

New York State
Maternal Mortality Review
Report
2006-2008



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Executive Summary

Maternal and infant mortality and morbidity are key indicators of the health of a society. Maternal deaths are devastating events with prolonged effects on partners, children, families, and obstetric health care teams. The United States is one of only eight¹ countries worldwide with a rise in maternal mortality from 2003 to 2013 and ranks 60th in the world² behind all other developed nations in maternal mortality. New York State (NYS) ranks 46th among 50 states³. Recent data⁴ (2013) showed that in NYS black mothers are more than three times more likely to die than white mothers.

To address this devastating public health issue, the New York State Department of Health (Department) instituted an on-going process of systematic review for all maternal deaths as part of the Maternal Mortality Review and Prevention Initiative (MMR) in 2010. This initiative aims to maintain a comprehensive view of the factors leading to maternal death and to inform interventions to reduce the risk of these deaths. The MMR is consistent with the objectives of the *Prevention Agenda 2013-2017: New York's State Health Improvement Plan* which aims to reduce maternal mortality in the state by 10% to 21.0 per 100,000 live births and to improve the racial and ethnic disparities in the state maternal death rate by 10% by 2017.

The goal of MMR is to identify female deaths that were **pregnancy-related** (either directly caused or exacerbated by the pregnancy) and to conduct a comprehensive review of factors leading to these deaths, and provide information to develop strategies and interventions to decrease their risk. The MMR also gives an overview of the deaths that were not pregnancy-related. Data sources used to identify all **pregnancy-associated** deaths (pregnancy related and not related deaths) included linked death, birth and hospital discharge records and events reported to the New York Patient Occurrence and Reporting Tracking System.

Once maternal death cases are identified, each case is reviewed using a standardized review tool that collects medical information on past pregnancies, prenatal and intra-partum medical history, prenatal hospitalizations, and the postpartum period. Data are analyzed and aggregated for review, discussion and action. To provide expert input into the initiative, the Department established a MMR committee of multidisciplinary clinicians and other key stakeholders from professional organizations and hospitals. Based on the trends in data collected through the MMR, the committee provides recommendations for prevention and improvements in medical care and management as well as identifying focus areas for education.

Key Findings

- Maternal mortality review identified 125 pregnancy-related and 215 pregnancy-associated, not related deaths from 2006 to 2008.
- The majority of women in the pregnancy-related deaths cohort were in their thirties (30-39), overweight or obese, spoke English as their primary language, were non-

¹ The other seven countries are: Afghanistan, Belize, El Salvador, Guinea-Bissau, Greece, Seychelles, South Sudan.

² Kassebaum NJ, Bertozzi-Villa A, Coqqueshall MS et al. Global, regional, and national levels and causes of maternal mortality during 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet*. 2014 Sep 13;384(9947):980-1004. doi: 10.1016/S0140-6736(14)60696-6. Epub 2014 May 2.

³ <http://hrc.nwlc.org/status-indicators/maternal-mortality-rate-100000> Accessed 4/3/2015.

⁴ Vital Statistics of New York State 2013

- Hispanic, delivered in a Level 3 hospital or regional perinatal center, delivered by caesarean section, and had no previous hospitalizations during the index pregnancy.
- Black women were the group with the largest number of pregnancy-related deaths.
 - Medicaid was the most common health insurance coverage among women in the pregnancy-related deaths cohort.
 - The leading causes of pregnancy-related deaths were hemorrhage (23%), hypertension (23%), embolism (17%), and cardiovascular problems (10%).
 - The leading causes of pregnancy-associated deaths were cancer (25%), external causes (12%), auto accidents (11%), assault (9%), diseases of the circulatory system (8%), and self-harm (6%).
 - The care and services for one third of the women in the pregnancy-related deaths cohort were deemed as not in accordance with national professionally recognized standards. Among these cases, 57% of the deaths were considered preventable.

Definitions

The following definitions will be used throughout this report. Additional terms are defined in the Glossary included in the Appendix.

Pregnancy-related death is defined as the death of a woman while pregnant or within a year from termination of pregnancy, occurring as result of a pregnancy-related illness (i.e. preeclampsia) or as a result of an underlying illness exacerbated by the physiology of pregnancy (i.e. mitral stenosis.) A pregnancy-related death that occurred within 42 day of the termination of the pregnancy is a **maternal death**.

Pregnancy-associated, not related death is defined as the death of a woman while pregnant or within one year of termination of pregnancy from any cause, not as a cause of pregnancy or illness exacerbated by pregnancy (i.e. motor vehicle accident.)

Maternal mortality ratio is defined as the number of maternal deaths per 100,000 live births in a given year.

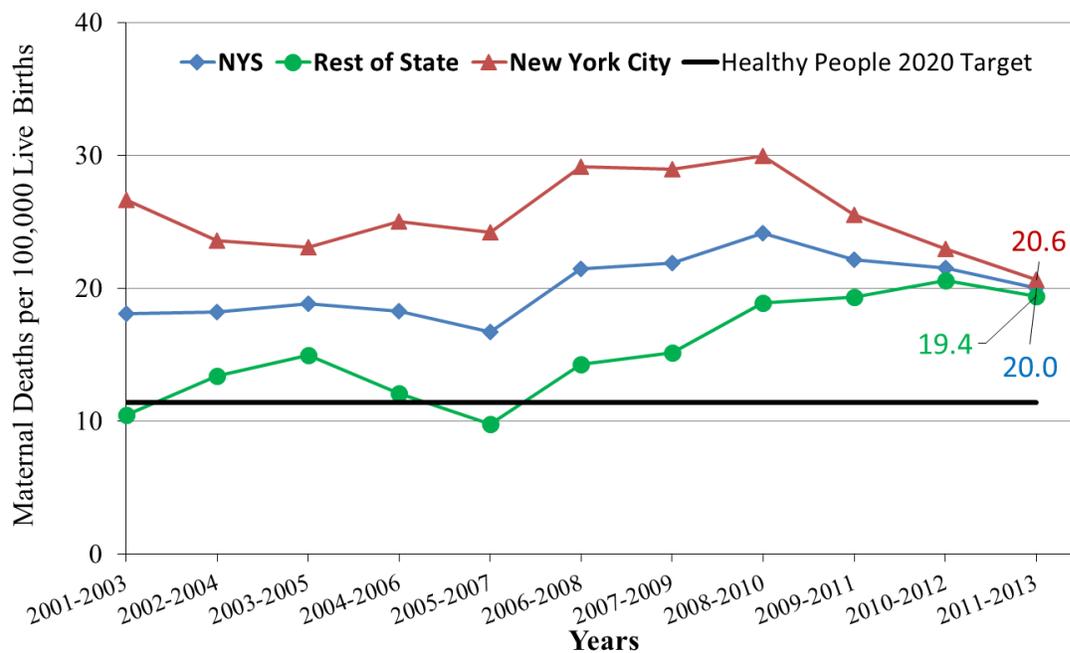
Termination of pregnancy is defined as the end of a pregnancy regardless of the process that lead to it; this term includes live births (vaginal deliveries and cesarean sections), spontaneous and induced abortions.

I. Background

Maternal deaths are devastating events with prolonged effects on fathers, partners, children, families, and obstetric health care teams. The United States is one of only eight countries worldwide with a rise in maternal mortality from 2003 to 2013 and ranks 60th in the world⁵ behind all other developed nations in maternal mortality. New York State (NYS) ranks 46th among 50 states⁶.

Maternal mortality in NYS peaked at 29.2 per 100,000 live births in 2008 and has decreased to 17.9 per 100,000 live births in 2013 (Figure 1). The most recent rate is 1.5 times higher than the Healthy People 2020 objective of 11.4 per 100,000 live births. Racial disparities in maternal deaths are significant and exceed the disparities noted in infant mortality and low birth weight births. The ratio of Black to White maternal deaths in NYS was 3.3 (2013) versus a national ratio of 2.7⁷ (2007).

Figure 1. NYS Three Year Rolling Average Maternal Mortality Rate



Source: NYS Vital Statistics

In 2010, the Department implemented a new MMR initiative to systematically review all NYS maternal deaths. Through a comprehensive review of factors leading to maternal deaths in NYS, the Department seeks sufficient information to develop strategies and interventions to decrease the risk of these deaths.

