

1999-2002 Florida Pregnancy Associated-Mortality Review (PAMR)

During 1999-2002, 218 total pregnancy-associated deaths were reviewed by Florida's PAMR team, and of these pregnancy-associated deaths, 143 (65.6 percent) were determined by the team to have been pregnancy-related. The overall maternal mortality ratio (as determined by Florida's PAMR team) was 17.6 deaths per 100,000 live births and ranged from 20.8 in 1999 to 15.1 in 2002. The maternal mortality ratio was higher for Black women, women aged 35 years and older, and for women who were overweight or obese.



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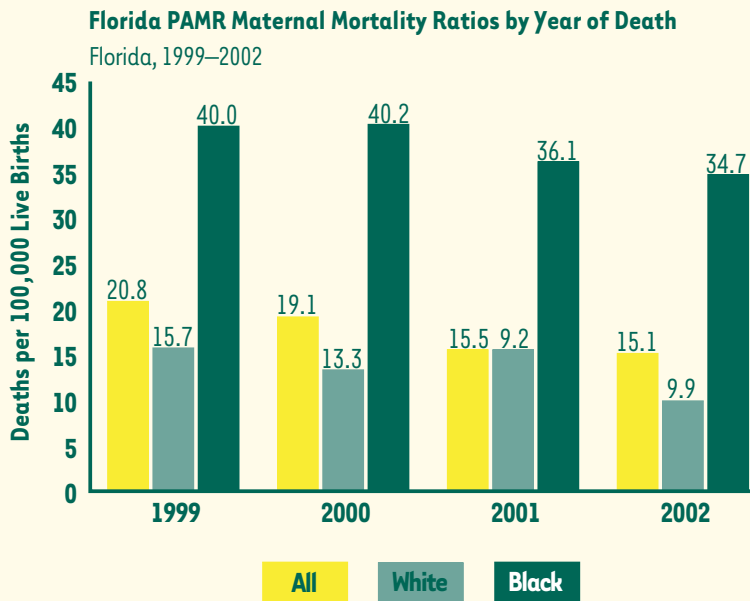
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Pregnancy-Associated Mortality Review (PAMR) – Florida, 1999–2002

Problem/Condition: According to Florida vital statistics (1), the maternal mortality rate in Florida experienced a downward trend between 1950, when it was 129 deaths per 100,000 live births, and 1993, when it reached its lowest rate of nine per 100,000. Since 1993, the maternal mortality rate in Florida (according to Florida vital statistics) has leveled off at between nine and 13 deaths per 100,000 (except for a 1999 rate of 19 per 100,000). *Please note that the maternal mortality rates shown above were calculated using pregnancy-related deaths identified through Florida’s PAMR review process, and differ from the lower ratios calculated using Florida’s vital statistics reporting on maternal mortality. Reasons that the PAMR ratios are higher than those calculated using Florida’s vital statistics data will be explored in this report.*

Racial disparity exists in pregnancy-related mortality in Florida and in the United States (U.S.). Since 1950, maternal mortality ratios in Florida among non-Whites have varied between two to 10 times higher than those for Whites. In 2002, the ratio of non-White to White maternal mortality was 2.7. With a total maternal mortality ratio of 10 per 100,000 in Florida in 2002 (1), major improvements are needed for Florida to meet the Healthy People 2010 objective of no more than 3.3 total maternal deaths per 100,000 live births (2).

Reporting Period Covered: This report summarizes the findings of Florida’s PAMR process for women whose deaths occurred in the calendar years 1999 through 2002.

Description of System: In 1996, Florida began re-examining the surveillance and analysis of maternal deaths using the Centers for Disease Control and Prevention's (CDC) and American College of Obstetrics and Gynecology's (ACOG) expanded definition of maternal mortality. Under this definition, maternal mortality is defined as: *“death of a woman, from any cause, while she is pregnant or within one year of termination of pregnancy, regardless of duration and site of the pregnancy.”* (Note that this definition differs from the Florida Office of Vital Statistics definition of maternal mortality, which prior to 1999 included those deaths that occurred within a 42-day post-pregnancy interval and were assigned a pregnancy-related ICD-9 code, and from 1999 forward included those deaths with a pregnancy-related ICD-10 code, regardless of time interval).

A statewide PAMR process, modeled after the National Fetal and Infant Mortality Review (NFIMR) Process, was implemented to understand better and address the factors and issues related to maternal mortality, especially those that are system-wide. In addition, ongoing surveillance and epidemiological study provides the population-based data context for the selected case reviews. The uses of the broader definition, as well as the utilization of linked data—maternal death certificates linked to birth, and fetal death certificates, and Florida's prenatal Healthy Start screenings—help Florida to assess more accurately its maternal mortality rate. Florida's PAMR process began in 1996 and is funded through Title V Maternal and Child Health Block Grant resources. The Florida Department of Health's decision to develop this systematic approach to examining maternal deaths was prompted by: 1) CDC publications confirming the underreporting of maternal deaths; 2) questions about the relationship of maternal deaths to changes that were occurring in healthcare delivery systems; and, 3) a cluster of maternal deaths observed in a Florida county (3).

The multidisciplinary PAMR team meets quarterly to confidentially review fifteen de-identified pregnancy-associated cases at each meeting, and after discussing the abstracted data for each case, deems the death as being pregnancy-related, possibly pregnancy-related, or not pregnancy-related. A multitude of data points, including recommendations for improving the systems of care for women, is collected on each case and entered into a database after each team meeting. The process of review, discussion, and dissemination of PAMR team findings to healthcare entities, healthcare providers, legislators, and citizens provides an effective mechanism to improve systems of care that can ultimately lead to reduced maternal mortality.

Results: During 1999–2002, 218 total pregnancy-associated deaths were reviewed by Florida's PAMR team, and of these pregnancy-associated deaths, 143 (65.6 percent) were determined by the team to have been pregnancy-related. The overall maternal mortality ratio (as determined by Florida's PAMR team) was 17.6 deaths per 100,000 live births and ranged from 20.8 in 1999 to 15.1 in 2002. The maternal mortality ratio was higher for Black women, women aged 35 years and older, and for women who were overweight or obese.

Interpretation: The maternal mortality ratio in Florida (as determined by the PAMR team using an expanded definition of maternal mortality) is consistently higher than the maternal mortality ratio calculated by Florida's Office of Vital Statistics, most likely due to increased ascertainment of pregnancy-related deaths via the PAMR process. The PAMR-calculated maternal mortality ratio has decreased between 1999 and 2002. National data is not available for the same period; however, the most current national

data show an increase in national maternal mortality between 1991 and 1999 (4). Despite a declining overall maternal mortality ratio, Florida's PAMR process found that Black women experienced a three times higher maternal mortality ratio than White women, representing a larger racial disparity than those found in low birth weight and infant mortality.

