Special Topics Report on Pregnancy-Related Deaths Due to Hemorrhage in Ohio, 2008-2016

The Ohio Department of Health 2020

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Table of Contents

Overview

The Ohio Department of Health (ODH) established the Ohio Pregnancy-Associated Mortality Review (PAMR) to identify and review pregnancy-associated deaths with the goal of developing interventions to reduce maternal mortality, particularly for pregnancy-related deaths.

A pregnancy-related death is the death of a woman while pregnant or within one year of pregnancy from any cause related to or aggravated by the pregnancy or management, excluding accidental or incidental causes. A pregnancy-associated death is the broader category and includes the death of a woman while pregnant or anytime within one year of pregnancy regardless of cause.

The purpose of this PAMR special topics data brief is to supplement the comprehensive report, A Report on Pregnancy-Associated Deaths in Ohio 2008-2016, with additional information on leading causes of pregnancy-related deaths.

Background on Hemorrhage in Pregnancy

Recently, a report with data from nine state maternal mortality review committees in nine states, including Ohio, found that hemorrhage and cardiovascular and coronary conditions were tied for the leading cause of pregnancy-related deaths (Building U.S. Capacity to Review and Prevent Maternal Deaths, 2018). In Ohio, hemorrhage was the third leading cause.
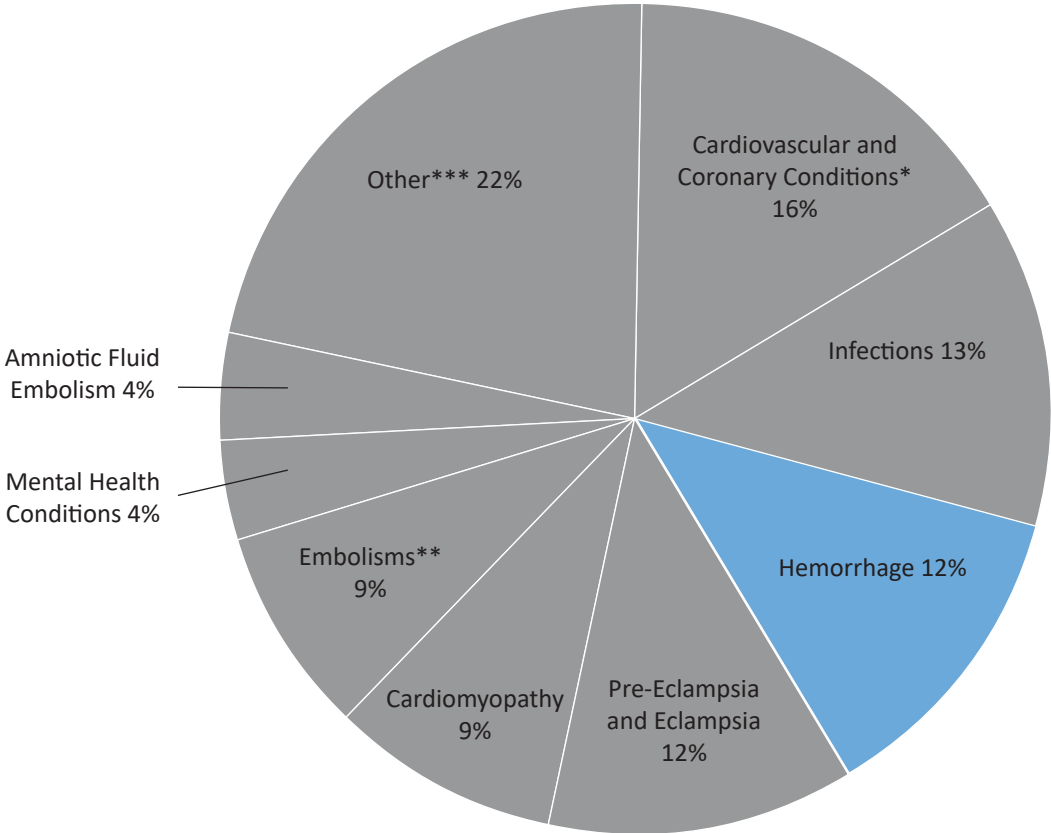
An obstetrical emergency is diagnosed when there is excessive blood loss after the delivery of the placenta. Postpartum hemorrhage (PPH) complicates approximately 4% of vaginal deliveries and has been traditionally defined as loss of more than 500 ml of blood. PPH complicates approximately 6 to 7% of cesarean deliveries and has been traditionally defined as loss of more than 1,000 ml of blood. Clinical estimates of the blood loss are often inaccurate and underappreciated. An excessive amount of blood loss visually identified may or may not come before a worsening of the maternal clinical condition. Sometimes the blood loss is internal. Uterine atony is responsible for about 90% of PPH cases. The uterus is a muscle that has been stretched by the pregnancy. After delivery the muscles should contract to prevent bleeding but sometimes that does not happen at all or inefficiently. Other causes are an abnormally adherent placenta (placenta accrete), lacerations, or maternal bleeding disorders.