⁵ Kassebaum NJ, Bertozzi-Villa A, Coqqueshall MS et al. Global, regional, and national levels and causes of maternal mortality during 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet*. 2014 Sep 13;384(9947):980-1004. doi: 10.1016/S0140-6736(14)60696-6. Epub 2014 May 2.

⁶ <http://hrc.nwlc.org/status-indicators/maternal-mortality-rate-100000> Accessed 4/3/2015.

⁷ Singh, Gopal K. Maternal Mortality in the United States, 1935-2007: Substantial Racial/Ethnic, Socioeconomic, and Geographic Disparities Persist, A 75th Anniversary Publication. Health Resources and Services Administration, Maternal and Child Health Bureau. Rockville, Maryland: U.S. Department of Health and Human Services; 2010.

The Department convened an expert Maternal Mortality Review committee that includes representation from the following professional organizations and associations: The New York Academy of Medicine, The American College of Obstetricians and Gynecologists (ACOG), The NYS Society of Pathologists, The NYS Nurses Association, The NYS Association of County Health Officials (NYSACHO), The NYS Association of Licensed Midwives, The NYS Academy of Family Physicians, The National Association of Social Workers, The New York City Department of Health and Mental Hygiene, The NYS Association of County Coroners and Medical Examiners, The New York City Office of the Chief Medical Examiner, The Association of Regional Perinatal Networks, The NYS Office of Alcoholism and Substance Abuse, The New York Chapter of the American College of Emergency Physicians, The Medical Society of the State of New York, The NYS Society of Anesthesiologists, The NYS Dietetic Association, The Greater New York Hospital Association, The Healthcare Association of NYS, and Regional Perinatal Centers. Based on the trends present in maternal mortality data collected through the MMR, the MMR committee identifies emerging issues, provides recommendations regarding opportunities for improvement including preventive measures and strategies to improve care and medical management, and identifies educational needs to be addressed. A detailed list of the members of the MMR committee is included in the Appendix.

II. New York State Maternal Mortality Review Initiative: Methods

Sources of Data

In the MMR initiative, the Department conducts comprehensive surveillance activities based on linked birth and death record data, hospital in-patient and emergency department data (inpatient and outpatient records from the Statewide Planning and Research Cooperative System records (SPARCS)) and a hospital-based adverse event reporting system, the New York Patient Occurrence Reporting and Tracking System (NYPORTS).

NYPORTS is a statewide, mandatory reporting system that collects information from hospitals and diagnostic treatment centers concerning adverse events defined as unintended, adverse and undesirable developments in a patient's condition. Maternal deaths are one of the 31 occurrences reportable to NYPORTS.

The data used to determine cases for surveillance consists of death records of women ages 10 to 55 years that died within one year (365 days) of a live birth or fetal death. The cases include:

- the maternal death certificates linked to a live birth or a fetal death certificate;
- the maternal death certificates not linked to a live birth certificate but have an ICD-10 code indicating a pregnancy-related cause of death and/or pregnancy is checked on a death certificate; and,
- the maternal death certificates linked to a SPARCS record in which there is an indication of pregnancy (established using the diagnoses and procedure codes listed in the record). The hospital records with indication of pregnancy from SPARCS were identified using a broad list of ICD-9 codes for pregnancy-related diagnoses and procedure codes (List available upon request).

Identification of cases for surveillance

Cases were organized for surveillance based on ascertainment data sources. **Standard surveillance** cases consisted of female deaths linked to a live birth with a year or less between the two events. To expand the identification of maternal deaths, NYS added an **enhanced surveillance** component that focuses on the examination of female death records not linked to a live birth certificate. The enhanced surveillance component identified for review the death records of women that were pregnant at the time of death or in the last 42 days before death, or that died within a year after a hospitalization with an indication of pregnancy, or the death certificate included an obstetric cause of death. NYPORTS cases not captured under standard surveillance were also included in the enhanced surveillance.

Review process

Once the Department identified and prioritized potential maternal mortality cases, a certified copy of the medical record is requested and submitted to the Department's medical record review contractor, the Island Peer Review Organization (IPRO). A nurse conducts a standardized record review using a 33 page review tool assembled by the Department from multiple tools from national and local initiatives (New York State Maternal Mortality Review Data Collection Form available upon request).

The current maternal mortality review abstraction tool was developed based on previous MMR experience from multiple review tools with the goal to ensure a comprehensive review of medical records. In addition to demographic, medical, psychosocial and intimate partner violence information, the data collection tool addresses the cause of death, potential preventability of the death (based on clinical review), past pregnancies, prenatal and intra-partum medical history, prenatal hospitalizations, and postpartum information.

Once the data collection tool is completed by the review nurse, the completed tool is sent to independent obstetricians to review the information abstracted and prepare a narrative summary of the case. Depending on the issues identified, the obstetrician may recommend that the case be sent to other independent medical specialists such as a physician specializing in infectious disease or cardiology for review and preparation of a supplemental case summary.

The tool and summaries are sent to the Department for data entry into a custom developed Microsoft Access database. The result of this review process is a composite of all available sources of information for each case in one MMR database. With the exception of the comparisons with the reference population (noted in the report), this report presents the analysis of the data collected during the MMR review process of the 2006-2008 deaths.

III. Findings from the 2006-2008 Cohort

Case identification

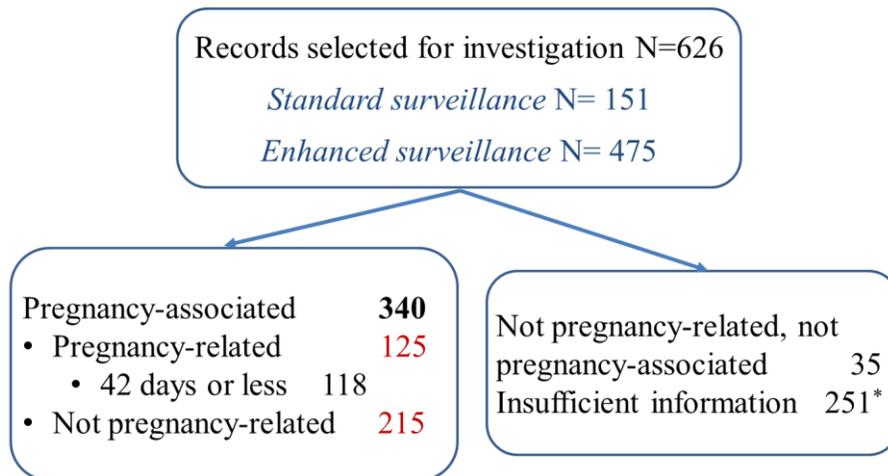
Death records of 10-55 year old females from 2006-2008 were linked to 2005-2008 birth records to identify the standard surveillance cases. Under standard surveillance, a total of 151 potential maternal death cases were found (Figure 2).

Enhanced surveillance yielded 475 additional records of 10-55 year old females that died within one year after a hospitalization with an indication of pregnancy (Figure 2).

The review of the medical records available for these deaths identified 125 pregnancy-related deaths and 215 pregnancy-associated, not related deaths.

The majority of pregnancy-related deaths were maternal deaths (118 out of 125 deaths). More maternal deaths were identified through the enhanced surveillance: 58 identified through standard surveillance vs 62 identified through enhanced surveillance. Reviews of deaths that occurred more than 42 days but less than one year after delivery yielded 7 pregnancy-related cases.