Public Health Actions: Similar to recommendations by the CDC regarding maternal mortality nationally (4), Florida's study of maternal mortality suggests that continued surveillance and case examination should be conducted to monitor the magnitude and causes of maternal mortality, attempt to identify factors that contribute to the racial disparity in maternal mortality, and use information gleaned from the pregnancy-associated mortality review process to help improve systems of care for women. The Florida Department of Health continues collaborative work with the CDC, ACOG, and other state health departments to develop strategies to best use PAMR findings to influence healthcare policy and practice.

Limitations: Limitations should be considered in the analysis of maternal mortality in Florida during 1999–2002. It should be noted that the PAMR project reviews a series of case studies and is not designed as a research study. The information presented is descriptive and not intended to identify causal factors for maternal death. The project is a means to observe systems of care across the state and obtain knowledge related to the effectiveness of service delivery. The observations can then be incorporated into plans for improvement of service delivery systems.

Introduction



Healthy People 2010 recognizes the reduction of maternal mortality as a national priority, with the goal of lowering the rate to no more than 3.3 maternal deaths per 100,000 live births (4). In Florida, the reduction of maternal mortality is also a public health priority, evidenced by the statewide comprehensive review of pregnancy-associated maternal mortality led by the Florida Department of Health and assisted by a multidisciplinary team of 31 concerned healthcare professionals.

According to Florida vital statistics (1), the maternal mortality rate in Florida experienced a downward trend between 1950, when it was 129 deaths per 100,000 live births, and 1993, when it had fallen to its lowest rate of nine per 100,000. Since 1993, the maternal mortality rate in Florida (according to Florida vital statistics) has leveled off at between nine and 13 deaths per 100,000 (except for the 1999 rate of 19 per 100,000). *Please note that the maternal mortality rates shown on page 4 of this report were calculated using pregnancy-related deaths identified through Florida's PAMR review process, and differ from the lower ratios calculated using Florida's vital statistics reporting on maternal mortality. Reasons that the PAMR ratios are higher than those calculated using Florida's vital statistics data will be explored in this report.*

Racial disparity exists in pregnancy-related mortality in Florida and in the United States (U.S.). Since 1950, maternal mortality ratios in Florida among non-Whites have been between two to 10 times higher than those for Whites. In 2002, the ratio of non-White to White maternal mortality was 2.7. With a total maternal mortality ratio of 10 per 100,000 (1), major improvements will be needed for Florida to meet the Healthy People 2010 objective of no more than 3.3 total maternal deaths per 100,000 live births (2).

In the 10 years prior to initiation of the PAMR process in 1996, there was no systematic review of maternal deaths in Florida. Florida, like many other states, historically reviewed maternal deaths via a limited process using only the death certificate and a narrow definition – “*death to a woman occurring within 42 days of pregnancy*” – and with a cause of death code of ICD-9: 630-676 (5).

The Florida Department of Health's decision to develop a systematic approach to examining maternal deaths was prompted by: 1) the CDC's publications confirming the underreporting of maternal deaths; 2) questions about the relationship of maternal deaths to changes that were occurring in healthcare delivery systems; and, 3) a cluster of maternal deaths observed in a Florida county. The CDC and ACOG's expanded definition of maternal mortality was adopted and includes, “*death of a woman, from any cause, while she is pregnant or within one year of termination of pregnancy, regardless of duration and site of the pregnancy.*”

In 1996, with heightened awareness, Florida began re-examining the surveillance and analysis of maternal deaths for 1993 through 1995. Using the new definition, increases in identified cases of maternal deaths during the 90-day post-pregnancy interval were ascertained. It should be noted that these deaths are associated with the pregnancy

by time period, yet may or may not be directly related to the pregnancy. These findings led to the determination that a statewide PAMR process, modeled after the National Fetal and Infant Mortality Review Process (NFIMR), was needed to understand better the factors and issues related to maternal mortality. *It is important to note that the PAMR process is conducted at the state level, while there are 12 local state-funded and several additional non-state funded FIMR projects in Florida.* The CDC and other states have reported increases in case ascertainment through a process of linking data sets. The Florida Department of Health's (DOH) Division of Family Health Services, in collaboration with the DOH's Office of Planning, Evaluation, and Data Analysis, has implemented new linkages (these linkages are discussed in the "Methods" section of this report), which have resulted in increased identification of cases. The use of a broader definition and linked data enables Florida to assess more accurately its maternal mortality rates.

This report about maternal mortality in Florida during 1999–2002 is modeled after the CDC's February 21, 2003, *MMWR Surveillance Summary* (4) concerning maternal mortality in the United States. It is hoped that through dissemination, review, and discussion of the findings contained in this report, healthcare entities and providers will be able to make improvements in the systems of care for pregnant and postpartum women that will ultimately reduce maternal mortality.

Florida's PAMR process involves collecting data about all reported deaths that are associated with pregnancy. These deaths are further classified as pregnancy-related, possibly pregnancy-related, and not pregnancy-related using the following definitions:

- **Pregnancy-Associated Mortality:** the death of a woman, from any cause, while she is pregnant or within one year of termination of pregnancy, regardless of duration and site of pregnancy (6).
- **Pregnancy-Related Mortality:** a pregnancy-associated death resulting from one or more of the following: 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 physiologic effects of the pregnancy that subsequently causes death (7).
- **Possibly Pregnancy-Related:** a death identified using case identification methods where determination of the death, following team review, could not be conclusively classified as either related or not related to the pregnancy.
- **Not Pregnancy-Related:** the death of a woman, while pregnant or within one year of termination of pregnancy, from a cause unrelated to pregnancy.

Case Identification

The Florida Department of Health's (DOH) Division of Family Health Services, in collaboration with the DOH's Office of Planning, Evaluation, and Data Analysis, has implemented linkages to maximize the identification of pregnancy-associated deaths. Women are included on the surveillance list of pregnancy-associated deaths by any of the following four ways:

- 1) **The response on the death certificate is "yes" to the question, "If female, was there a pregnancy in the past 3 months?"**
- 2) **The ICD-10 code indicates a death classified as being due to "Pregnancy, Childbirth and the Puerperium."**
- 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 assess risk and subsequently to identify those women most at risk for adverse health outcomes).**

The death certificates are initially reviewed by a physician and nurse team and categorized as pregnancy-related, possibly pregnancy-related, and not pregnancy-related. Cases are then selected for abstraction with the goal that all pregnancy-related and a combination of some possibly pregnancy-related and not pregnancy-related cases are reviewed. (Stratified random sampling is used to select the possibly related and not pregnancy-related cases for review.) The team's goal is to review 15 abstracted cases per quarter, for a total of 60 cases per year. The composition of the team is described in the multidisciplinary, review-team process section of this document.

Case Abstraction Process

The PAMR abstraction process is modeled after the NFIMR process. Abstraction forms capture information from the medical and social history, prenatal, labor and delivery, postpartum, social service, care coordination, and terminal events records. FIMR abstractors, professionals with experiences in accessing and reviewing medical and social records, are hired to review selected PAMR records in their areas. Once a case has been selected at the state level, the information is provided to the abstractor by the project coordinator, who is a registered nursing consultant at the Florida DOH. Authority to access information for the review is based on section 395.3025, Florida Statutes, and under sections 405.01 and 405.03, *Florida Statutes*. Once information is deemed complete, a case summary is written. No identifiers of health providers, facilities, or patients are included in the summary. All case-specific information is kept strictly confidential. All review team members sign confidentiality statements prior to each review.