PAMR Findings

Cause of Death

Figure 1 displays the underlying causes of 2008-2016 pregnancy-related deaths. Hemorrhage was the third leading cause of death (n=22).

Figure 1: Underlying Causes of Pregnancy-Related Deaths by Leading Causes, Ohio 2008-2016

*Not including cardiomyopathy.

**Not including amniotic fluid embolism.

***Includes cerebrovascular accident, homicide, and others.

From 2008 to 2016 there were 23 pregnancy-associated deaths with hemorrhage as the underlying cause of death, twenty-two (96 %) were pregnancy-related. The single pregnancy-associated, but not related, hemorrhage death was due to an intracranial bleed.

The data presented throughout the remainder of the report are restricted to the 22 of 23 deaths due to hemorrhage determined to be related to pregnancy.

The pregnancy-related mortality ratio (PRMR) is defined as the number of pregnancy-related deaths per 100,000 live births. Given the 22 pregnancy-related deaths due to hemorrhage from 2008 to 2016, the PRMR is 1.7, meaning Ohio women experienced pregnancy-related deaths due to hemorrhage at a rate of 1.7 deaths per 100,000 live births.

Among pregnancy-related hemorrhage deaths, broken down by specific Pregnancy Mortality Surveillance System (PMSS)[1] cause of death, uterine atony/postpartum hemorrhage was the most common (n=7), followed by ruptured ectopic pregnancy (n=4), and hemorrhage-rupture/laceration/intra-abdominal bleeding (n=3).