Figure 2. NYS surveillance of pregnancy associated deaths, 2006-2008



Source: NYS MMR

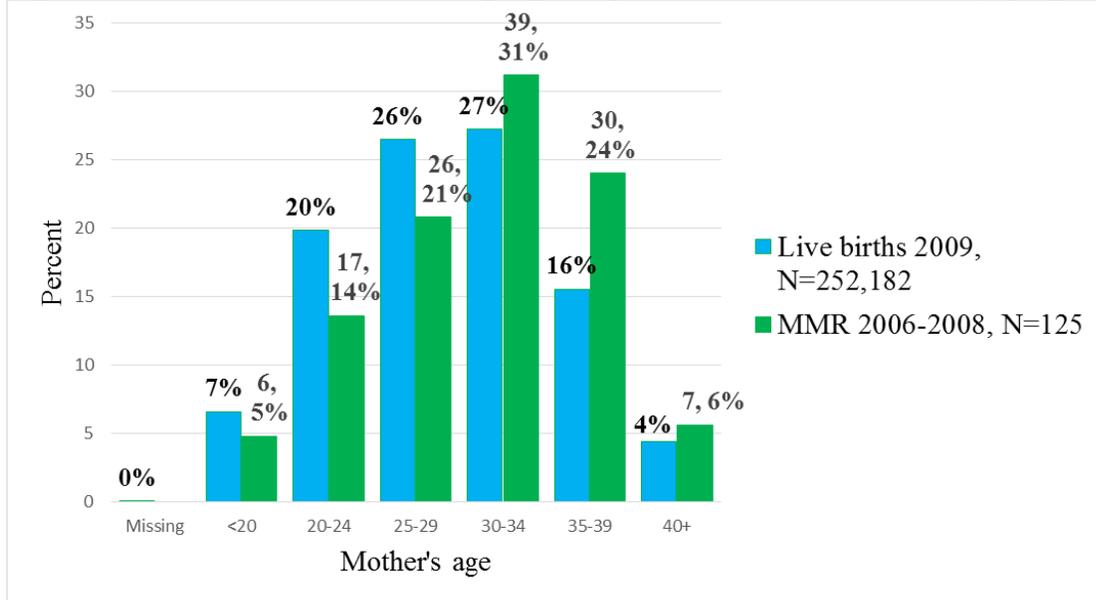
*Note: The reviews could not be conducted on 251 of the 626 deaths identified for review. A more detailed account of these 251 records was included in the section Data Challenges of this report.

Pregnancy-related deaths

Demographics

Over half (55%) of the 125 women in the 2006-2008 pregnancy-related death cohort were 30-39 years old and about 6% were 40 years or older; 18% of these cases were women 24 years old or younger (Figure 3, Table 1).

Figure 3. NYS live births 2009 and pregnancy-related deaths 2006-2008, by age of mother



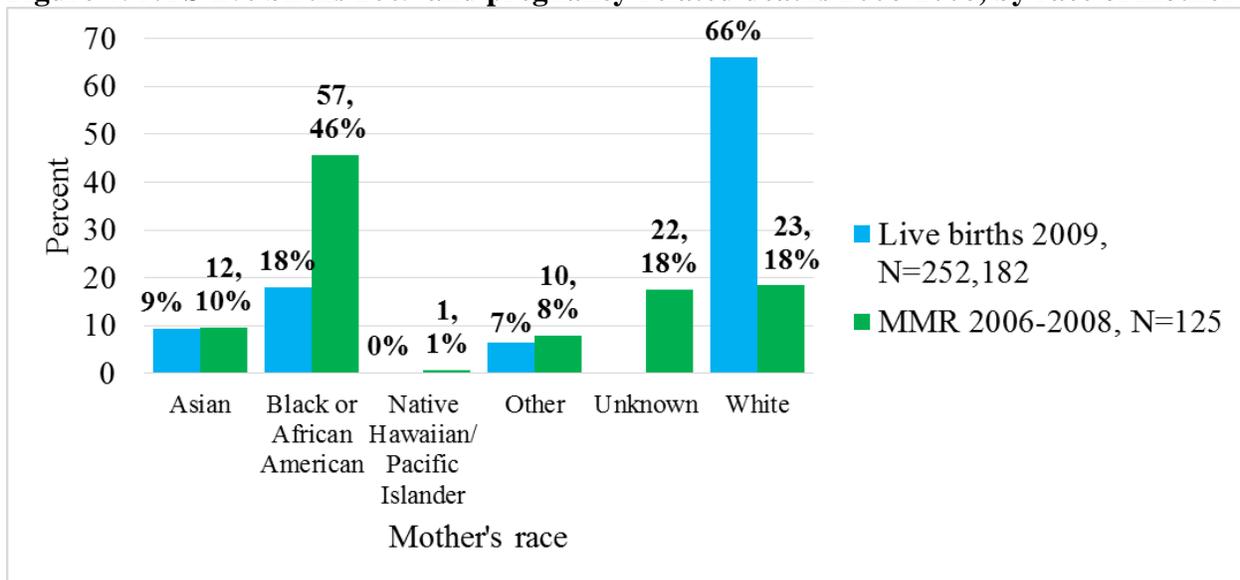
Source: NYS MMR and NYS Vital Statistics

Women in the pregnancy-related cohort were more likely to be 30 years of age and older than women experiencing live births. On average, women in the pregnancy-related death cohort were two years older ($p<.0001$, Figure 3) than those in the 2009 birth cohort.

The race distributions of live births and the pregnancy-related deaths showed that Black women were overrepresented in the pregnancy-related deaths cohort thus reflecting the racial disparity in maternal mortality rates between Black and White women observed at the state level. Black women comprised 46% of the pregnancy-related cohort, followed by White (18%) and Asian women (10%). The proportion of Black women within the pregnancy-related cohort was more than twice the proportion of Black women in the reference population (Figure 4, Appendix Table 2). The differences in the race distributions were significant ($p<.001$).

The majority of women in the pregnancy-related deaths cohort were non-Hispanic (60%). Nineteen percent of women were Hispanic and for 21% the ethnicity was unknown (Appendix, Table 2).

Figure 4: NYS live births 2009 and pregnancy-related deaths 2006-2008, by race of mother



Source: NYS MMR and NYS Vital Statistics

Among women in the pregnancy-related death cohort the employment status was known for the majority of women (85.6%) and was almost equally divided between employed (42%) and unemployed (43%). Occupation was known for 45.6% of women in the pregnancy-related death cohort. The occupations reported included professionals (13%), service/housekeeper/child care (13%), and sale/administrative support (10%) (Table 1).

The pregnancy-related death cohort was comprised of women of all levels of education. The largest group was women that graduated from high school (13.6%), followed by women with college credit but no degree (11.2%), and women who completed 9th-12th grade but no diploma (10.4%). Education level was not reported for almost half of the cohort (48%) even after data augmentation (Table 1).

The types of health insurance coverage varied among women in the pregnancy-related death cohort. For approximately 15% (19) of the cases, the insurance information was missing. Among the remaining 106 cases, 10% (11) had two health insurance coverage plans. The most common insurance was Medicaid (45%), followed by private insurance (34%) and managed care (13%) (Table 1).

Primary language was reported as English for the majority of women in the pregnancy-related death cohort (63%). Primary language was unknown for 22%, and another language for the remaining 15%.

There was an even distribution between women in the pregnancy-related cohort who were single 48% (including separated, divorced or widowed) and women who were married 48% (including those who reported living with a domestic partner or had a paternity acknowledgement filed in the birth record). Marital status was unknown for the remaining 4% of the cohort.

Table 1. NYS Pregnancy-related deaths 2006-2008 and maternal demographic characteristics

Pregnancy-related deaths, N=125	Count	Percent
Age at death in years		
<20	6	4.8
20-24	17	13.6
25-29	26	20.8
30-34	39	31.2
35-39	30	24.0
40+	7	5.6
Employment		
Unemployed	54	43.2
Employed	53	42.4
Unknown	18	14.4
Occupation		
Unemployed	29	23.2
Professional	16	12.8
Service/Housekeeper/Childcare	16	12.8
Sales/Administrative support	12	9.6
Other	7	5.6
Factory/Labor	4	3.2
Student	2	1.6
Unknown	39	31.2
Education		
8 th grade or less	5	4.00
9 th -12 th grade, no diploma	13	10.40
High school graduate or GED	17	13.60
Some college credit, but no degree	14	11.20
Associate degree	3	2.40
Bachelor degree	8	6.40
Master degree	4	3.20
Doctorate/professional degree	1	0.80
Unknown	60	48.00
Health insurance⁸		
Medicaid	53	45.30
Private insurance	40	34.19
Managed care	15	12.82
Other	5	4.27
Family Health Plus/Child Health Plus B	2	1.71
Self pay or none	2	1.71