Data Sources

During the case abstraction process, the case abstractors accessed the following sources. In most of the reviewed cases, more than one source was accessed for information:

- Terminal event record
- Labor and delivery record
- Autopsy report
- Other hospitalization record
- Pathology report
- Complete prenatal care record
- Partial prenatal care record
- Medical examiner's report
- Toxicology report
- Emergency medical services record
- Healthy Start care coordination record
- Law enforcement record
- Home healthcare record
- Six-week postpartum check record
- Social services record
- Other records, such as infertility workup, infant record

Multidisciplinary Review Team Process

The review team is a multidisciplinary committee of 31 professionals (physicians, nurses, nurse midwives, social workers, and researchers), representing groups such as

the Florida Obstetrical and Gynecological Society, Society for Maternal Fetal Medicine, Florida Hospital Association, Regional Perinatal Intensive Care Centers, Florida Medical Association, National Association of Social Workers, Florida Association of Healthy Start Coalitions, Florida Department of Health, Medical Examiners Commission, Florida Office of Vital Statistics, Florida State University School of Nursing, Florida Agricultural and Mechanical University School of Nursing, American College of Obstetricians and Gynecologists, Agency for Healthcare Administration (Florida's Medicaid agency), Florida Osteopathic Medical Association, Florida Academy of Family Physicians, and local county health departments.

The review team meets quarterly to discuss abstracted records. They examine trends, common elements, and formulate potential strategies to address these factors. Team members volunteer their time and provide their own travel costs. The goal of the review team is to identify gaps in care, systemic service delivery problems, and areas in which linkages between community resources can be improved to facilitate improvements in the system of care.

Each case is reviewed for issues relating to maternal mortality. Issues identified include:

- 1) Documented history of medical problems**
- 2) Medical problems during pregnancy**
- 3) Medical problems associated with labor and delivery**
- 4) Medical problems during the postpartum period**
- 5) Nutrition issues**
- 6) Access to prenatal care**
- 7) Substance use**
- 8) Absence of prenatal risk assessment**
- 9) Lack of social support**
- 10) Problems with housing**
- 11) Mental health problems**
- 12) Family violence or neglect**
- 13) Social issues**
- 14) Access to transportation**
- 15) Problems with provision or design of services**
- 16) Environmental or occupational hazards**
- 17) Concerns about family planning access or contraceptive method**

Cases are also assessed for gaps in care, successes in service utilization, degree of relevant information available, and positive system components. The team makes recommendations for system changes and supplemental services. After review, the team then gives a final classification to each case as pregnancy-related, possibly pregnancy-related, or not pregnancy-related.

Data Analysis

Pregnancy-related mortality ratios were calculated by using the number of pregnancy-related deaths obtained through the PAMR process (numerator) and live birth data (denominator) obtained from the Florida Office of Vital Statistics. This live birth population included all women who delivered a live birth in Florida during the selected time period. From 1999 through 2002, 73.9 percent of the 812,373 births in Florida were to White women, 22.8 percent were to Black women, and 3.1 percent were to women of other races. During the same period, 23.2 percent of births in Florida were to women of Hispanic ethnicity, and 3.0 percent of births in Florida were to women of Haitian ethnicity.

For both the numerator and denominator of maternal mortality ratios, race was defined as the race of the mother and was classified as White, Black, or other. Because there was only one death in the “other” race category ($n = 1$), data regarding this race category were not included in the race-specific analyses for this report. Two ethnicity categories were available in the data, Hispanic and Haitian. Race and ethnicity information were obtained from the maternal death certificates.

The women’s ages, education information, and marital status also were obtained from the maternal death certificates. The women’s ages at the time of death were initially grouped into the following categories: 19 and younger, 20 to 24, 25 to 29, 30 to 34, 35 to 39, and 40 and older. The small numbers of pregnancy-related deaths in some of these age categories, however, necessitated compressing the categories into the following groups for a more meaningful analysis: 19 and younger, 20 to 24, 25 to 34, and 35 and older. Education information was based on the total years of education completed at the time of death, and is broken into: less than 12 years of education, 12 years of education, or more than 12 years of education. The analysis of pregnancy-related deaths by level of education was restricted to those women aged 20 years or older, the age at which most women would be assumed to have graduated from high school. Marital status was classified as married or not married.

History of chronic illness information, entry into prenatal care, and timing of death were obtained through the records abstraction process. Prenatal care entry was classified as having begun in the first, second, or third trimester, or having had no prenatal care. There were 46 cases for whom prenatal care entry was unable to be ascertained. Timing of death was categorized as: during the first trimester, second trimester, or third trimester (with no labor and delivery); labor and delivery; postpartum, not discharged; postpartum discharged; and, no source data (those cases for which timing of death in relation to the pregnancy were unable to be ascertained).

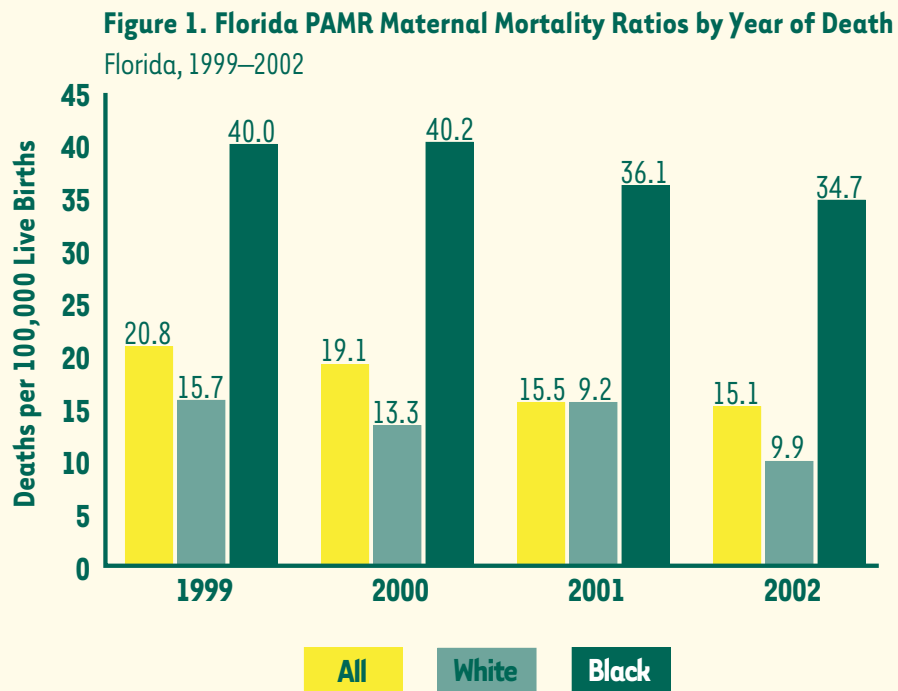
All analyses were performed using Statistical Package for Social Sciences (SPSS) software. The 95 percent confidence intervals (CI) were calculated for risk ratios using the Katz method (8).