Table 1: Pregnancy-Related Deaths Due to Hemorrhage by Specific Pregnancy Mortality Surveillance System (PMSS) Cause of Death, Ohio 2008-2016
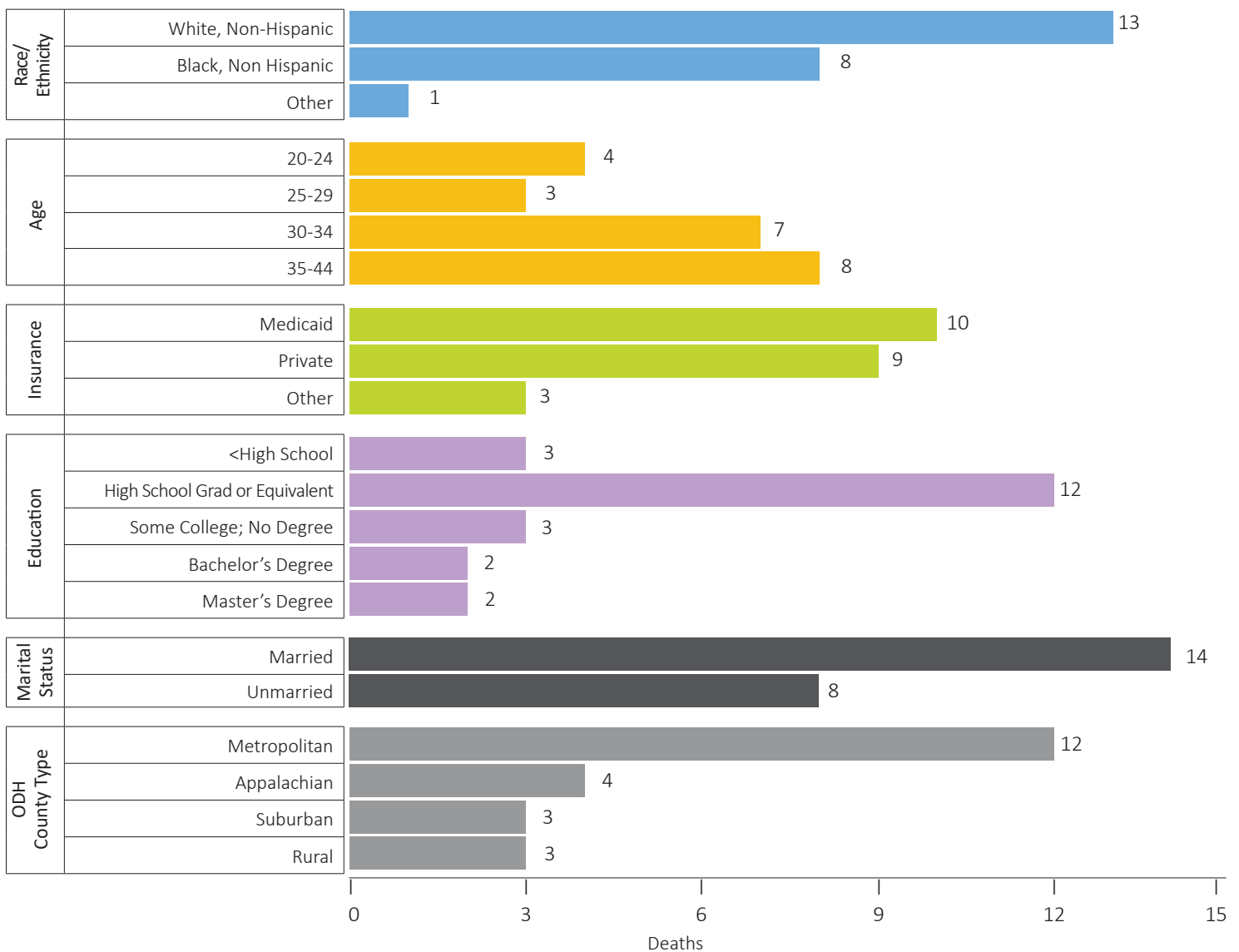
PMSS Cause of Death	Number of Deaths
10.1 Hemorrhage-Rupture/Laceration/Intra-abdominal Bleeding	3
10.2 Placental Abruption	2
10.3 Placenta Previa	1
10.4 Ruptured Ectopic Pregnancy	4
10.5 Hemorrhage-Uterine Atony/Postpartum Hemorrhage	7
10.6 Placenta Accreta/Increta/Percreta	1
10.8 Hemorrhage due to Primary DIC	2
10.9 Other Hemorrhage/NOS	2
Total	22

[1] *The Centers for Disease Control and Prevention (CDC) Pregnancy Mortality Surveillance System (PMSS) established underlying cause of death codes, which are a standard approach for classifying pregnancy-related deaths in a clinically meaningful way. The PAMR committee assigns a PMSS cause of death as part of the review. CDC PMSS:* https://www.cdc.gov/reproductivehealth/maternalinfanthealth/pregnancy-mortality-surveillance-system.htm.