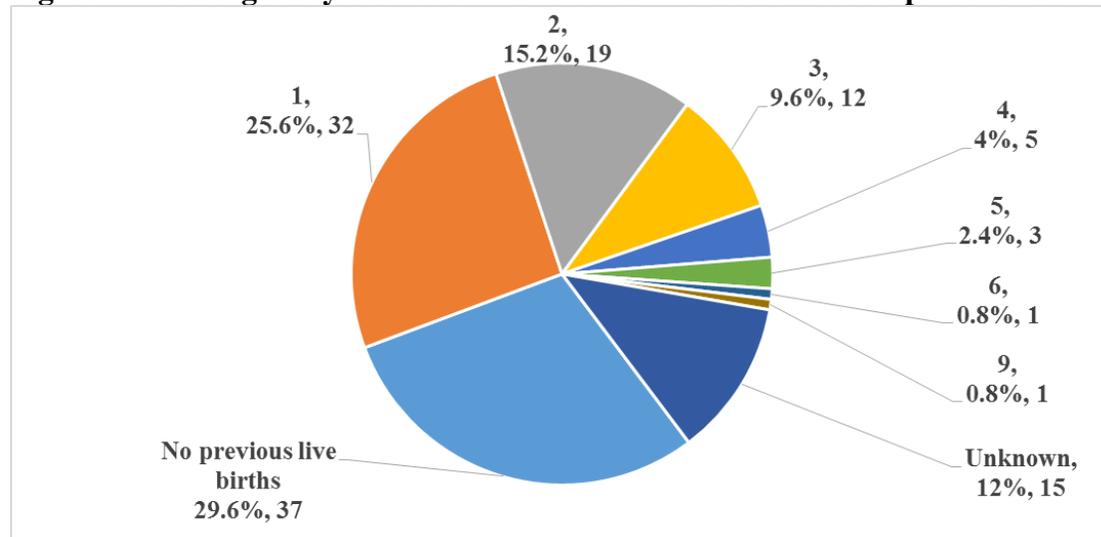
⁸ Note: Since a number of women had more than one type of health insurance coverage the groups and counts presented in Table 3 for Health insurance are not mutually exclusive.

Prenatal history

Previous live births

About one third of the women in the pregnancy-related death cohort had no previous live births. The largest number of deaths occurred among women with no previous live births and decreased as the number of live births increased: an inverse relationship (Figure 5, Appendix: Table 3).

Figure 5. NY Pregnancy-related deaths 2006-2008 and number of previous live births



Source: NYS MMR

Prenatal medical history

The facility providing prenatal care was known for 85 out of the 125 women in the pregnancy-related deaths cohort. In most of the cases, only one facility was reported as providing prenatal care (76%); in 7% of cases two health care facilities were reported and no facility was reported for the remaining 17% of the cases. Hospital clinics were the most common facility providing prenatal care (46%) followed by private offices (20%) and high risk clinics (13%) (Table 4).

In most of the cases in the pregnancy-related deaths cohort, only one prenatal care provider was reported (33%); two providers were reported for 10% of the cases and three providers for 2%. No provider was reported for almost 9% of the cases. Provider information was unknown for almost half of the cohort (46%). Obstetricians were the most common prenatal care providers (67%, 45 out of 67) followed by perinatologists/maternal fetal medicine specialists (18%) and midwives (12%) (Table 5). Twenty percent of the cases received high-risk referrals and most of these received high-risk care as a result of this referral (88%, 22/25).

Table 4. NYS Pregnancy-related deaths 2006-2008 and number and types of facilities providing prenatal care

Number of facilities	Count of cases	Percent of total, N=125	Specific source	Count of cases
Unknown	40	32.0%		
None	14	11.2%		
One	65	52.0%	Health department clinic	3
			Hospital clinic	37
			Neighborhood health center	5
			High-risk clinic	5
			Private office	15
Two	6	4.8%	Hospital clinic	2
			Neighborhood health center	2
			High-risk clinic	6
			Private office	2

Source: MMR Database

Table 5. NYS Pregnancy-related deaths 2006-2008 and number and type of prenatal care providers

Number of providers reported	Count of cases	Percent of total, N=125	Specific source	Count of cases
None	11	8.80%		
One provider	41	32.80%	Family practice physician	1
			Obstetrician	32
			Nurse practitioner	1
			Perinatologist/MFM	3
			Midwife	3
Two providers	13	10.40%	Obstetrician	11
			Nurse practitioner	2
			Perinatologist/MFM	7
			Midwife	3
			Other	3
Three providers	2	1.60%	Obstetrician	2
			Perinatologist/MFM	2
			Midwife	2
Unknown	58	46.40%		

Source: NYS MMR

Data was missing on the trimester of initiation of prenatal care for 23% (29) of the women in the pregnancy-related deaths cohort and on the number of prenatal visits for 20% (25). For 10% of women in this cohort no visits were reported.

Kotelchuck’s revised graduated index of prenatal care utilization combines the trimester of pregnancy when the first prenatal care visit occurred, the number of visits and the length of pregnancy into a measure that reflects the completeness of prenatal care received during pregnancy. In this cohort, a quarter of women received adequate prenatal care (31, Table 6). A little over a quarter of women were classified as intermediate (34) meaning that prenatal care was initiated during the first or second trimester but the number of visits was less than recommended. Six percent of women had intensive care which means they had more visits than generally recommended (7). Eight percent (10) of women started prenatal care late and/or received fewer visits than recommended. They were classified in the inadequate prenatal care category. Ten percent of the cases were classified as having no prenatal care because the number of visits was zero (13). For almost a quarter (30) the information was not complete or was implausible (for example, gestation of 20 weeks and first visit during the third trimester).

Table 6. NYS Pregnancy-related deaths 2006-2008 and prenatal care utilization

Prenatal care	Count of cases	Percent
Adequate	31	25
Intermediate	34	27
Intensive	7	6
Inadequate	10	8
No prenatal care	13	10
Unknown	30	24
Total	125	100

Source: NYS MMR

A list of medication taken prenatally was reported for almost three quarters of the women in the pregnancy-related deaths cohort (95). Of those with a reported list, the majority had only one medication (58%, 55, Appendix: Table 7a). Dietary supplements (28%) and prenatal vitamins (23%) accounted for over half of the medications reported. Other medications listed were antihypertensive (8%), antibiotics (6%), anticoagulants (5%), insulin (4%), iron (3%), antidepressants (2%), corticosteroids (2%) and thyroid medication (2%) (Appendix: Table 7b). The top four reasons for using the medications listed were pregnancy (49%), hypertension (8%), infection (7%) and diabetes (5%) (Appendix: Table 7c).

The review of the most recent prenatal laboratory screening tests showed that of the 14 standard tests listed on the form, the average number of tests found in charts was 9 with a median of 10. There were 8 cases without any tests, only 6 cases having all 14 tests and 16% with 12 tests. Most frequently done tests were blood type (10%), followed by D (Rh) type (10%), antibody screen (10%) and hemoglobin and hematocrit levels (10%).

Provider-identified Risk Factors

Table 8. NYS Pregnancy-related deaths 2006-2008 and number of provider-identified risk factors

Number of risk factors	Number of cases
0	45 (36%)
1	40 (32%)
2	23 (18%)
3	8 (6%)
4	6 (5%)
5	1 (1%)
6	1 (1%)
7	1 (1%)
152 risk factors reported	125 pregnancy-related cases

Over one third of pregnancy-related deaths cohort had no risk factors documented and almost one third had only one risk factor (Table 8). Hematologic risk factors including anemia and sickle cell disease were the most frequently reported (19%, 29). The second most reported category of risk factors was hypertension (17%, 26) followed by cardiac (13%, 20), pulmonary (9%, 13), endocrine (8%, 12) and psychiatric disorders (5%, 8). Detailed counts are presented in Appendix: Table 9.

With the exception of cardiac risk, the five highest occurring risk factors were documented mostly for Black women. Cardiac risk was mostly documented for White women (Table 10).

Hispanic women had no hematologic or cardiac risk factors documented (Table 10).