Results

Florida's PAMR team reviewed 218 pregnancy-associated deaths occurring between 1999 and 2002. Of these, the team determined 143 deaths were pregnancy-related. Many of the deaths were identified by multiple methods. Of the 143 pregnancy-related deaths, 108 (75.5 percent) were identified by matching a birth or fetal death certificate, 102 (71.3 percent) were identified by using the pregnancy checkbox on the woman's death certificate, 74 (51.7 percent) were identified by using ICD- 9 or 10 coding, and 67 (46.9 percent) were identified through Florida's Healthy Start screening process.

The overall PAMR-determined, pregnancy-related mortality ratio was 17.6 deaths per 100,000 live births for the four-year period. This contrasts with the 12.9 per 100,000 live-births ratio calculated by using Florida vital statistics reports of maternal deaths during the same period (1). The PAMR-calculated, pregnancy-related mortality ratio decreased from 20.8 per 100,000 in 1999 to 15.1 in 2002 (see Figure 1). Similarly, the ratio calculated using Florida vital statistics reports also decreased over the same period, from 19.3 in 1999 to 9.7 in 2001 and 2002.

Please note that the numerator for the PAMR-calculated pregnancy-related mortality ratio is based upon those cases in the PAMR database, which were deemed by the review team to be pregnancy-related.



The risk for pregnancy-related death was significantly higher for women aged 35 years or more. These women had a pregnancy-related mortality ratio that was approximately three times higher than that for women aged 19 years or less (Table 1). Race was also significantly associated with maternal mortality; Black women were approximately three times more likely to die from pregnancy-related causes than White women (Table 1).

Table 1

Maternal mortality ratios (MMR) and risk ratios by age group, race, and Hispanic ethnicity -- Florida, 1999-2002 (Deaths per 100,000 Live Births)

| | Deaths | MMR | Risk Ratio | 95% CI* |
|---------------------------|----------|------|------------|-------------|
| Age group (yrs) | | | | |
| 19 or younger | 10 | 10.1 | Referent | |
| 20-24 | 33 | 16.1 | 1.6 | .79 - 3.24 |
| 25-34 | 62 | 15.8 | 1.6 | .80 - 3.06 |
| 35 or older | 38 | 33.3 | 3.3 | 1.65 - 6.64 |
| Race and Ethnicity | | | | |
| | Deaths** | MMR | Risk Ratio | 95% CI* |
| White, non-Hispanic | 51 | 12.2 | Referent | |
| Black, non-Hispanic | 69 | 38.1 | 3.1 | 2.17 - 4.48 |
| Hispanic | 22 | 11.7 | 1.0 | 0.58 - 1.58 |

*Confidence Interval

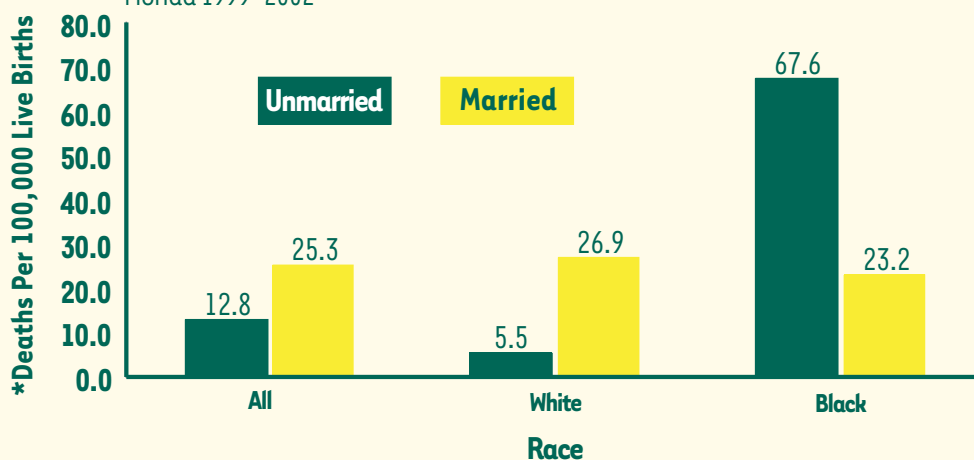
**Excludes one death in "Other" race category

Two ethnicity categories were available in the data, Hispanic and Haitian. Analyses were performed to look for any significant differences in risk for women of Hispanic or Haitian ethnicity. There was no statistical difference in risk associated with Hispanic ethnicity. For women of Haitian ethnicity, there was an observed, statistically significant, higher ratio; however, caution is warranted in this finding, since the confidence intervals were large.

Overall, the mortality ratio for pregnancy-related death for unmarried women was higher than that for married women (see Figure 2). However, the pattern of this risk differed for Black women and White women. The mortality ratio for White unmarried women was approximately five times higher than that for White married women, while the mortality ratio for Black married women was approximately three times higher than that of Black unmarried women. These findings are similar to national findings published in the CDC's February 2003 MMWR on maternal mortality (4).

Figure 2. Maternal Mortality Ratios* by Race and Marital Status

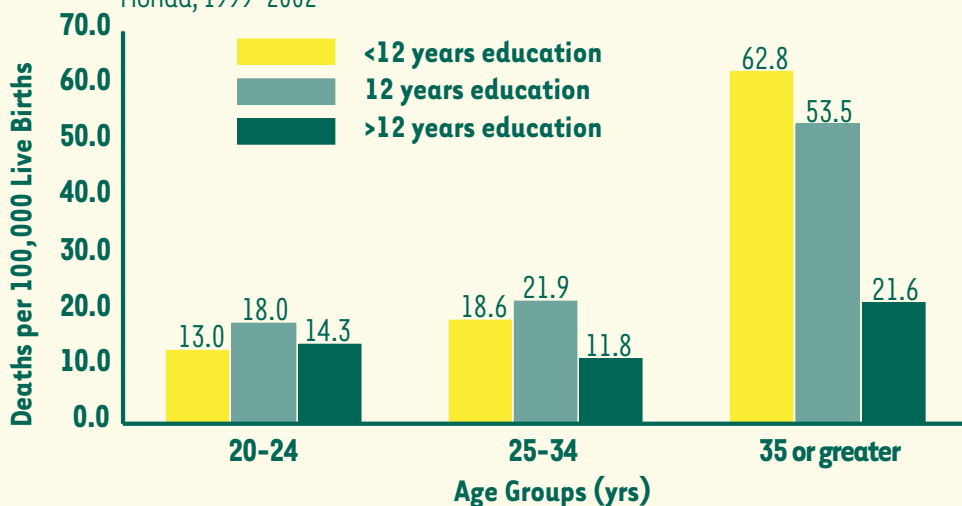
Florida 1999-2002



For the 20 to 24 age group, women with less than 12 years of education had the lowest maternal mortality ratio, while in the 25 to 34 and 35 and older age groups, women with more than 12 years of education had the lowest maternal mortality ratio (see Figure 3). An analysis of age by race was done to determine any racial

Figure 3: Maternal mortality ratios by age and education

Florida, 1999-2002



differences within age categories; however, the results are not reported due to low numbers within each category.