Demographics

Figure 2 describes the demographic characteristics of 22 women who died of pregnancy-related hemorrhage. Most deaths occurred among women aged 35 to 44, with a high school diploma (or equivalent), who were non-Hispanic white, were married, and lived in metropolitan counties. While most deaths were among non-Hispanic white women, there was a disproportionate number of deaths among non-Hispanic black women, compared with the overall population.
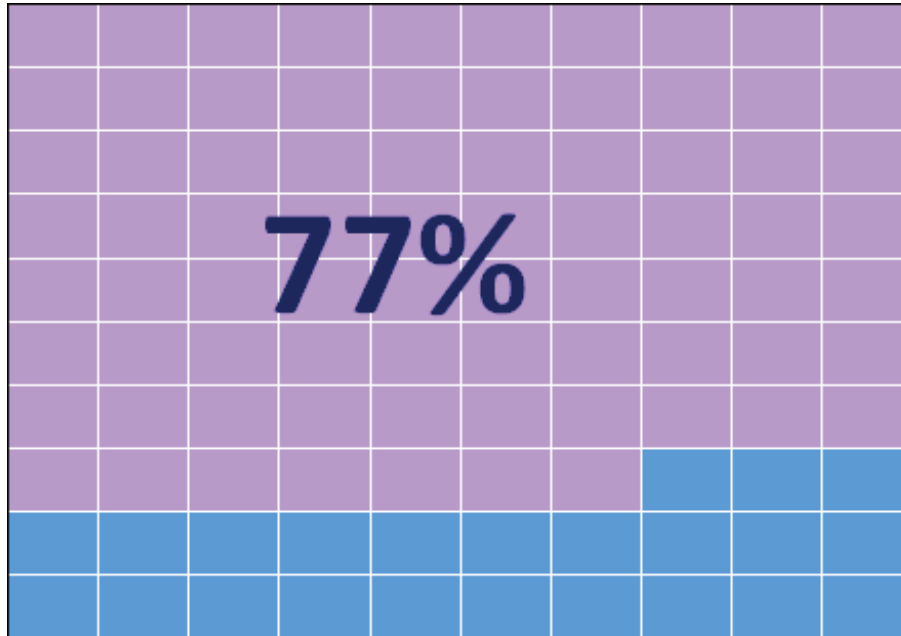
Figure 2: Number of Pregnancy-Related Deaths Due to Hemorrhage by Maternal Demographics, Ohio 2008-2016

Data interpretation example: The row for married means that 14 of the 22 women who died of pregnancy-related hemorrhage from 2008 to 2016 occurred among women who were married.

The majority of the 22 pregnancy-related deaths due to hemorrhage, 77%, occurred within 24 hours of delivery. The others all occurred within the next two weeks: two the day after delivery, one within a week, and two within two weeks.
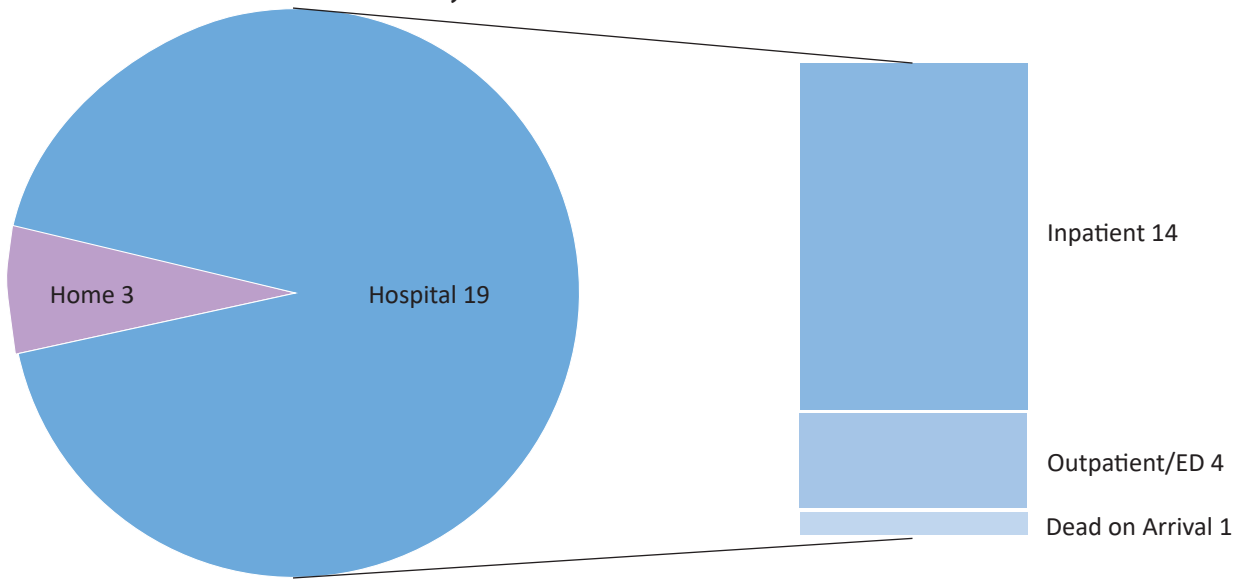
Figure 3: Pregnancy-Related Deaths due to Hemorrhage by Timing of Death in Relation to Pregnancy, Ohio 2008-2016

