

2008 REPORT

**LOUISIANA
PREGNANCY-ASSOCIATED
MORTALITY REVIEW**



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I. Introduction

Despite the marked decline in maternal mortality in the United States over the past century, reduction in mortality over the past several decades has remained limited.¹ The aggregate rates of pregnancy-associated death remain unacceptably high, and both geographic and racial/ethnic disparities are alarming. Through public health surveillance from 2003-2007 Louisiana has been identified as having one of the highest maternal mortality rates in the United States.²

In 1992, the Louisiana Pregnancy Mortality Surveillance System (LPMSS) was initiated by the Louisiana Department of Health and Hospitals (DHH) Office of Public Health (OPH) State Center for Health Statistics (SCHS) with the purpose of identifying women who died during or within ninety days of pregnancy. Cases were identified by the death certificate check box labeled "If deceased was female 10-49, was she pregnant in the last 90 days?" The Centers for Disease Control and Prevention (CDC) Division of Reproductive Health for pregnancy mortality surveillance was initiated in 1987 and in 2006 teamed with the Louisiana Center for Health Statistics and Vital Records to better identify maternal deaths. Data requested by the CDC included 2004 death certificates for all women who died during pregnancy (ICD-10 chapter O) or within one year of pregnancy, regardless of the cause of death, and the birth or fetal death certificates associated with said women.



In 2000, the Louisiana DHH-OPH Maternal and Child Health (MCH) Program reviewed all pregnancy mortality from 1995 to 1999. After 2000, pregnancy mortality was reviewed annually using only maternal death certificates and associated birth or fetal death certificates provided by the OPH SCHS Records through the LPMSS.

In 2007, the Louisiana MCH Program conducted a 2000-2005 pregnancy mortality evaluation using data provided by the Center for Health Statistics and Vital Records through LPMSS and maternal death and birth or fetal death linked data. The purpose of the study was to determine if the use of enhanced linkage procedures improved data collection of pregnancy deaths and how maternal deaths vary by different definitions. Several recommendations resulted from the study including the need to improve the methodology and procedure of pregnancy mortality review in the state of Louisiana.³

In 2010, the MCH Program initiated the Louisiana Pregnancy Associated Mortality Review (LA-PAMR) under the authorization of the Louisiana Perinatal Commission. PAMR reviewed 2008 pregnancy-associated deaths using data provided through the LPMSS and by linking maternal death certificates and Louisiana Hospital Inpatient Discharge (LAHIDD) records with birth and fetal death certificates. In addition to the aforementioned formal database sources, clinical data were abstracted from hospital records, prenatal care records, and autopsy reports to form a comprehensive review. Consistent with ACOG/CDC definitions, all deaths that occurred during or within one year of pregnancy, regardless of the cause of death, were reviewed.

This comprehensive framework for surveillance and individual case review where all available clinical information for each death is evaluated is based on methodology modeled by the CDC Pregnancy Mortality Surveillance System.⁽⁴⁻⁶⁾ Instead of classifying cause of death solely based on ICD codes, this format of structured review allows for classification based on temporal and causal relationships between clinical factors associated with the pregnancy and death.

This is a report of the 2008 active pregnancy-associated mortality surveillance through the use of an expanded case review model. Future comprehensive reporting will be based on the analysis of aggregate case data over 2-3 years to allow for more adequate number of cases.

II. Methodology for the LA-PAMR

Pregnancy-associated deaths from January 1 through December 31, 2008 were reviewed. Cases were ascertained by the LPMSS, Louisiana Hospital Inpatient Discharge Data (LAHIDD) and linkage of death, birth and fetal death certificate information from vital records.

Data sources used for 2008 LA-PAMR:

LPMSS provided 15 death records. The data included 2008 death records with an ICD-10 chapter O cause of death, or those with the death certificate check box labeled "If deceased was female 10-49, was she pregnant in the last 90 days?" marked as 'yes.'

Linkage of 2008 death with 2007-2008 birth and fetal death certificates identified cases already found by LPMSS as well as additional cases. Matching variables used for the linkages included mother's social security number, date of birth, first and last name, and soundex of first and last name. In addition, child's last name and its soundex in birth or fetal death records were matched with mother's last name and its soundex in the death records. Deaths were defined as pregnancy-associated if they meet any one of the following criteria: (1) time of death was less than 365 days after delivery of a live birth or fetal death, (2) checked box 'yes' indicating recent pregnancy on death certificate, or (3) ICD-10 chapter O cause of death.