Overall, women who entered prenatal care in the second trimester had the highest maternal mortality ratio. This was also true for White women; although among Black women, those with no prenatal care had the highest maternal mortality ratio (see Table 2). Limitations of this table include: a high number of cases for which prenatal care initiation was unknown (46 unknowns) and an inability to report confidence intervals due to low numbers in each category.

Table 2

Maternal mortality ratios by race and prenatal care initiation – Florida, 1999 - 2002 (Deaths per 100,000 Live Births)

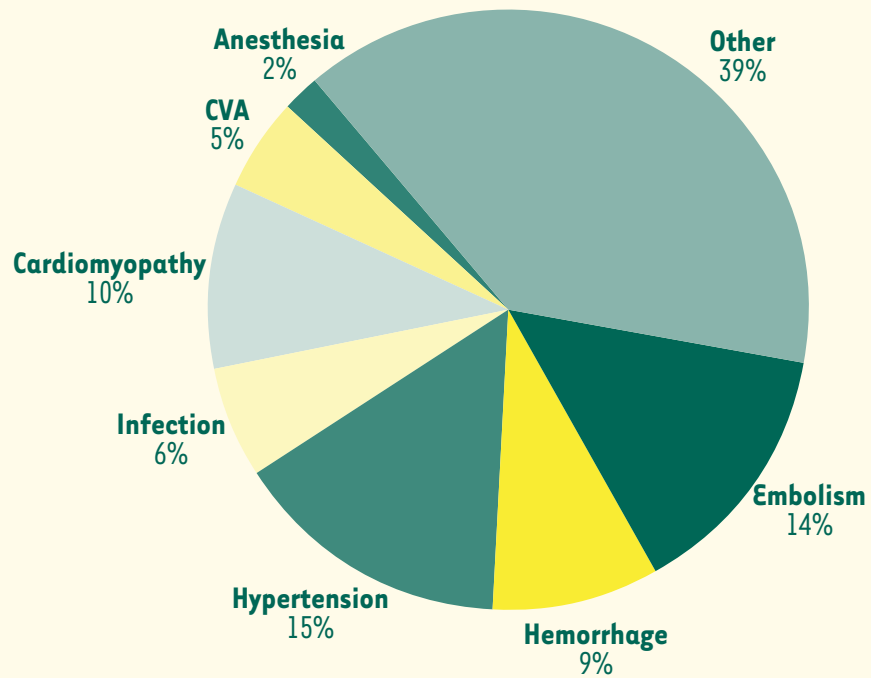
| Prenatal Care Initiation | All | White | Black |
|---------------------------------|-------------|--------------|--------------|
| First Trimester | 10.6 | 6.4 | 27.9 |
| Second Trimester | 23.1 | 26.2 | 19.7 |
| Third Trimester | 5.4 | 9.1 | 0.0 |
| No Care | 12.5 | 0.0 | 29.1 |

The Florida PAMR dataset includes cause of death from two different sources. An analysis of each of the cause-of-death variables was undertaken using: 1) the official Florida vital statistics' cause of death and 2) the "PAMR-determined" cause of death. The team used the abstracted case summary and team expertise to categorize the "PAMR-determined" cause of death for discussion purposes and to inform the team about recommendations. The team acknowledges that this categorization is based upon hindsight and without full-case information, and it is not intended to replace the vital statistics cause of death.

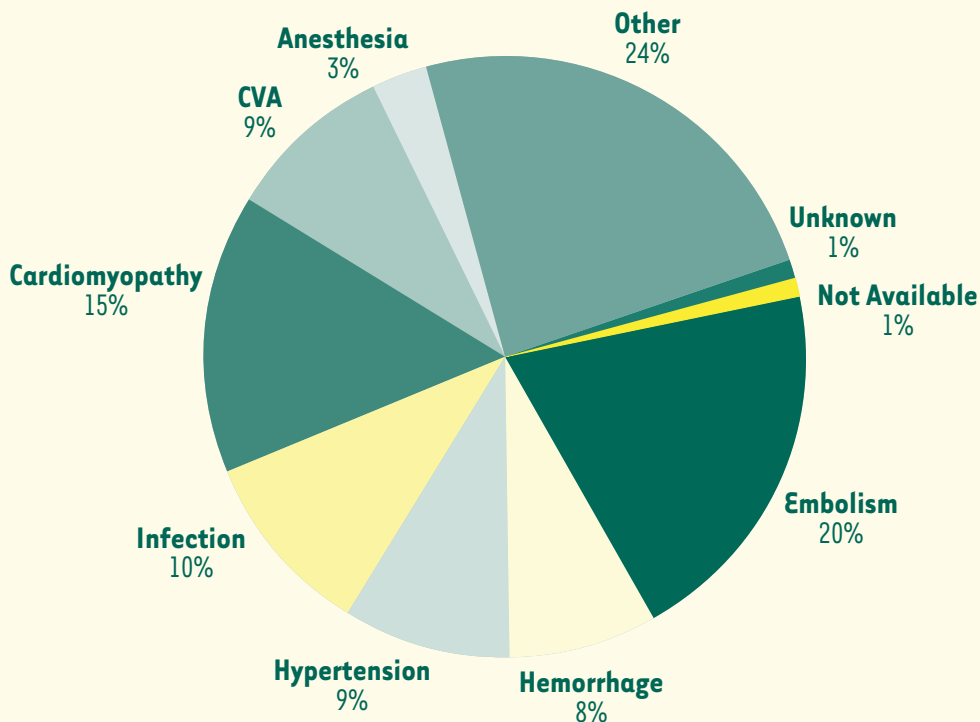
A physician member of Florida's PAMR team further categorized the causes of death within each set based upon the categories used in the CDC's February 2002 MMWR on maternal mortality, including: embolism, hemorrhage, infection, cardiomyopathy, cerebrovascular accident (CVA), anesthesia, unknown, and other. (Examples of causes of death that were grouped into the "other" category include "Complication of labor and delivery, unspecified," and "Other specified pregnancy-related conditions.") Although the CDC's grouping also included the category "pregnancy-induced hypertension (PIH)," the physician classifying Florida's deaths instead elected to use the category "hypertension." The distinction was made because Florida's data did not consistently include information about the onset of hypertension (during or before pregnancy). Thus, this category includes hypertension, preeclampsia, and eclampsia. After the "other" category (39 percent), the leading causes of death according to Florida vital statistics records (data taken directly from death certificates) were hypertension (15 percent), embolism (14 percent), and cardiomyopathy (10 percent). (See Figure 4). After the "other" category (24 percent), the leading "PAMR-determined" causes of death were embolism (20 percent), cardiomyopathy (15 percent), and infection (10 percent). (See Figure 5)

It is likely that there are fewer deaths classified as “other” in the “PAMR-determined” set of causes of death, because the PAMR team is afforded the opportunity to review and discuss a rich set of information on most cases. Therefore, many deaths that may have been more vaguely classified on the death certificate may have been reclassified, when the PAMR team reviewed case abstraction information (for example, reclassified from “cardiac arrest, unspecified” on the death certificate, which would fall into the “other category,” to “postpartum cardiomyopathy” by the PAMR team, which would fall into the “cardiomyopathy” category). As previously noted, the PAMR team recognizes that they are operating with the benefit of hindsight. Their classification of causes of death is for discussion and learning purposes, and is not meant to replace the official Florida vital statistics record.