Note: the pregnant at time of death classification includes deaths that occurred the day of delivery.
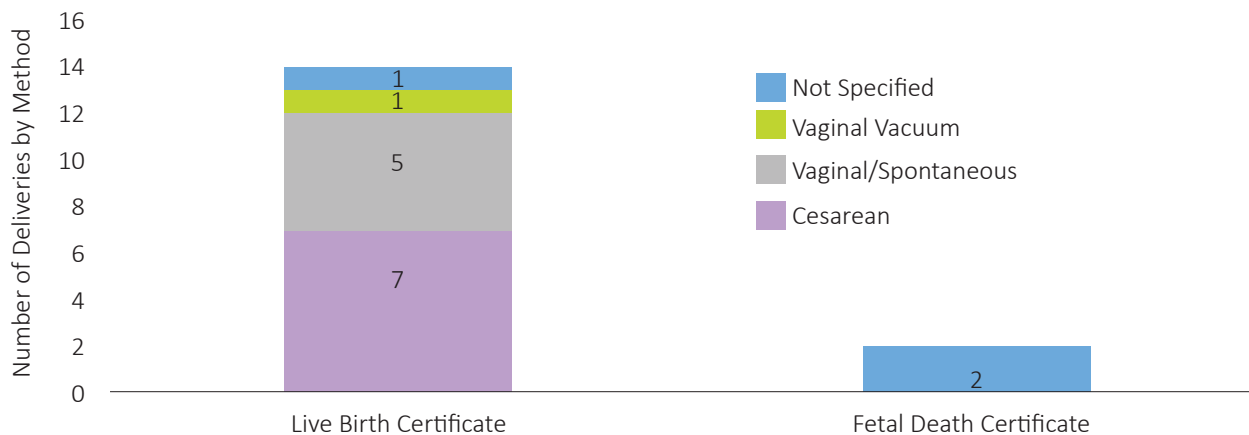
The majority of pregnancy-related deaths due to hemorrhage occurred in the hospital (86%). Figure 4 describes the place of death and specifies hospital location.

Figure 4: Pregnancy-Related Deaths Due to Hemorrhage by Place of Death, Ohio 2008-2016

Home 3 — Hospital 19 — Inpatient 14 — Outpatient/ED 4 — Dead on Arrival 1

Among the 22 pregnancy-related deaths due to hemorrhage, 14 linked live birth certificates and two linked fetal death certificates which document method of delivery, were obtained. In cases in which the fetus is less than 20 weeks gestation or not extracted, the completion of a fetal death certificate is not required. Figure 5 describes the delivery methods by certificate type.

Figure 5: Pregnancy-Related Deaths Due to Hemorrhage with Linked Birth or Fetal Death Certificates by Certificate Type and Method of Delivery, Ohio 2008-2016

Contributing Factors and Preventability

For each case, the review committee identifies factors that contributed to the death. These factors include steps along the way that, if altered, may have prevented the woman's death. The committee considers factors that operate at the following levels: *patient/family, health care provider, facilities* where the woman sought care, and *systems* that influence the lifestyle, care, and health services for the woman. Contributing factors are further broken down into classes, and dominant, representative themes for each class are listed in Table 2. All 22 pregnancy-related deaths due to hemorrahge are represented in Table 2.