Linkage of 2008 Louisiana Hospital Inpatient Discharge Data (LAHIDD) with 2007-2008 birth and fetal death certificates did not identify any additional deaths. LAHIDD records indicating that a patient had expired within 365 days of delivery or ICD-9 codes 630-679 were used for the linkage. Matching variables used for the linkages included mother's social security number, date of birth, first and last name, and soundex of first and last name. In addition, the child's last name and its soundex in birth or fetal death records were matched with the mother's last name and its soundex in the LAHIDD. Linkages were conducted using SAS and LinkPro.

All linked records were manually reviewed by the OPH-SCHS. Hard copies of death, birth, and fetal death certificates were examined to ensure files matched and to verify that each woman was or had been pregnant within one year of her death.

Identified cases were reviewed if they met all of the following inclusion criteria:

1. The death occurred during or within a year of pregnancy.
2. The death occurred in Louisiana.
3. At the time of death, the woman was a Louisiana resident.
4. If the death occurred within one year of delivery, the birth or fetal death occurred in Louisiana

There were 52 death records from 2008 that met all of the inclusion criteria for review. After being verified by an MCH epidemiologist and a preventive medicine resident, 50 death records were confirmed as pregnancy-associated.

Clinical Data Abstraction Procedures:

Data abstraction forms were developed by an MCH epidemiologist, reviewed by the MCH Director of Perinatal Services, a preventive medicine resident, and a FIMR data abstractor, and approved by the MCH Maternity Medical Director. Abstraction tools were created based on existing templates in use for pregnancy mortality data abstraction by the CDC, Florida PAMR, New York State Safe Motherhood Initiative, and the Louisiana Fetal and Infant Mortality Review (FIMR) BASINET offline case abstraction form.⁷

Four abstraction forms based on availability of records were authorized for data collection, including (1) Medical History and Prenatal Care Records, (2) Non-Delivery Hospital Records, (3) Delivery Hospital Records, and (4) Autopsy/Coroner Reports. Additional data were supplemented by vital records including death, birth, and fetal death records. This data was available electronically and was managed by an MCH epidemiologist who participated in the review process.

Active clinical abstraction was conducted under the authorization of the Louisiana Perinatal Commission. Prior to abstraction, a letter signed by the Chairman of the Louisiana Commission on Perinatal Care and Prevention of Infant Mortality was sent to hospital administrators and coroner's office directors. Before abstraction began, Regional MCH clinical abstractors were provided with each woman's name and date of birth, the name of her hospital at birth and death, and the name of coroner's office. A linked master surveillance identification number was created for each death record and sent to clinical abstractors by email. No identifying information was sent electronically. Clinical abstractors and preventive medicine residents completed clinical record reviews of institutional records at hospitals and coroner's offices. The clinical abstractors maintained clinical data files in a secure location (locked file cabinet) in hardcopy only. Abstracted data were entered in a Microsoft Access database system, for review and subsequent data analysis.

Review Procedures:

An MCH epidemiologist and preventive medicine resident reviewed completed files and prepared detailed de-identified case summary worksheets for each case. Completed case sets were then presented to the Maternal Mortality Review Committee (MMRC) for case evaluation, classification and recommendations. The MMRC was composed of key clinical experts and stakeholders representing mental health, the office of public health, vital records, the perinatal commission, physicians, nursing and social services.

Final case classification based on the CDC/ACOG definition:

Pregnancy-Associated Death – the death of a woman while pregnant or within one year of pregnancy termination, regardless of cause of death or outcome of pregnancy.

Pregnancy-Related Death – the death of a woman while pregnant or within one year of pregnancy termination, irrespective of the duration and site of the pregnancy from:

1. Complications of the pregnancy itself;
2. A chain of events initiated by pregnancy that led to death; or
3. The effects of pregnancy caused the aggravation of an unrelated condition that subsequently caused death.