Figure 4: Distribution of Pregnancy-Related Cause of Deaths
Vital Statistics—Florida, 1999–2002



**Figure 5: Distribution of Pregnancy-Related Cause of PAMR Determined—
Florida, 1999–2002**



Of the “hypertension” deaths (15 percent of total) reported by the Florida Office of Vital Statistics, 59.1 percent were related to preeclampsia, and 22.7 percent were related to eclampsia. Of the “embolism” deaths (14 percent of total) reported by Florida’s Office of Vital Statistics, 65 percent were the result of an amniotic fluid embolism, and 15 percent from pulmonary embolism. Of the “hemorrhage” deaths (9 percent of the total) reported by Florida’s Office of Vital Statistics, 53.8 percent were associated with coagulation disorders. Any additional, specific causes of death within each of the categories with an occurrence of less than three cases are not listed due to the threat of a loss of confidentiality for the case(s).

Of the “Other” deaths (24 percent) categorized by the PAMR team, 18.2 percent were due to cardiac disorders, 9.1 percent were due to respiratory disorders, 9.1 percent were due to complications from an ectopic pregnancy, and 9.1 percent were due to liver disorders. Of the “embolism” deaths (20 percent) categorized by the PAMR team, 51.7 percent were due to an amniotic fluid embolism and 44.8 percent were due to a pulmonary embolism. Of the “hypertension” deaths (9 percent) categorized by the PAMR team, 46.2 percent were the result of preeclampsia, and 46.2 percent resulted from eclampsia.

The vast majority of pregnancy-related deaths occurred during the postpartum period

(see Figure 6) (for PAMR, the postpartum period is defined as the period following birth up to one year after birth). Forty-one percent of the women died postpartum in the hospital, never having been discharged home after delivery, and 33 percent died during the postpartum period, following hospital discharge after delivery. Of the 47 women who died during the postpartum period, following hospital discharge after delivery, 26 (55.32 percent) died six or fewer weeks after discharge (see Figure 7). The most common causes of death for the women who died during the postpartum period following hospital discharge after delivery were cardiomyopathy (38.3 percent), embolism (17 percent), and CVA (12.8 percent).

Figure 6: Time Period Distribution of Pregnancy-Related Deaths
Florida, 1999–2002

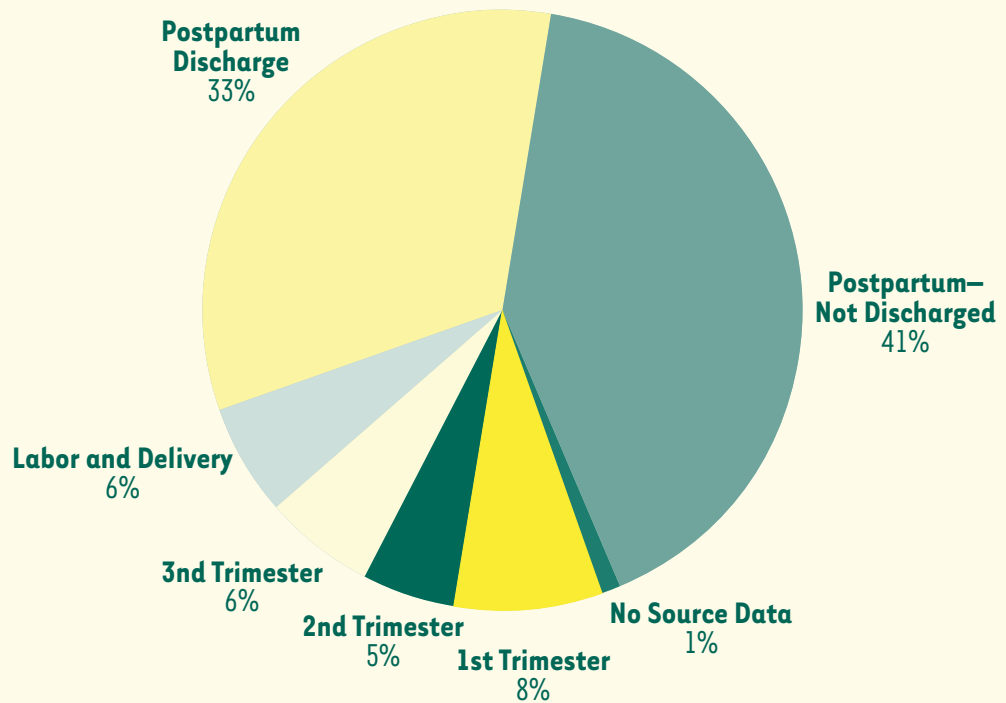


Figure 7: Interval Between Date of Hospital Discharge and Date of Death for Pregnancy Related Deaths - Postpartum Discharged, Florida 1999-2002

| Interval Between Date of Hospital Discharge and Date of Death | Number | Percent |
|---|-----------|----------------|
| < or = 6 weeks | 26 | 55.32% |
| 6 weeks to 3 months | 8 | 17.02% |
| 3 months or > | 12 | 25.53% |
| Data Not Present | 1 | 2.13% |
| Total | 47 | 100.00% |

An analysis of the history of chronic disease prevalence among women with pregnancy-related deaths shows that 67.1 percent of the women had a history of chronic disease. Chronic diseases are those that are usually long-lasting in duration, sometimes permanent, often leave a residual disability, and require a long period of observation, supervision, or care. Of the 67.1 percent of women with a history of chronic disease, approximately half were Black and half were White; however, **it is important to note that Black women are overrepresented in the PAMR group.** Many of the women had multiple chronic diseases. Overall, the most commonly reported chronic diseases among the women with pregnancy-related deaths were obesity (11.8 percent) and hypertension (11.2 percent).

A special analysis was undertaken to examine the correlation of obesity to pregnancy-related mortality. Obesity was measured using the body mass index (BMI), which accounts for both height and weight in assessing obesity. The formula is “weight” divided by the “square of the height,” where weight is expressed in kilograms and height is in meters. Ranges of the BMI are used to classify women as shown in Table 3. For example, the BMI range of 30.0 to 34.9 is classified as “Obese 1,” and the BMI range of 40 and above is classified as “Obese 3.” The degree of obesity increases with each category. Women who are Obese 3 exhibit the highest level of obesity.