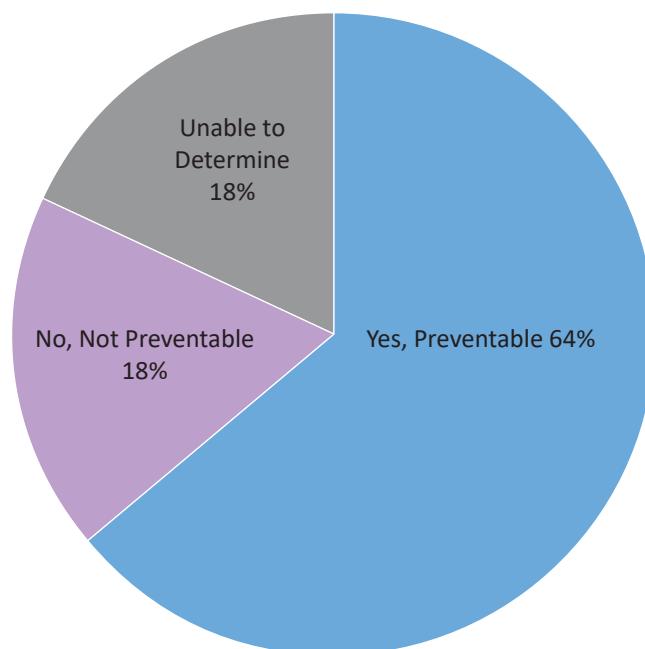Table 2: Contributing Factors of Pregnancy-Related Deaths Due to Hemorrhage, Ohio 2008-2016

Patient/Family		
Factor Class	Count	Representative Themes
Knowledge	6	Lack of knowledge regarding importance of event, treatment, or follow-up
Chronic Disease	4	Obesity
Cultural/Religious	4	Religious objections to medical care
Delay	3	Delay or failure to seek care
Adherence	2	Non-adherence to medical recommendations
Mental Health Conditions	2	Inadequate mental health condition treatment
Substance Use Disorder-Alcohol, Illicit/Prescription Drugs	2	Illicit drug use
Tobacco Use	2	
Access/Financial	1	Lack of insurance and financial resources
Social Support/Isolation	1	Isolation
Unstable Housing	1	Inadequate access to housing
Provider		
Factor Class	Count	Representative Themes
Clinical Skill/Quality of Care	12	Use of ineffective treatment, misdiagnosis
Delay	12	Delay in or lack of diagnosis, treatment, or follow-up (e.g. delay in surgery, securing airway, and managing hemorrhage)
Referral	5	Failure to refer or seek consultation
Knowledge	4	Use of ineffective treatment
Assessment	4	Misdiagnosis, failure to screen, inadequate assessment of risk
Communication	3	Lack of communication between providers
Continuity of Care/Care Coordination	1	Lack of continuity of care
Facility		
Factor Class	Count	Representative Themes
Assessment	1	Failure to screen/inadequate assessment for risk
Clinical Skill/Quality of Care	1	Use of ineffective treatment
Delay	1	Delay in or lack of diagnosis, treatment, or follow-up
Referral	1	Failure to refer or seek consultation

Table 2: Contributing Factors of Pregnancy-Related Deaths Due to Hemorrhage, Ohio 2008-2016 (continued)

System		
Factor Class	Count	Representative Themes
Personnel	11	Inadequate training, unavailable personnel
Continuity of Care/Care Coordination	8	Lack of case coordination
Policies/Procedures	7	Lack of standardized policies/procedures (e.g. hemorrhage checklist, massive transfusion protocol)
Access/Financial	6	Barriers to access: insurance, provider shortage, transportation, prenatal care
Communication	5	Lack of communication between providers
Clinical Skill/Quality of Care	4	Inadequate training, unavailable personnel, inadequate Emergency Medical Services response
Equipment/Technology	3	Inadequate or unavailable equipment/technology
Outreach	1	Inadequate community outreach

