pregnancy complications.
- Prior to hospital discharge, providers should perform a cardio/pulmonary assessment on all postpartum women.
- Providers should be aware of subtle changes in vital signs and their implications for potential physical decline.
- Providers should be aware of potential barriers with electronic medical records for viewing, monitoring, and tracking patient vitals, and fluid intake and output.
- Providers should consider using a graphic tool for documenting vital signs that serves as a quick alert to potential changes in health status such as the Modified Early Obstetric Warning System (MEOWS) implemented in the United Kingdom [2].
- Licensed abortion clinics should hold periodic practice drills on management of hemorrhage and anesthesia complications.

- Providers should provide and document preconception education and counseling regarding risk of chronic illness and its association with morbidity and mortality.
- Providers should provide case management and coordination of care to high risk women during pregnancy and the postpartum periods.
- Providers should increase awareness among women on seizure medication that dosages may require alteration during pregnancy.
- Providers should screen women for substance abuse, partner violence, and depression; refer as needed and follow-up on progress.
- Communication should be improved among medical providers, nurses, patients, and families.

System Factors

A lack of policies and procedures may lend itself to deficient quality of care, which potentially can affect a woman's health outcome.

Issues

1. Barriers to accessing care: lack of insurance, provider shortage, transportation
2. Lack of standardized policies and procedures

System Recommendations

- Clinical systems should be aware of pregnant women not accessing care due to lack of insurance.
- Clinical systems should assure systems are in place to assist with care coordination and follow up for uninsured women.
- Clinical systems should provide comprehensive and effective delivery of postpartum discharge instructions.

- Institutions should assess whether transportation barriers may preclude a woman from accessing high–risk specialty care.
- Drills must be implemented for emergency treatment particularly in outpatient procedures performed under conscious sedation.
- Birthing facilities should review their policies and procedures for triaging pregnant patients, evaluate the training levels of staff and identify areas for improvement to promote appropriate emergency response.
- All facilities should institute standard bereavement services for families and providers.
- Facilities should review policies and procedures for triaging pregnant patients in labor and delivery suites to ascertain adequacy of staff training and equipment to handle medical complications.
- Clinical systems should be vigilant in documenting and monitoring vital signs and fluid intake and output particularly when filling electronic medical records.

Individual and Community Factors

It has been established that a woman’s health prior to her pregnancy can greatly affect the birth outcome, as well as the woman’s health status after birth. Some deaths may be associated with a woman’s personal decision regarding her health and her care. It is important that healthcare providers enable women to make informed decisions.

Issues

1. Women with pre-existing medical conditions such as hypertension, obesity, diabetes, and asthma
2. Lack of documentation of patient education and counseling regarding a woman’s risk factors

3. Lack of patient knowledge regarding the association of their health status to potential pregnancy complications
4. Lack of knowledge of symptoms signifying a complication

Individual/Community Recommendations

- The community should be educated on potential risks of short pregnancy intervals.
- Discharge instructions should be comprehensive and individualized and offered to mothers and their partners.
- Women with complex medical issues must be informed of the health risks associated with their condition and pregnancy.

Death Review Factors

The PAMR process relies on information from death certificates and autopsy reports for the identification and evaluation of pregnancy-related deaths.

Issues

1. Lack of autopsy on unexplained or inconclusive deaths
2. Death certificates are not always completed accurately
3. Missing prenatal records in hospital charts

Death Review Recommendations

- Medical providers should communicate directly with the medical examiner to improve the acceptance of cases and accuracy of autopsy findings to avoid poorly investigated maternal deaths.
- Women who die with an unknown cause of death should be referred to the Medical Examiner for a potential autopsy.
- Maternal deaths with multiple complications should have an autopsy performed to accurately identify the underlying cause of death.

Recommendations Related to Specific Causes of Death

Hemorrhage

In 2010, nine women died from hemorrhage. Of these nine women, four had ruptured ectopic pregnancies, three had placenta accreta, one had retained placenta, and one had uterine laceration. Beginning in 2009, Florida witnessed a significant increase in pregnancy-related deaths due to ectopic pregnancy. Florida's PAMR partnered with the Center for Disease Control to perform an analysis of the pregnancy-related deaths due to ectopic pregnancy during 2009 and 2010. The details of this analysis are outlined in the MMWR vol. 61, No. 06 [3].

Clinical Recommendations

- Ectopic pregnancy should be suspected in women of reproductive age presenting with abdominal pain.
- Facility protocols should be reviewed and facilities should have periodic practice drills to improve the management of hemorrhage.
- Providers should closely monitor a patient's vital signs. Implementing systems such as the United Kingdom's Modified Early Obstetric Warning System (MEOWS) may serve as a quick alert to potential changes in a patient's health status [2].
- Florida's Perinatal Quality Collaborative should consider developing and implementing a quality improvement project aimed at treatment of postpartum hemorrhage.
- Institutions should develop "massive transfusion protocols" requiring management with a team response approach.

Individual and Community Recommendations

- Community awareness should be raised that substance use and abuse can compound existing health conditions and may mask signs of serious medical complications.
- Community awareness should be raised about the need to seek prompt medical attention in women of reproductive age experiencing abdominal pain.

Hypertensive Disorders

Five women died from hypertensive disorders. Four of these women had a cerebrovascular hemorrhage associated with pre-eclampsia, eclampsia, and/or hypertension; and one had encephalopathy.

Clinical Recommendations

- It is important that obstetric and emergency department providers deliver early and prompt treatment of hypertensive disorders to prevent cerebrovascular accident.
- Health care providers should be aware of the appropriate treatment for pre-eclampsia (such as timing and type of interventions).
- Health care providers need to be more vigilant in monitoring and acting upon abnormal deviations in vital signs and fluid input and output, especially in women with cardiac disorders.
- Providers should be vigilant in monitoring for pulmonary edema in patients with preeclampsia.
- Patients placed on hypertensive medication should demonstrate a stable blood pressure prior to discharge.