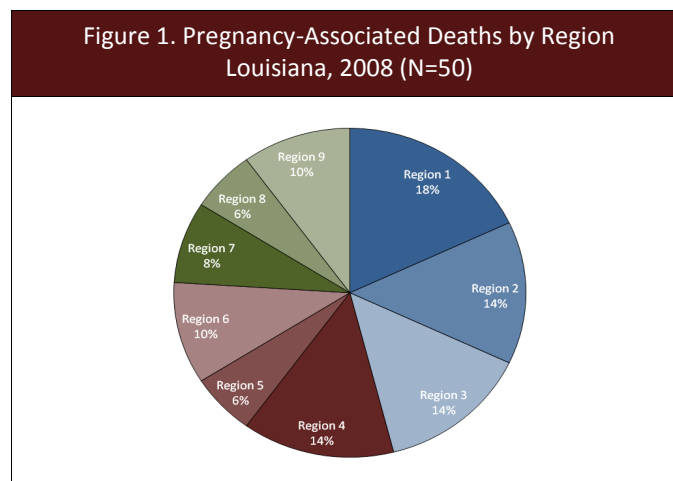
2008 LA-PAMR Review Findings:

III. Demographic Characteristics of Pregnancy-Associated Deaths

Age at death ranged from 13 to 43 years. The majority (78%) of deaths were among women between 20 and 34 years of age. Of the deaths reviewed, more than half (58%) of the women were white. Education level was almost evenly distributed between women who were high school graduates (40%) and women with less than a high school education (36%). The majority of women (62%) were not married. At the time of death, 70% of women lived in an urban area versus 30% in a rural area. Among women who died after completion of pregnancy, 80% of deliveries were paid for by Medicaid. Region 1 accounted for the most deaths at 18% (n=9), followed by regions 2, 3, and 4 with 14% each.

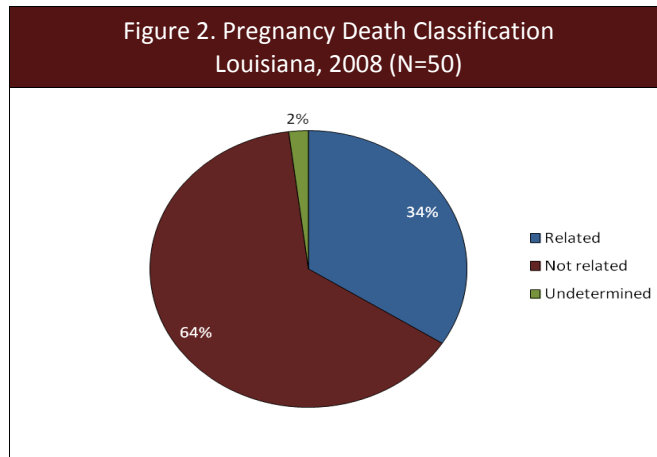
| Characteristics | | Number (n) | Percent (%) |
|-----------------------------|--------------------------|------------|-------------|
| Age (Years) | Less than 20 | 5 | 10.0 |
| | 20-30 | 39 | 78.0 |
| | 35+ | 6 | 12.0 |
| Race | White | 29 | 58.0 |
| | Non-White | 21 | 42.0 |
| Education | Less than High School | 18 | 36.0 |
| | High School | 20 | 40.0 |
| | Greater than High School | 12 | 24.0 |
| Marital Status | Unmarried | 31 | 62.0 |
| | Married | 19 | 38.0 |
| Residence Geographical Area | Rural | 15 | 30.0 |
| | Urban | 35 | 70.0 |
| *Payment Method at Delivery | Medicaid | 35 | 80.0 |
| | Non-Medicaid | 9 | 20.0 |

*Only applicable for women who died after delivery (inclusive of live births and fetal deaths).



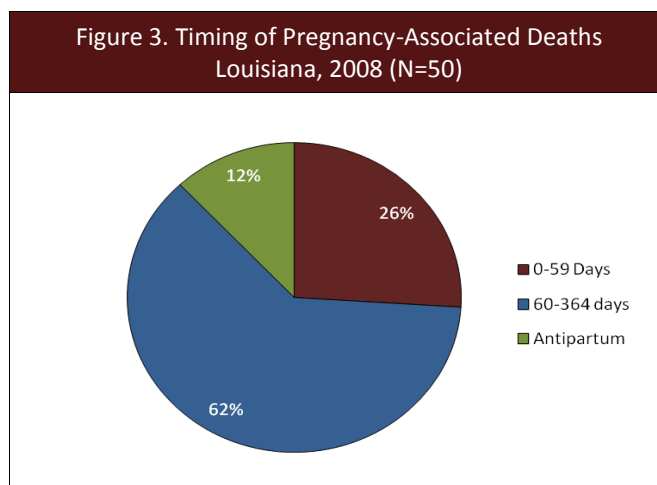
IV. Pregnancy Death Classification

The Louisiana Maternal Mortality Case Review Committee (MMRC) identified 50 pregnancy-associated deaths among the 52 cases selected for review in 2008. Of the total 50 pregnancy-associated deaths, the Review Team determined that 17 (34%) deaths were pregnancy-related and 32 (64%) deaths were not related to pregnancy. In 2% of the cases the Review Team was unable to determine whether or not the death was related to pregnancy.