Prior to 2012, the committee did not consistently determine preventability, therefore Figure 6 displays preventability determination of 2012 through 2016 deaths. A death was considered preventable if the committee determined that there was at least some chance of the death being averted. Recently, a report from state maternal mortality review committees, from nine states, including Ohio, found that 70% of deaths due to hemorrhage were thought to be preventable (Building U.S. Capacity to Review and Prevent Maternal Deaths, 2018). PAMR determined that 64% of Ohio's pregnancy-related deaths due to hemorrhage were preventable.

Figure 6: Preventability of Pregnancy-Related Deaths
Due to Hemorrhage, Ohio 2012-2016

Unable to Determine 18%

No, Not Preventable 18%

Yes, Preventable 64%

Postpartum Hemorrhage (PPH) Vignette

Lorenda's Story — Postpartum Hemorrhage

Lorenda was a 37-year-old black woman who had three pregnancies leading to three children. She delivered each by cesarean section. She died 14 days after her third baby was born.

Prenatal Period:

She began prenatal care early in pregnancy at eight weeks gestation and had 12 visits with her OB/GYN. Her medical history was significant for a large (4.5 inches in diameter) fibroid found on the lower front part of her uterus blocking the birth canal. A cesarean delivery was recommended because of the size and location of the fibroid.

Delivery Hospitalization:

In the operating room

At term, she was scheduled for a cesarean section, which was performed by her doctor under spinal anesthesia. The incision on the uterus was larger than usual because of the fibroid. The surgery was complicated by hemorrhage (excessive blood loss). Her estimated blood loss was 2 liters. The average circulation for an adult human is between 4.5 and 5.5 liters. At 1 p.m. she delivered a baby boy who weighed 7 pounds, 8 ounces and did well.

In the recovery room

The surgery was complete one hour after delivery. The only problem noted was that the patient had a large blood loss. She was transferred to the recovery room, where attempts to start a second IV were difficult. In the recovery room she had increased vaginal bleeding. Medications to make the uterus firm were given and bleeding slowed. Labs at that time showed evidence of anemia with a low hemoglobin (protein responsible for transporting oxygen in the blood) of 7.9 and hematocrit (proportion of blood volume that consists of red blood cells) of 23.2%. Three and half hours after her surgery ended, the patient was found unresponsive with a blood pressure that was low at 53/28 and a high heart rate of 196 beats per minute. She was given Narcan as her anesthesiologist thought she could not be roused because she had too much pain medication. A breathing tube was placed 10 minutes later. Soon after that, the patient was found without pulse or blood pressure and a Code Blue (an emergency situation announced when a patient is in cardiopulmonary arrest and requires a team of providers to rush to the location and begin immediate resuscitative efforts) was called. A blood transfusion was started as part of that response. Her heart rate was restored and she was taken to the intensive care unit (ICU).

In the ICU

Once in the ICU, a massive transfusion protocol was started. Over the next three hours, oozing from her incision and puncture sites was noted. Follow-up labs noted continued anemia and a very low fibrinogen (a blood plasma protein that is a coagulation factor responsible for normal blood clotting) level of 53. She was diagnosed with disseminated intravascular coagulation (loss of clotting factors) with intra-abdominal bleeding. The patient was taken to the operating room and underwent a hysterectomy. About 2 liters of blood were noted in the abdomen before the surgery. After surgery, possible seizure activity was noted. A neurologist saw the patient at 7 a.m. the next morning and made the diagnosis of encephalopathy (brain damage).

Postpartum Period:

Later in the afternoon of post-operative day one, she was transferred to a hospital with a higher level of care where she died 14 days later with cause of death encephalopathy due to oxygen deprivation due to cardiopulmonary arrest due to acute blood loss. An autopsy was done by the hospital pathologist. Findings were consistent with the cause of death.