Source: NYS MMR

Table 10. NYS Pregnancy-related deaths 2006-2008 and documented provider-identified risk factors by race and ethnicity

Risk factor category	Race				Ethnicity			Total N,%
	Black	White	Asian	Other	Hispanic or Latino	Not Hispanic	Unknown	
Hematologic	17	7	3	2	1	21	7	29, 19%
Hypertension	13	2	0	11	6	15	5	26, 17%
Cardiac	5	10	1	4	3	10	7	20, 13%
Pulmonary	7	2	1	3	4	6	3	13, 9%
Endocrine	6	0	1	5	4	6	2	12, 8%
Psychiatric disorder	2	4	0	2	2	2	4	8, 5%
Other	21	8	3	12	11	16	17	44, 29%
Total	71	33	9	39	31	76	45	152, 100%

Source: NYS MMR

Substance use

Substance use during pregnancy was infrequently reported. Out of the 15 women who reported to have smoked prior to pregnancy, 13 continued to smoke during pregnancy. Of the three women reported to have used alcohol prior to pregnancy, one continued during pregnancy.

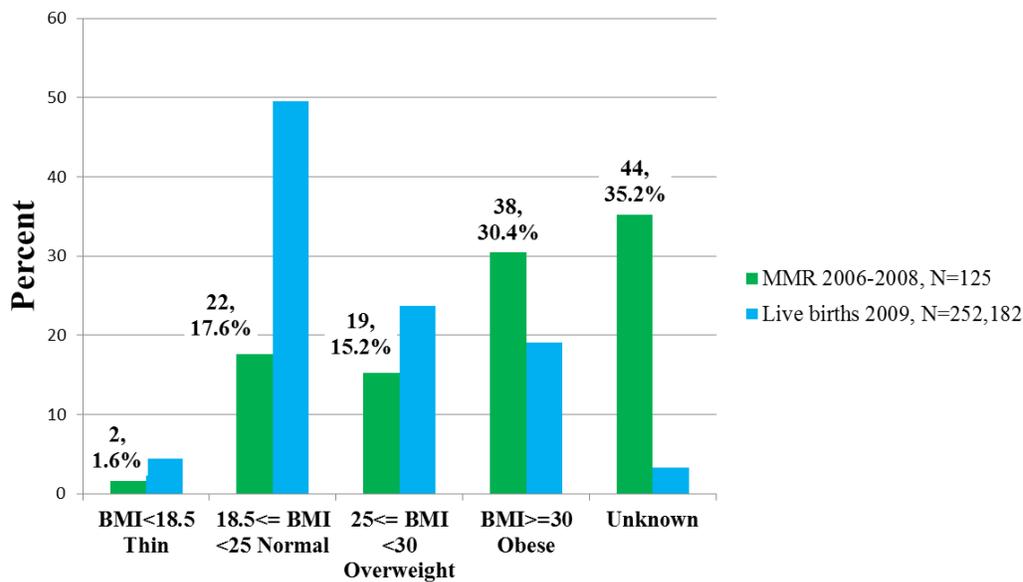
Illicit drug use was noted for seven women prior to pregnancy and five during pregnancy. Two of the women who reported using drugs during pregnancy had missing information regarding drug use prior to pregnancy. Drug dependency was reported for one woman.

Based on chart notes and positive toxicology screens done upon admission, the reviewers identified two additional cases with drug use during pregnancy beyond the self-reported information. In total, eight instances of drug use during pregnancy were identified: one use of barbiturates, two of cocaine, four of marijuana and one of valium.

The use of multiple substances was reported for one woman in the pregnancy-related death cohort. The woman with reported dependency on drugs, also reported smoking prior to pregnancy and alcohol and illicit drug use prior to and during pregnancy. More specifically, use of cocaine and valium was noted. The other woman with reported cocaine use also reported smoking prior to and during pregnancy. Three of the four marijuana users were also smokers.

Weight status

Figure 6. NYS live births 2009 and pregnancy-related deaths 2006-2008 by mother’s pre-pregnancy body mass index



Source: NYS MMR and NYS Vital Statistics

Pre-pregnancy weight and height were available for 81 women in the pregnancy-related deaths cohort. Almost half of the cohort consisted of women with an unhealthy weight (30% were obese and 15% were overweight). A comparison with all women with live births in 2009 shows that

obesity is one and a half times (30% vs 19%) more prevalent in women in the pregnancy-related deaths cohort (Figure 6). These differences in weight status were significant ($p < .0001$).

The 38 women classified in the obese group had very high BMIs. BMI was known for 34 out of the 38 women and for these the average was 39 and median 37. The remaining 4 were classified as obese based on the doctors' notes found in the medical chart.

Prenatal hospitalizations

The great majority of women in pregnancy-related deaths cohort did not have any hospitalizations during the index pregnancy (78%, 97; not shown). A total of 46 hospitalizations were recorded in 28 cases; 14% of pregnancy-related cases had one hospitalization, 4% had 2, 4% had 3 and one case had 4 hospitalizations.

The majority of hospitalizations occurred during the 2nd trimester (39%) and during the last trimester (39%) with the remaining 23% occurring during the first trimester of the pregnancy. From the 46 hospitalizations, the majority were one day admissions (28), 10 were for 5 days or less and the remaining were for 7, 10 and 19 days. Five hospitalizations had the length of stay missing. Four hospitalizations required a transfer to a higher level hospital.

Intrapartum medical history

Hospital of delivery or termination of pregnancy (TOP) (data not shown)

In the majority of cases (76%, 95) the delivery or TOP occurred at a level 3 hospital (57, 46%) or a Regional Perinatal Center (38, 30%).

Type of delivery

Table 11a. NYS pregnancy-related deaths 2006-2008 and type of delivery

Type of delivery	Count	Percent
Undelivered	15	12.00
NSVD	21	16.80
Operative vaginal delivery	1	0.80
C-section: elective/scheduled	13	10.40
C-section: unscheduled non-emergent	17	13.60
C-section: emergent	40	32.00
C-section: peri- or post-mortem	9	7.20
Other	8	6.40
Unknown	1	0.80
Total	125	100%

Source: NYS MMR

More than half of the cases (63%, 79) were C-section deliveries: emergent C-sections (32%, 40), followed by unscheduled non-emergent C-sections (14%, 17), elective scheduled C-sections (10%, 13) and peri- or post-mortem C-sections (7%, 9) (Table 11a). Half of all C-sections were emergent (50%, 40/79). Women with normal spontaneous vaginal deliveries represented 17% (21) of the pregnancy-related deaths cohort. Women who died prior to delivery represented 12% (15) of the women in the cohort. The remaining 6 % (8) of the women experienced dilation and extraction (n=2), hysterotomy followed by hysterectomy (n=1), laparoscopic removal of ectopic pregnancy (n=3), spontaneous abortion (n=1), and vacuum delivery (n=1). Type of delivery was unknown for one woman in the cohort.

The most frequent indications for C-section were preeclampsia and eclampsia (14%), fetal distress (9%), previous C-section (6%), bleeding (4%), placental issues (4%) and maternal disease (4%). Indications were not reported for half of the C-sections (Table 11b).

Table 11b. NYS pregnancy-related deaths 2006-2008 and indication for cesarean section delivery

Indication for C-section	Count	Percent
Preeclampsia, eclampsia	11	14.10
Fetal intolerance of labor/fetal distress	7	8.97
Previous C-section	5	6.41
Bleeding	3	3.85
Placental issues	3	3.85
Maternal disease	3	3.85
Failure to progress	2	2.56
Multiple gestation	2	2.56
Malpresentation	1	1.28
CPD/Fetal disproportion	1	1.28
Missing	40	51.28
Total	78	100%

Source: NYS MMR

Obstetric complications during labor and delivery

Table 12. NYS Pregnancy-related deaths 2006-2008 and complications during labor and delivery

Type of complication	Count	Percent		
Hypertensive disorders	Preeclampsia	21	40	24.84
	HELLP syndrome	10		
	Eclampsia	6		
	Hypertension	3		
Hemorrhage	34	21.12		
Undelivered at time of death	9	5.59		
Cardiac arrest	8	4.97		
Oligohydramnios	6	3.73		
Placental complications	6	3.73		
Gestational diabetes mellitus	5	3.11		
Abortion - elective and spontaneous	5	3.11		
Maternal disease	4	2.48		
Postmaturity	4	2.48		
Pulmonary problems	4	2.48		
Uterine rupture	4	2.48		
Other	32	19.88		
Total	161	100		

Source: NYS MMR

A small fraction of the women in the pregnancy related deaths cohort did not have any obstetric complications reported during labor and delivery (13%, 16/125, not shown). Among the 161 complications reported, the most frequently reported were hemorrhage (21%, 34) and hypertensive disorders (25%, 40) (Table 12).