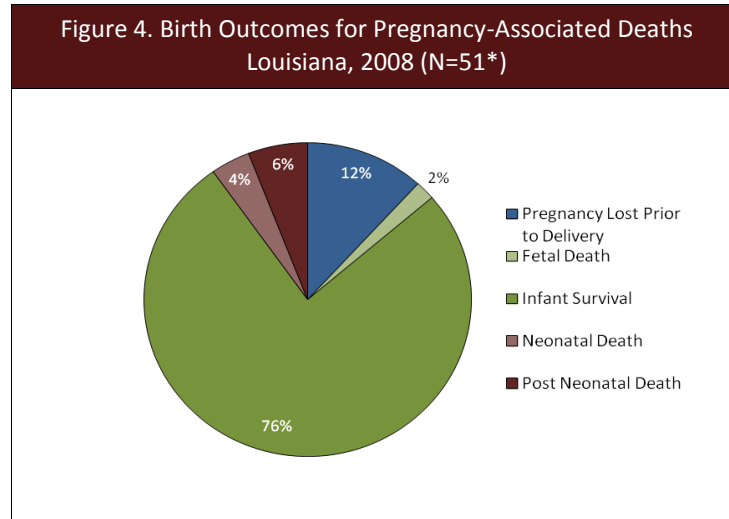
V. Timing of Pregnancy-Associated Deaths

The majority of pregnancy-associated deaths occurred during or beyond the post-partum period. Among the 50 pregnancy-associated deaths 62% (n=31) occurred between 60 and 364 days post delivery, and 26% (n=13) occurred within 60 days of pregnancy completion. Twelve percent (n=6) of the deaths occurred during the antepartum period.



VI. Birth Outcomes for Pregnancy-Associated Deaths

In all 12% of cases in which maternal death occurred during pregnancy, the pregnancy was lost. See Figure 3. The remaining 88% of maternal deaths occurred after delivery and had varying birth outcomes including 2% fetal death, 4% neonatal death, 6% post neonatal death and 76% infant survival.

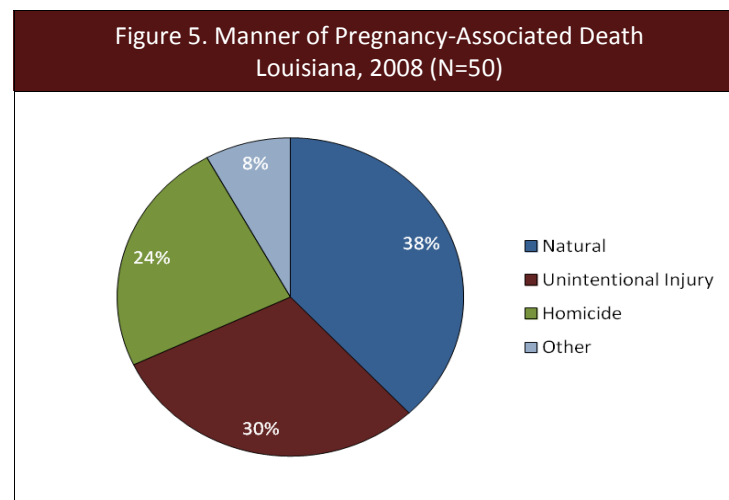


*In 2008 there were 50 pregnancy-associated deaths and 51 effected babies due to multiple gestation.