The analysis suggests that women in the PAMR dataset whose deaths were pregnancy-related were more likely to have a high BMI when compared with a reference group of pregnant women. The reference group used is comprised of women screened using Florida’s Healthy Start Prenatal Screen during the years 1999 through 2002. To examine the association between the BMI and pregnancy-related death, an analysis that applied the principles and techniques of case control methodology was conducted. The analysis used pregnancy-related deaths from 1999 through 2002 as the cases, and women who did not die and were screened using the Healthy Start Prenatal Screen in 1999 through 2002 as controls (116 cases and 400,893 controls). Twenty-seven of the 143 women that had pregnancy-related deaths were of unknown height or weight, and therefore, could not be used in the analysis. This decreased the number of cases from 143 to 116. Each year, approximately 50 percent of all women who give birth in Florida are screened during the prenatal period using the Healthy Start Prenatal Screen. The pre-pregnancy height and weight of women in both groups were documented during their prenatal care and the BMIs were calculated from these data.

Table 3 shows that the women who experienced pregnancy-related deaths are more likely to be in the higher BMI categories compared to the women screened using the Healthy Start Screen. For example, 16.1 percent of the PAMR women who had pregnancy-related deaths were in the Obese 1 category (BMI=30–34.9) compared to only 10.8 percent of the women screened using the Healthy Start Screen in that category. A similar pattern was found in the Obese 2 (BMI=35–39.9) and Obese 3 (BMI=40 and over) categories. The last column in Table 3 indicates the relative difference between the percentages for the PAMR women and the comparison group. For example, in the Obese 1 category, the 2 percentages are 16.1 and 10.8. When the 16.1 is divided by the 10.8, the result of 1.49 is posted in the last column. The 1.49 is a summary statistic that indicates that 16.1 is 1.49 times as high as the 10.8.

Table 3**Pregnancy-Related Deaths 1999–2002 (PAMR) and Women Screened by Healthy Start (Comparison) by Body Mass Index Classification**

| Body Mass Index | Classification | Women | Percent | Women | Percent | PAMR Comparison Ratio of Percents |
|-----------------|----------------|------------|---------------|---------------|---------------|-----------------------------------|
| <18.5 | Under weight | 8 | 5.6% | 28453 | 7.1% | 0.79 |
| 18.5–24.9 | Normal weight | 29 | 20.3% | 206696 | 51.6% | 0.39 |
| 25.0–29.9 | Over weight | 31 | 21.7% | 92373 | 23.0% | 0.94 |
| 30.0–34.9 | Obese 1 | 23 | 16.1% | 43179 | 10.8% | 1.49 |
| 35.0–39.9 | Obese 2 | 11 | 7.7% | 18342 | 4.6% | 1.68 |
| 40.0+ | Obese 3 | 14 | 9.8% | 11850 | 3.0% | 3.31 |
| Unknown | Unknown | 27 | 18.9% | 0 | 0.0% | |
| Total | | 143 | 100.0% | 400893 | 100.0% | 1.00 |

Table 4 shows the adjusted odds ratios for deaths, computed from the case-control data. Pregnancy-related deaths were associated with all of the higher BMI categories compared to the referent category, which is the normal BMI (18.5 – 24.9). All of these odds ratios were statistically significant. The last two columns of table 4 show the 95 percent confidence limits (CL) for the odds ratios. The confidence limits are a measure of the random variation that could occur in the odds ratios. For example, the 95 percent CL for the Obese 1 category in Table 4 are 2.20 to 6.56. This means that for another time period, if all other factors remained the same, there is a 95 percent chance the odds ratio computed from the new data would be between 2.20 and 6.56. Confidence limits that include 1 indicate the odds ratio is not statistically significant. Having a below normal BMI was also associated with pregnancy-related death, but was not statistically significant.

Table 4**Adjusted Death Odds Ratios for Pregnancy-Related Deaths 1999–2002 (PAMR) using Women Screened by Healthy Start 1999–2002 as Controls**

| Body Mass Index | Classification | Adjusted Odds Ratio for Death | Adjusted Odds Ratio Lower 95%CL | Adjusted Odds Ratio Upper 95%CL |
|------------------------|-----------------------|--------------------------------------|--|--|
| <18.5 | Under weight | 2.00 | 0.92 | 4.38 |
| 18.5–24.9 | Normal weight | 1.00 | referent | referent |
| 25.0–29.9 | Over weight | 2.39 | 1.44 | 3.97 |
| 30.0–34.9 | Obese 1 | 3.80 | 2.20 | 6.56 |
| 35.0–39.9 | Obese 2 | 4.27 | 2.13 | 8.56 |
| 40.0+ | Obese 3 | 8.42 | 4.45 | 15.94 |

One important limitation of this analysis is the use of women who have completed a Healthy Start Prenatal Screen as the control group. This group is likely not representative of all women who give birth in Florida, since only 50 percent of the women who give birth in Florida are screened. Future analyses should include the use of matched case-control techniques to help account for this potential bias and should also consider additional factors such as race, age, and reported chronic illness.

The Florida Healthy Start Prenatal Screen was developed to identify pregnant women at risk for preterm or low birth-weight delivery. Florida Statute and code mandate the offer of the prenatal screen instrument to all pregnant women upon the first prenatal visit. Using risk assessment results, interventions can be planned and tailored to the assessed level of risk. Analysis of the 2001 Florida birth cohort suggests that women most at risk for an adverse outcome were less likely to be offered the Healthy Start prenatal screen. This suggests that many of the cohort women who may have benefited most from a prenatal risk assessment were less likely to be offered the prenatal risk assessment screen. This underscores the need for providers to be continually educated about the importance of offering the prenatal risk assessment screen to every pregnant woman.



The Healthy People 2010 objective is to reduce maternal mortality to 3.3 maternal deaths per 100,000 live births (4). This same goal was set in Healthy People 2000, but not achieved. Florida is not yet close to reaching the Healthy People 2010 goal, and substantial improvements will need to be made to reach the goal by 2010.

The Florida PAMR-calculated, maternal mortality ratios decreased from 20.8 per 100,000 live births in 1999 to 15.1 in 2002. As reported previously, PAMR-calculated, maternal mortality ratios were higher than ratios calculated using Florida vital statistics data. According to Florida vital statistics, the maternal mortality ratio decreased from 19.3 in 1999 to 9.7 in 2002. The difference between the two sets of ratios likely reflects the PAMR team's enhanced identification of pregnancy-related cases through use of a system, which uses an expanded definition of maternal mortality, and identifies cases through several mechanisms (pregnancy checkbox; matches with birth/fetal death records, and Florida's Healthy Start Screen).