A large fraction of women in the pregnancy-related deaths cohort had no placental complications reported (n=57, 46%). The most frequent placental complication reported for the 68 women with these complications was manual removal of placenta (53%) followed by abruptio placenta (9%) and retained placenta (5%) (Table 13).

The majority of cases had only one type of anesthesia for labor and delivery. Only eight cases had two types administered. General anesthesia was the most frequent type administered (29%), followed by epidural (25%) and spinal (17%) (Appendix: Table 14).

Blood transfusions were noted in 49 cases; most women received them (n=41) were intrapartum and 7 prenatally. The timing of blood transfusion was unknown for one woman (data not shown).

Table 13. NYS pregnancy-related deaths 2006-2008 and placental complications

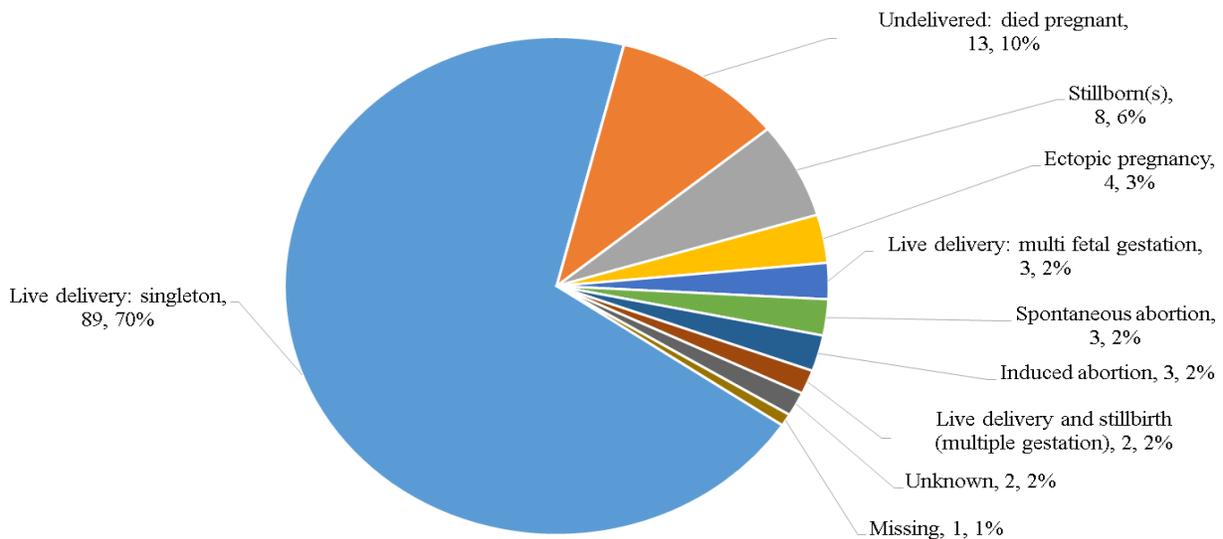
Placental complications reported	Count of cases, Percent of Total	Type of complication	Count	Percent
Yes	68, 54%	Manual removal of placenta	41	52.56
		Abruptio placenta	7	8.97
		Retained placenta	4	5.13
		Percreta, increta or accrete	3	3.85
		Previa	2	2.56
		Other – unrelated	21	26.92
		Total complications reported	78	100.00
No	57, 46%			
Total	125, 100%			

Source: NYS MMR

Pregnancy outcomes

The most frequent pregnancy outcome was a live singleton baby (70%). Ten percent of women died while still pregnant and were undelivered, and 6% were stillbirths (Figure 7, Appendix: Table 15).

Figure 7. NYS pregnancy-related deaths 2006-2008 and pregnancy outcomes



Source: NYS MMR

Postpartum history

Postpartum complications

Table 16a. NYS Pregnancy-related deaths 2006-2008 and postpartum complications

Complications	Number of cases it was reported	Percent
Hemorrhage	38	27.74
HDP	31	22.63
ARDS	11	8.03
Infection	11	8.03
Anoxic brain injury	9	6.57
Embolism	9	6.57
Other	9	6.57
Cardiomyopathy	6	4.38
Cardiac arrest	4	2.92
Intracranial hemorrhage	4	2.92
DIC	3	2.19
Pulmonary edema	2	1.46
Total	137	100

Source: NYS MMR

In contrast with the complications reported during labor and delivery, the reported postpartum complications are more extensive and points to a wide array of health issues. The most frequently reported postpartum complication was hemorrhage (28%), followed by hypertensive disorders (23%), acute respiratory distress syndrome (8%), and infections (8%). A small number of cases had no postpartum complications reported (n=3) and postpartum complications were unknown for over a third of pregnancy-related cases (n=42, 33%) (Table 16a).

Among the women in the pregnancy-related deaths cohort with reported complications (81), half had one complication that occurred mostly during normal vaginal deliveries and emergent C-sections (49%, 40). Over a third of women had two complications (35%, 28) which occurred mostly during emergent C-sections. Twelve women had three complications (15%, 12) which occurred mostly during unscheduled non-emergent (n=5) and emergent (n=4) C-sections (Appendix: Table 16b).

Blood transfusions were administered postpartum for 55 women in the pregnancy-related deaths cohort. Transfusions were administered mainly for women who received C-sections (37) with more than half being emergent C-sections (20, Appendix: Table 17).

Psychosocial assessment

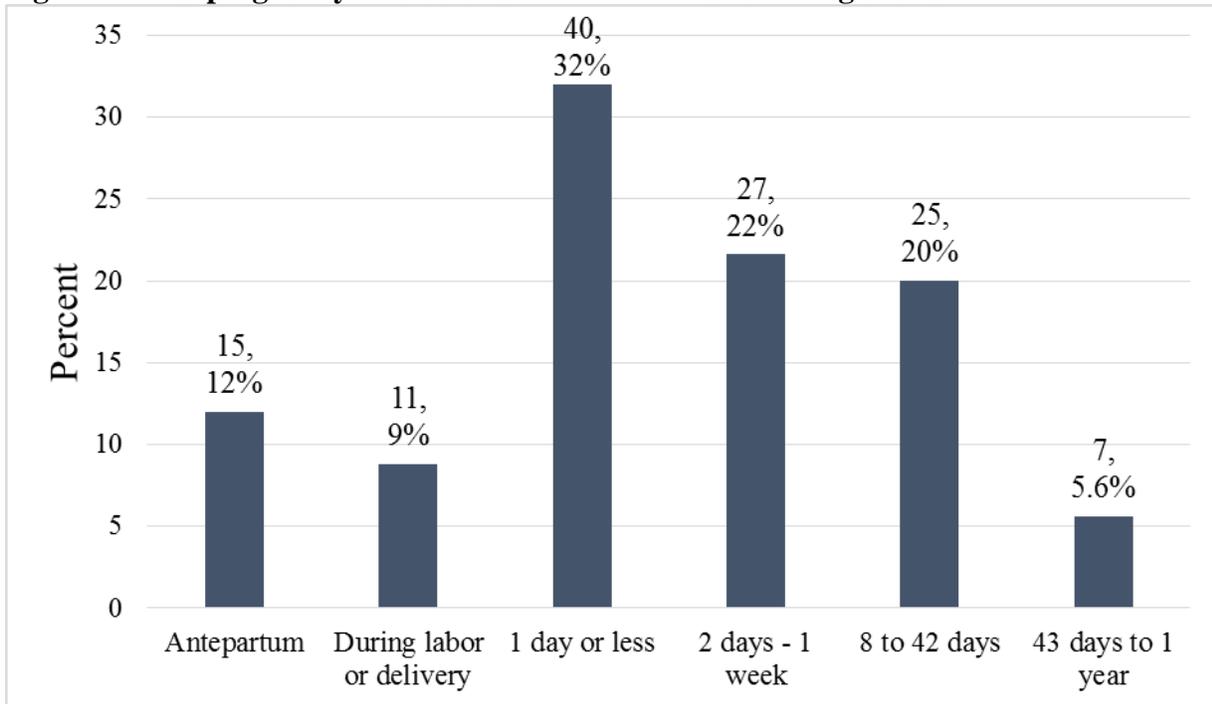
The psychosocial assessment section of the MMR form collects information on a variety of psychosocial issues identified by the mother’s health care team and are noted on the mother’s prenatal or intrapartum medical records.