VII. Manner and Causes of Pregnancy-Associated Death

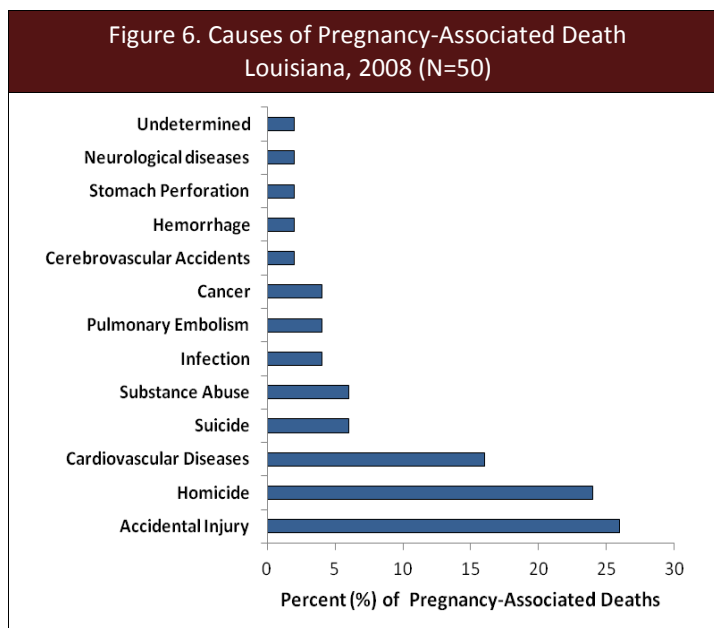
1. Manner of Pregnancy-Associated Death

Of the pregnancy-associated deaths reviewed by PAMR, 38% (n=19) were due to natural or medical causes, 30% (n=15) to unintentional injury (including accident and substance abuse), 24% (n=12) to homicide, and 8% to other manners of death.



2. Causes of Pregnancy-Associated Death

Figure 6 displays the distribution of both medical (natural) and non-medical (injury) causes of pregnancy-associated death. The leading medical cause of death was cardiovascular disease (including 2 cases associated with aortic aneurism), which accounted for 16% (n=8) of deaths. Accidental injury and homicide were the leading causes of pregnancy-associated death at 24% and 26% respectively. Other medical and non-medical causes of death individually accounted for 6% or less each. Note that the MMRC reclassified three causes of death in contrast to the recorded death certificate. An undetermined death was reclassified as death due to infection; a cardiac disease death was reclassified to substance abuse; and an injury death was reclassified to a suicide.



3. Medical Causes of Pregnancy-Related Death

Cardiovascular disease accounted for 47.1% of pregnancy-related deaths. Infection, pulmonary embolism and cancer accounted for approximately 11.8% each. Stomach perforation, hemorrhage and cerebrovascular causes each accounted for 5.9% of pregnancy-related death cases.

**Table 2. Medical Causes of Pregnancy-Related Death
Louisiana, 2008 (N=17)**

| Causes of Death | Percent (%) |
|---------------------------|--------------------|
| Cardiovascular Diseases | 47.1 |
| Infection | 11.8 |
| Pulmonary Embolism | 11.8 |
| Cancer | 11.8 |
| Stomach Perforation | 5.9 |
| Hemorrhage | 5.9 |
| Cerebrovascular Accidents | 5.9 |

4. Injury Causes of Pregnancy-Associated Death

Non-medical or injury causes accounted for 56% (n=28) of all pregnancy-associated deaths. The leading causes of injury associated death include homicide (n=12) and accidental injuries (n=13). Among accidental deaths, the majority were associated with motor vehicle accidents (n=10). Eleven percent (11%) of injury associated deaths were classified as associated with suicide.

| Table 3. Injury Causes of Pregnancy-Associated Death Louisiana, 2008 (N=50) | |
|--|-------------|
| Causes of Death | Percent (%) |
| Homicide | 42.9 |
| Discharge of Firearm | 32.1 |
| Sharp Object | 10.7 |
| Suicide | 11.0 |
| Drug Overdose | 7.1 |
| Discharge of Firearm | 3.6 |
| Accidental Injury | 46.0 |
| MVA Occupant | 28.6 |
| MVA Pedestrian | 7.1 |
| Exposure to Smoke/Inhalation | 3.6 |
| Accidental Poisoning | 7.1 |