Key Questions

Was the death pregnancy-related?
Yes, her blood loss was directly related to her cesarean section.

What was the cause of death?
Hemorrhage. She died from excessive blood loss with associated disseminated intravascular coagulation (loss of clotting factors) leading to cardiac arrest with brain damage. The patient bled so much that her body could not make enough clotting factors to keep up. Her blood thinned out, making her bleed more until her heart stopped.

Was there some opportunity to alter the outcome?
Yes. The patient was not monitored closely in the recovery room, so early changes in her vital signs such as blood pressure and heart rate were not identified. Additionally, she lost consciousness due to low blood pressure due to blood loss and it was misdiagnosed as drowsiness from too much pain medication. She should have been given a blood transfusion much sooner. She should have had a single nurse evaluating her vital signs every 15 minutes for the first two hours after her surgery. The diagnosis of intra-abdominal bleeding was not made in a timely manner; she should have gone back to the operating room much sooner.

What were the factors that contributed to this death?	What are the recommendations and actions that address those contributing factors?
Delay or lack of diagnosis, treatment, or follow up	Develop and adhere to standardized policies regarding post-cesarean (operative) care of women There should be 1:1 nursing care in the recovery room
Failure to refer or seek consultation	Obstetric providers and staff should be trained in the assessment and management of postpartum hemorrhage
Miscommunication between providers	There should be clear communication between different specialists caring for patients

Committee Recommendations

As part of the review of each death, the committee identifies recommendations (including strategies and action steps) that may address factors that contributed to the death. Those recommendations were grouped into categories and themes.

Table 3: Committee Recommendations of Reviewed Pregnancy-Related Deaths Due to Hemorrhage, Ohio 2008-2016

Category	Themes
Care Coordination	Earlier access to care at time of death (e.g. delays in surgical evaluation)
	Hospital delivery education
	Manage medical conditions (e.g. pre-eclampsia)
	Intubation management
Protocols and Procedures	Massive transfusions: create and follow protocols for preparation, administration, and management
	Hemorrhage management protocols: standardize and follow procedures (e.g. checklists for management of hemorrhage and equipment)
Provider Training	Treatment and prevention education (e.g. safety bundles)
	Postpartum hemorrhage: protocol for education and training regarding recognition and treatment
	Simulation trainings for hemorrhage
Patient Education	Educate patients regarding when to seek care

PAMR Initiatives

To prevent maternal deaths, PAMR's first major activity was providing simulation training to low resource hospitals to prepare for obstetric emergencies. The emergency scenarios included hemorrhage. Trainings occurred in three parts from 2014 through 2017 through both 1) direct trainings at local host facilities; and 2) train-the-trainer courses for nurse educators and managers to provide them with the tools to independently and effectively train local staff via simulation. After these trainings, participants demonstrated increased knowledge about obstetric emergencies and increased self-efficacy in their ability to respond. Train-the-trainer participants were found to have shared information from the trainings and conducted additional simulation exercises in their facilities.

Ohio PAMR conducted five patient safety webinars in 2017, one of which was "Understanding and Treating the Bleeding Patient: Strategies for Success" and is currently archived on the ODH PAMR Web site.

Summary

Initiating and sustaining a robust maternal mortality review committee is the key to improving surveillance of maternal deaths by understanding trends, causes, contributing factors, and preventive steps for maternal mortality. PAMR continues to comprehensively review deaths with the goal of developing recommendations and strategies to prevent these tragic events moving forward.

References

Building U.S. Capacity to Review and Prevent Maternal Deaths, 2018. Report from maternal mortality review committees, 2018. Retrieved from: http://reviewtoaction.org/Report_from_Nine_MMRCs. Accessed March 12, 2019.

Gabbe et al (eds). Obstetrics: Normal and Problem Pregnancies, 7th edition, 2016. Elsevier Publishing Company, Philadelphia, PA.