The psychosocial assessment was completed for a quarter of women in the pregnancy-related deaths cohort (32, 26%). For seven women no issues were identified in the charts and for five cases the information was missing; for the remaining 20 women the number of issues identified ranged from 1 to 5; the most common number of issues was 1 for 13 women, followed by 2 for 5 women; two women had 3 and 5 issues identified, respectively. The most frequently reported issues were non-compliance with treatment (9), depression (4), homelessness (4), and mental illness (3). Domestic violence occurring prior to pregnancy was identified in three cases (data not shown).

Timing of death

Most of the pregnancy-related deaths occurred within a week of the end of the pregnancy (75%, 93, Figure 8). The largest proportion of deaths occurred the day after the end of pregnancy. With the exception of the antepartum deaths that were mostly undelivered women, the remaining deaths resulted mostly in live births: 8 live births in 11 deaths during labor, 33 live births in 40 deaths a day after delivery, and 25 live births in 27 deaths that occurred within a week after delivery.

Figure 8. NYS pregnancy-related deaths 2006-2008 and timing of death

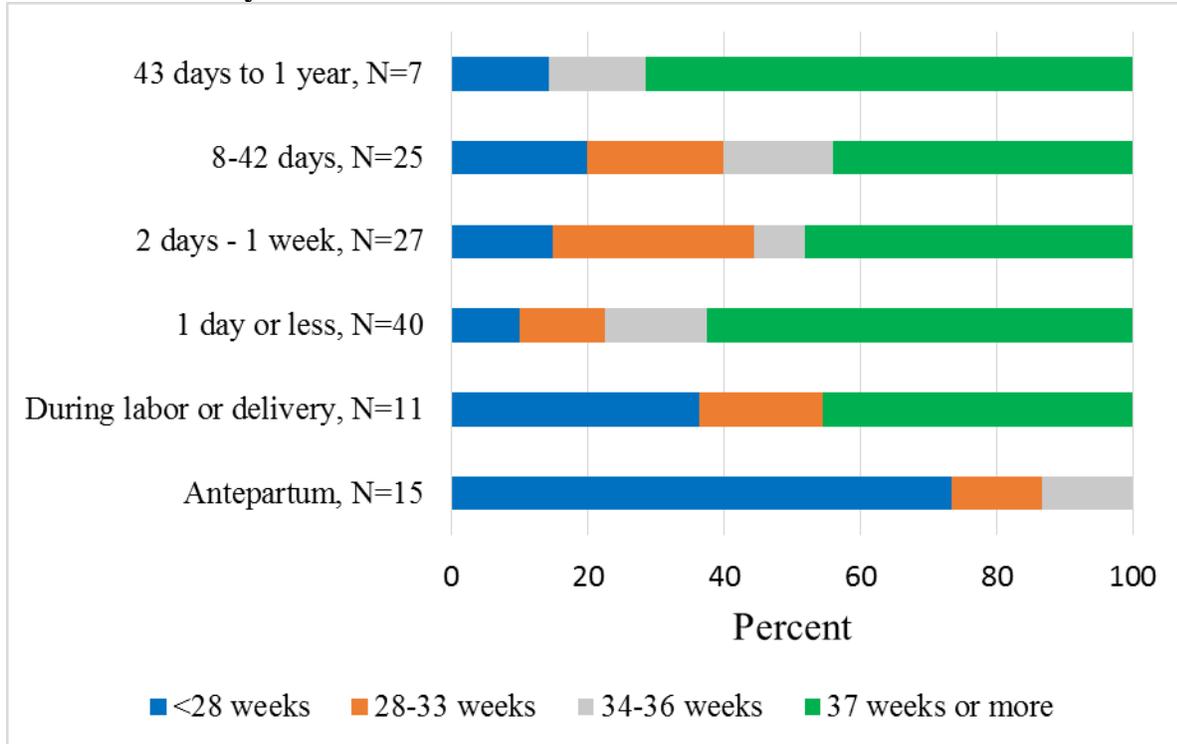


Source: NYS MMR

With the exception of women who died antepartum, where gestational age was primarily less than 28 weeks, a range of gestational ages is seen in each group, when women are grouped by time of death relative to delivery. Among women in pregnancy-related deaths cohort, full term

pregnancies are most frequently seen among women who died the first day after delivery or more than 43 days after delivery (Figure 9).

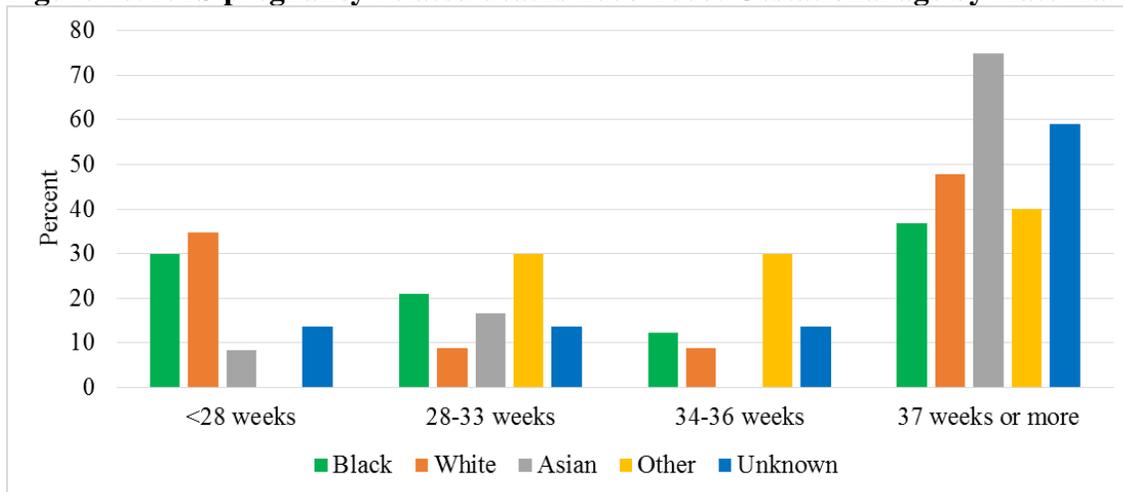
Figure 9. NYS pregnancy-related deaths 2006-2008: Gestational age by time of death relative to delivery



Source: NYS MMR

Women with full term pregnancies represented the largest proportion of deaths in every racial group (Figure 10).

Figure 10. NYS pregnancy-related deaths 2006-2008: Gestational age by maternal race



Source: NYS MMR

MMR Causes of death

Table 18. NYS Pregnancy-related deaths 2006-2008 and MMR cause of death

MMR cause of death	Count	Percent
Hemorrhage	29	23.20
Hypertension	29	23.20
Embolism	21	16.80
Cardiovascular problems	12	9.60
Intracerebral hemorrhage (not associated with PIH)	5	4.00
Cardiac arrest/failure, NOS	4	3.20
Infection	4	3.20
Hematopoietic (sickle cell, thalassemia, ITP)	3	2.40
Neurologic/neurovascular problems	3	2.40
Pulmonary problems	3	2.40
Cardiomyopathy	2	1.60
Multiple organ/system failure, NOS	2	1.60
Other conditions	2	1.60
Unknown cause of death	2	1.60
Cancer	1	0.80
Gastrointestinal disorders	1	0.80
Injury	1	0.80
Other cause of death	1	0.80
Total	125	100.00

Source: NYS MMR

Each case was assigned an MMR cause of death based on the review of all the information available. The MMR cause of death most closely aligned with the causes of death from the NYPORTS root cause analyses (70%, 32/46) and the autopsy reports (68%, 36/53).

The four leading MMR causes of death were hemorrhage (23%), hypertension (23%), embolism (17%) and cardiovascular problems (10%) (Table 18).