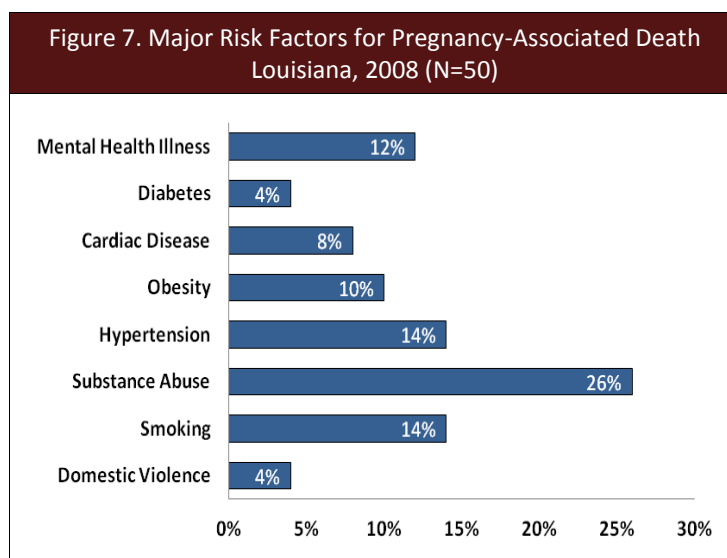
VIII. Pregnancy Death Classification Comparison

A pregnancy-related death was defined as a death while pregnant or within one year of the pregnancy termination, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management. The LA-PAMR review process found seventeen (34%) of the 50 pregnancy-associated deaths to be pregnancy-related, while the classification by ICD-10 codes found only 2 deaths as pregnancy-related. Of the 47 deaths classified as pregnancy-associated by ICD-10 Codes, 14 were reclassified as pregnancy-related by the review.

| Table 4. Pregnancy Death Classification Comparison Between Case Review and ICD-10 Codes Louisiana, 2008 (N=50) | | | | |
|---|---|-------------|--------------|-------|
| Pregnancy Death Classification Based on Review | Pregnancy Death Classification Based on ICD-10 Codes | | | Total |
| | Related | Not-Related | Undetermined | |
| Related | 2 | 14 | 1 | 17 |
| Not-Related | 0 | 32 | 0 | 32 |
| Undetermined | 0 | 1 | 0 | 1 |
| Total | 2 | 47 | 1 | 50 |

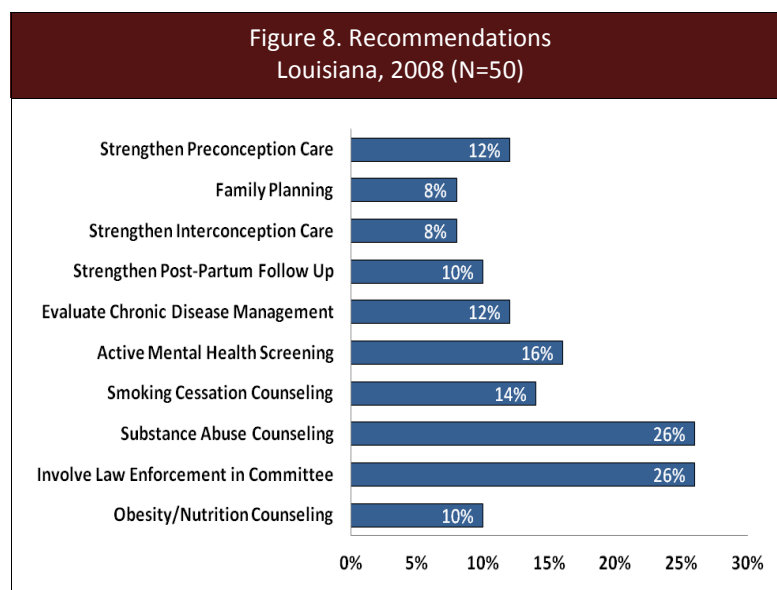
IX. Major Risk Factors for Pregnancy-Associated Death

History /current substance abuse (26%) and mental health illness (12%) were the most recognized major clinical risk indicators identified among pregnancy-associated deaths. Among chronic medical co-morbid conditions, hypertension (14%), cardiac disease (8%), and diabetes (4%) also were identified as significant risk factors. Smoking (14%) and obesity (10%) were the principle modifiable clinical risk indicators.



X. Recommendations through Review of Pregnancy-Associated Deaths

As is evident in this analysis, pregnancy-associated mortality is a highly relevant public health concern which impacts maternal health outcomes across diverse ages, races, education levels and geographic areas in Louisiana.



Prevention of violent deaths:

Due to the large number of pregnancy-associated homicide deaths (24% of all 50 pregnancy-associated deaths and 43% of the 33 deaths that are pregnancy-associated but not pregnancy-related), the committee recommended the incorporation of law enforcement/criminal justice system representatives as key stakeholders and participants in the PAMR review process. The possibility of increased access to police reports and criminal justice system reviews of pregnancy-associated deaths is an anticipated benefit.