- Medical providers should increase patient awareness about the significance of shortness of breath by including this as a warning sign in postpartum discharge instructions.

Individual and Community Recommendations

- Women and their family members should be aware of the warning signs of hypertension and preeclampsia.

Infection

Seven women died from infection. Of these seven, four women had generalized septicemia and three had non-pelvic infections (pneumonia).

System Recommendations

- Practice standards should be established for assessment and treatment of patients suspected of having influenza.
- A thorough autopsy should be performed on cases of complicated sepsis with unknown trigger.

Cardiomyopathy

Cardiomyopathy was the cause of pregnancy-related death after 42 days postpartum (>6 weeks postpartum) in nearly half of the cases. Six women died due to cardiomyopathy and the percentage of cardiomyopathy deaths in 2010 was 13.6% compared to 8.3% for the period covering 2005-2009.

Clinical Recommendations

- Raise provider awareness regarding risk factors and symptoms of peripartum cardiomyopathy.

- It is important to provide case patient education and multi-disciplinary coordination of care for women with cardiomyopathy.

Other Conditions

Seven women died from other conditions. Of these seven, the causes of death included hematopoietic disorders, pulmonary problems, cancer, collagen vascular disease, and injury. In 2010, the Florida PAMR identified a number of pregnancy-related deaths to women with sickle cell trait or sickle cell disease. For some of these cases it was difficult to ascertain the true underlying cause of death as these women had co-morbid conditions. To better understand the factors associated with their deaths, the PAMR team discussed the potential for performing a special analysis of cases involving sickle cell trait and disease.

Conclusion

Florida has been actively conducting ongoing surveillance of maternal mortality cases since 1996. To date, over 2,000 pregnancy-associated cases have been reviewed by a multidisciplinary team of maternal child specialists in the PAMR project. Each de-identified case is carefully and respectfully considered by the team before issues are identified and recommendations have been disseminated to the larger community through the team's dedicated efforts. Many of the PAMR team's recommendations have been disseminated to the larger community through publications, presentations, posters, and use of the media.

The 2010 PAMR report identifies a reduction in pregnancy-related deaths associated with cesarean delivery and morbid obesity. However, it identifies increasing trends in the percentage of pregnancy-related deaths due to hemorrhage including ectopic

pregnancies, cardiomyopathy, infection, and hematopoetic disorders. This report also shows the consistent disparity between races with pregnancy-related death among Black Non-Hispanic women remaining 2.2 times higher than White non-Hispanic women.

The loss of a woman due to pregnancy is a loss to a family, community, state, and nation. The United Nation's World Health Millennium Development Goal #5 is to improve maternal health and reduce maternal mortality ratios by three quarters by the year 2015 [4]. It is hoped that through these efforts, current systems of care for pregnant and postpartum women will be enhanced, women's overall health will be improved and fewer mothers will die or suffer from injuries related to pregnancy.

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Florida's Pregnancy-Associated Mortality Review Members

Kris-Tena Albers, A.R.N.P., C.N.M.; Director Infant Maternal and Reproductive Health (IMRH), Department of Health (DOH)

Marie Bailey, M.A., M.S.W.; Public Health Statistics Manager, (DOH)

Donna Barber, R.N., M.P.H.; Children's Medical Services (CMS), Department of Health (DOH)

Rhonda Brown, R.N., B.S.N.; IMRH, (DOH)

Deborah Burch, R.N., M.S.N, C.P.C.E.; PAMR Coordinator, IMRH, (DOH)

Donna Carden, M.D., F.A.C.E.P.; University of Florida

Ed Carney, M.D., American College of Obstetrics and Gynecology (ACOG) Fellow

Cheryl Clark, PhD.; MCH Practice and Analysis (DOH)

Anthony Clark, M.D.; Pathology Associates, Medical Examiner's Commission

Eleanor Cofer, R.N., B.S.N.; Regional Perinatal Intensive Care Clinics, (CMS)

Karen Coon, R.N., A.R.N.P.; Healthy Start Program Manager, IMRH, (DOH)

Isaac Delke, M.D.; University of Florida, (ACOG)

Sheronika Denson, M.S.; Office of Planning, Evaluation, and Data, (DOH)

Linda Enfinger, R.N., M.S.W.; Agency for Health Care Administration (AHCA)

Miriam Gurniak, C.N.M.; Tallahassee Memorial Hospital Family Practice Residency Program

Nancy Hardt, M.D.; Univ. of Florida, College of Medicine

Karen Harris, M.D.; Vice Chair Florida Section ACOG

Leticia Hernandez, PhD.; MCH Practice & Analysis (DOH)

Washington Hill, M.D.; Director, Maternal Fetal Medicine Sarasota Memorial Hospital

Joan Hulett, R.N.C.; Florida Chapter Association of Women's Health, Obstetric and Neonatal Nurses (AWHONN)

Jane Murphy, M.P.A.; Executive Director, Healthy Start Coalition of Hillsborough County

Margaret Neal, M.D.; Pathology Associates

Dani Noell, M.S.N., A.R.N.P., R.N.C.; Lead PAMR Abstractor

Susan Potts, L.C.S.W.; IMRH, (DOH)

William Sappenfield, M.D.; Professor University of South Florida College of Public Health and Chair Lawton and Rhea Chiles Center

Betsy Wood, B.S.N., M.P.H.; Chief, Bureau of Chronic Disease Prevention and Health Promotion, (DOH)

Robert Yelverton, M.D.; Chief Medical Officer, Women's Care Florida, ACOG