Cause of death information was grouped according to the categories used by the CDC in the February 2003 MMWR on maternal mortality (4). According to Florida vital statistics data, after the "other" category (39 percent), the leading causes of death according to Florida vital statistics records were hypertension (15 percent), embolism (14 percent), and cardiomyopathy (10 percent). (See Figure 4). After the "other" category (24 percent), the leading "PAMR-determined" causes of death were embolism (20 percent), cardiomyopathy (15 percent), and infection (10 percent). (See Figure 5). These differ from the most common "PAMR-determined" causes of death reported in the 1997-First Quarter and 1999 Florida PAMR report (3), which listed adult respiratory distress syndrome and preeclampsia/eclampsia as the top two causes of death.

The analysis of the time of death in this study suggests that special attention needs to be given to postpartum women. One third of the women who suffered pregnancy-related deaths died during the postpartum period after being discharged from the hospital, and more than half of those women died within the first six weeks after discharge. This finding is noteworthy, since the postpartum checkup does not usually take place until six to eight weeks after delivery, and many women are not seen by a healthcare provider between the hospital discharge and the postpartum checkup. Systems that will assure the health needs of postpartum women are being met, and will assure that postpartum women know how to recognize "danger signs" and know when to access health care, are vital to reducing the maternal mortality rate. Women are typically educated about signs of obstetrical hemorrhage and infection prior to hospital discharge after giving birth; but, education about the importance of seeking care for symptoms such as swelling, redness, warmth, pain in a lower extremity (which could be associated with deep-vein thrombosis), shortness of breath, chest pain, palpitations, syncope (all of which could be symptoms associated with cardiomyopathy or pulmonary embolism), and education about the importance of seeking care for symptoms such as severe or prolonged headache (symptoms associated with CVA), are not routinely employed as part of the hospital discharge education.

The fact that women age 35 or older, had a 3.3 times greater risk of dying from a pregnancy-related cause than women age 19 or younger raises some concerns, in light of the fact that women in the United States are becoming pregnant at older ages, and that the risk of chronic illness increases with age (4). The DOH recognizes the need for preconceptional and interconceptional education for women, including information about the importance of properly managing chronic illnesses prior to pregnancy and attaining one's ideal weight prior to pregnancy.

The results of the obesity analysis demonstrate a statistically significant relationship between pregnancy-related death and being overweight or obese. This raises concern about the growing number of Americans who are overweight and obese, and the impact this may have on maternal mortality. Healthy People 2010 goals reported a baseline of only 42 percent of adults in the United States being at a healthy weight (2). Co-morbidity of obesity and other chronic illnesses may warrant future attention by the PAMR team since 67 percent of the women in this analysis with pregnancy-related deaths had a history of chronic illness.

The data in this report reaffirms a marked racial disparity in maternal mortality between Black and White women. Further studies are needed to determine the root causes that may be impacting the racial disparity in maternal mortality between Black and White women.

Limitations

Limitations should be considered in the analysis of maternal mortality in Florida during 1999 through 2002. It should be noted that the PAMR project is a review of a series of case studies and is not designed as a research study. The information presented is descriptive and not intended to identify causal factors for maternal death. The project is a means to observe systems of care across the state and obtain knowledge related to the effectiveness of service delivery. The observations can then be incorporated into the planning for service delivery system improvements.

There are limitations within the process that influence the determination of a maternal mortality rate. Accuracy of the reporting of maternal deaths is problematic. Issues include improper coding or diagnosis on the death certificate, data entry errors, or incomplete matching with birth-fetal death certificates or prenatal screens. Challenges associated with abstracting data include availability, access, and completeness of records; and, more importantly, the fact that even the best documentation cannot fully capture the events occurring during the course of care and at the time of a death.

Florida's PAMR review process does not presently include survivor interviews, which can serve as a rich source of information regarding the events and circumstances leading up to and surrounding a maternal death. There are often important information gaps that could likely be addressed through interviews with a woman's family, friends, co-workers, or neighbors.

In addition, the PAMR team process of retrospectively reviewing cases offers the advantage of hindsight. The team is cognizant of the advantage that hindsight gives them when making recommendations. The team also recognizes that subjectivity is inherent in the process by the very nature of this unique interdisciplinary team review. A different mix of team members is present at each meeting due to team members' schedules not

allowing each member of the team to attend each case review meeting. Because of this, issues identified and recommendations made at each case review meeting are influenced by the particular makeup of the team at that meeting. A different mix of team members at any given meeting would likely have led to a somewhat different set of identified issues and recommendations from that meeting.

Public Health Measures

Although maternal deaths attributable to pregnancy remain relatively rare, it is important that each death be identified and carefully reviewed at the state level. The lessons learned from the review of these deaths then need to be shared with those who have the opportunity to influence policies and practices related to the systems of care in place for preconceptional, interconceptional, pregnant, and postpartum women. Decreasing the mortality rate is also important because of the potential impact of the death on the physical, emotional, and social development of the surviving children and families.

The continuing disparity in pregnancy-related mortality between Black and White women indicates the need to identify the differences that contribute to the excess mortality among Black women. Specific interventions should be developed, and modifications to the system of care implemented to reduce maternal mortality, especially among Black women.

The DOH has undertaken a comprehensive, statewide campaign to encourage healthier eating and increased activity to help decrease obesity among Floridians. Those healthcare professionals caring for women of childbearing age should be sure to counsel women about the potential risks of entering a pregnancy while overweight or obese, and encourage women to attain their ideal weight status prior to conceiving. Similarly, women with chronic illnesses should be counseled to manage their illness appropriately prior to becoming pregnant, and to discuss the risks of pregnancy with their physician prior to becoming pregnant. It is important for, not only gynecologists/obstetricians and women's health nurse practitioners/nurse midwives, but also for primary care providers and pediatricians to provide anticipatory guidance related to preconceptional and interconceptional health to all women of childbearing age.

Public health measures may be undertaken to educate both healthcare providers and women about the risks that exist during the postpartum period. Healthcare providers need to be especially alert when postpartum women present with signs and symptoms; and, postpartum women need education prior to hospital discharge about signs and symptoms that may indicate a need to seek immediate health care. The team has recommended that discharge planners for labor and delivery floors examine their discharge education curricula, and include education about early warning signs and the importance of seeking care for symptoms such as swelling, redness, warmth, pain in a lower extremity (which could be associated with deep-vein thrombosis), shortness of breath, chest pain, palpitations, syncope (which could be symptoms associated with cardiomyopathy or pulmonary embolism), and education about the importance of seeking care for severe or prolonged headache (symptoms associated with CVA).

Continued study of the factors associated with maternal mortality is an important public health activity. It is hoped that the findings within this report will be helpful to those who are attempting to develop effective strategies to prevent maternal mortality for all women.

The Florida Department of Health plans to undertake an in-depth, qualitative analysis of the recommendations for improvements in systems of care for preconceptional, interconceptional, pregnant, and postpartum women that have been made by the PAMR team members following the review of cases during 1999 through 2002. This analysis will seek to identify and describe the most commonly identified themes, and will be published as a brief, stand-alone report at a future date. Distribution of this report will be aimed toward providers of healthcare services for preconceptional, interconceptional, pregnant, and postpartum women

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