Additionally, the committee recommended that significant consideration be given to formal state participation in the CDC sponsored National Violent Death Reporting System (NVDRS) surveillance project. The NVDRS surveillance initiative would facilitate the development of a more comprehensive and detailed surveillance framework. Once established, this framework would be essential to crafting informed public health responses to violence associated maternal deaths such as those related to intimate partner violence. In concert with this, an active, systematic mental health and violence risk screening, during both antepartum and postpartum periods, should be prioritized for at-risk pregnancies. Expanded access to effective mental health services for maternal-child populations remains a critical challenge and priority.


Obesity and smoking cessation intervention:

Interventions targeting smoking cessation and obesity during pre and interconception care also ranked high among priority recommendations and represent important priorities in achieving risk reduction during pregnancy. Expansion of intervention resources which target tobacco cessation for pregnant populations is now a priority and federal requirement for states under the adopted Affordable Care Act legislation. Recently enacted Louisiana Medicaid payment reforms/advances related to provider reimbursement are also an important initial step.

**Co-morbidity management:**

Given the strong association of co-morbid conditions and pregnancy related deaths, the quality/control evaluation of chronic disease management should also be prioritized. Historically, hypertension and hemorrhage have been the most prevalent clinical correlates associated with pregnancy-related deaths. However, the 2008 review of Louisiana pregnancy-associated deaths, consistent with recent national maternal mortality death reviews, showed that there has been a shift toward maternal cardiovascular events which are now the predominant clinical risk correlate. Enhanced clinical assessment and monitoring of pregnant women with underlying cardiovascular risk profiles should be prioritized by health providers.

Additional considerations impacting pregnancy-related deaths include enhancement of screening and prevention protocols and clinical intervention measures which prevent morbidity and mortality associated with venous thromboembolism (VTE) and obstetric hemorrhage. Emphasizing this type of prevention is consistent with current ACOG initiatives to promote enhanced maternal clinical safety. Strengthening the



quality and implementation of effective family planning, preconception/interconception care and postpartum follow up in specific women with underlying medical co-morbidities should remain a priority strategic focus.

Given the prevalence of substance abuse (26%) as a clinical risk indicator, the development of enhanced resources for behavioral health/substance abuse screening during preconception, antenatal and birth/postpartum time periods needs to be emphasized. Regional service capacity and fiscal limitations are recognized as substantial systemic and structural challenges which must be overcome. However, the implementation of effective, systems based substance-use interventions that are accessible to pregnant populations remain a critical priority.

Mental health and chronic pain screening:

A number of cases in which the manner of death was associated with accidental overdose (poisoning), a co-diagnoses of mental illness and/or chronic pain conditions was documented. This highlights a need for enhanced healthcare provider education and appropriate surveillance of pain management in perinatal settings. The review team supports the efforts of the Louisiana Prescription Monitoring Program (PMP) and recommends they include a section for pregnant women and pain management surveillance.

This is a report of the 2008 active pregnancy-associated mortality surveillance through the use of an expanded case review model. Future comprehensive reporting will be based on analysis of aggregate case data over 2-3 years to allow for more adequate number of cases. Additionally, during the subsequent review of 2009 and 2010 cases the composition of the Mortality Review Committee will be expanded to incorporate expertise of stakeholders in law enforcement, mental health, nursing, social services and emergency medicine.

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XI. Glossery

CDC: Centers for Disease Control and Prevention

DHH: Department of Health and Hospitals

FACOG: Fellow of The American Congress of Obstetricians and Gynecologists

FIMR: Fetal and Infant Mortality Review

LAHIDD: Louisiana Hospital Inpatient Discharge Data

LA-PAMR: Louisiana Pregnancy-Associated Mortality Review

LPMSS: Louisiana Pregnancy Mortality Surveillance System

MCH: Maternal and Child Health

MD: Medical Doctor

MMRC: Maternal Mortality Review Committee

MPH: Master of Public Health

MSN: Master of Science in Nursing

NVDRS: National Violent Death Reporting System

OPH: Office of Public Health

PHD: Doctor of Philosophy

PMP: Prescription Monitoring Program

SCHS: State Center for Health Statistics