Table 19. NYS Pregnancy-related deaths 2006-2008, leading MMR causes of death, selected characteristics of mother, type of delivery, timing of death and pregnancy outcome

Characteristics		Hemorrhage	Hypertension	Embolism	Cardiovascular problems
		N=29	N=29	N=21	N=12
Race	Black	14	15	9	4
	White	1	6	4	5
	Asian	7	1	1	0
	Native Hawaiian or Other Pacific Islander	1	0	0	0
	Other	0	2	2	2
	Unknown	6	5	5	1
Age	<20	1	0	3	0
	20-24	1	3	5	0
	25-29	8	6	4	3
	30-34	11	12	1	4
	35-39	6	8	7	5
	40+	2	0	1	0
BMI	BMI<18.5 Thin	0	1	0	0
	18.5<=BMI<25 Normal	6	7	3	2
	25<=BMI<30 Overweight	5	3	2	2
	BMI>=30 Obese	10	9	7	1
	Unknown	8	9	9	7
Type of delivery	C-section	18	22	9	6
	Undelivered	1	2	6	2
	NSVD	5	3	5	4
	Operative vaginal delivery	0	1	0	0
	Other	4	1	1	0
Timing of death after end of pregnancy in days[^]		3	8	.8	3.3
Mean, median		1	5	1	1
Pregnancy outcome	Live baby	22	25	13	8
	Undelivered	0	2	6	2
	Stillborn	2	1	2	1*
	Ectopic	4	0	0	0
	Abortion	0	1	2	1
	Unknown	1	0	0	1

Source: NYS MMR

Note: * Stillborn with a live delivery.

[^]Two cases with unusual situations were removed from calculating the mean and median for timing of death: one hemorrhage case (days=101), and one hypertension (days=115).

Selected maternal characteristics were explored for the leading MMR causes of death (Table 19). Black women had the highest number of deaths for all leading causes of death with the exception of cardiovascular problems where numbers of deaths were divided almost evenly between white and black women. Most of the pregnancy-related deaths occurred among women aged 30-39 years for all four leading causes of death. With the exception of deaths due to cardiovascular problems, over half of the women in the other three groups were overweight or obese.

C-section was the most common mode of delivery for all four leading MMR causes of death and the majority of deliveries resulted in live infants. Deaths due to hypertension occurred over the first week after the termination of pregnancy (mean 8 days, median 5 days) while deaths due to hemorrhage, embolism and cardiovascular problems occurred much sooner (mean 3, 0.8 and 3 days and median 1, 1 and 1 days, respectively) (Table 19).

Assessment of care

Care and services provided in 38% of the deaths were deemed not in accordance with national professionally recognized standards or guidelines. The review team determined that a large percent of the instances where care was not in accordance to standards were preventable deaths (57%). By comparison, only 3% of the deaths that occurred in situations where care was in accordance with standards, were preventable (Appendix: Table 20).

Care not in accordance with standards

Table 21. NYS Pregnancy-related deaths 2006-2008, assessment of care relative to standards of care and number of deficiencies noted

Care according to standards			Care not in accordance to standards		
Deficiencies	Count of cases	Percent	Deficiencies	Count of cases	Percent
0	60	84.50	0	None	
1	10	14.08	1	14	29.78
2	1	1.40	2	4	8.51
3	0		3	15	31.91
4	0		4	10	21.27
5	0		5	2	4.25
6	0		6	2	4.25

Source: NYS MMR

Almost one third (30%) of cases where care was not in accordance with standards had only one deficiency documented, 9% had 2, one third had 3 deficiencies and 30% had 4 or more

deficiencies. In contrast, there were no deficiencies for cases with care in accordance with standards (85%) (Table 21).

Most deficiencies were noted at the physician, midwife or resident level (n=44), followed by System (n=27), Nursing (n=17), Hospital (n=16) and Support services (n=12). A review of the comments on physician deficiencies reported that, of these 44 pregnancy-related deaths, 23 women received inappropriate treatment, in 14 cases there was a delay in the administration of treatment and 13 women received an incomplete diagnosis. One example of inappropriate treatment was administration of a large bolus of magnesium sulfate using the internal jugular (a central line); a calcium antagonist which prevents the heart from contracting.

The comments on system deficiencies pointed to a lack of internal protocols for interdisciplinary teams (n=16) or a break in communication (n=14). Examples of system deficiencies in communication and protocols include absence of adequate communication protocol within the obstetrical team, no escalation in the case of acute respiratory failure and no consultation with maternal fetal medicine or pulmonary medicine.

Lack of communication was also reported as a problem in 9 out of 17 cases with a Nursing deficiency. A second Nursing deficiency reported was failure to recognize gravity of condition (8 of 17 cases). An example of nursing failure to recognize the gravity of condition included failure of an emergency department nurse to appreciate the significance of elevated blood pressure. The main hospital deficiency reported was lack of internal protocols (10 of 16 comments) such as inadequate procedures to deal with emergency situations like post-partum bleeding. Internally, hospitals were lacking effective internal policies and protocols in a number of critical aspects of health care delivery. There were instances where the triage and evaluation of patients was not done in a manner that ensured timely recognition of patients in critical condition. Multidisciplinary medical teams did not have clear leadership resulting in an uncoordinated treatment of the patients. Other factors contributing to substandard health care delivery were the absence of treatment plans for critically ill patients and the lack of timely reporting of test results to the medical team.

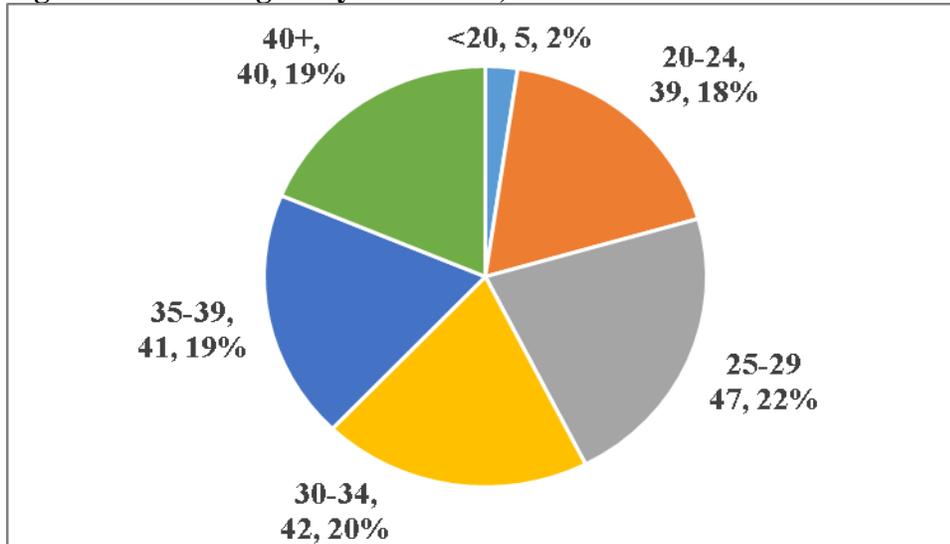
Patient deficiencies were recorded for a third of the pregnancy-related cases. Approximately half of these cases received care according to standards and half did not. The most frequent Patient deficiency reported was non-compliance with treatment (6 of 10 cases). Non-compliance with treatment was also reported in 10 cases with care that met the recognized standards. An example of patient non-compliance with treatment included failure of the patient to present for any prenatal care and failure of the patient to take prescribed antihypertension medication, where such care and medication might have prevented eclampsia, consequent cerebrovascular accident and maternal death.

Pregnancy-associated, not related deaths

A total of 215 pregnancy-associated maternal deaths, not related to the pregnancies were ascertained through death records linked to inpatient (85%) and outpatient (15%) hospital records with an indication of pregnancy (list of ICD codes available upon request). A large percentage (94, 44%) were originally included in the standard surveillance category and after a full IPRO review they were deemed as not pregnancy related. A total of 17 cases had obstetric ICD10 codes for cause of death.

More than half of the 215 pregnancy-associated, not related deaths occurred 42 days or longer from the end of the pregnancy (60%); 15 of these cases were also reported by NYPORTS. The 215 pregnancy-associated deaths were distributed uniformly across age groups of women 20 years and older (Figure 12).

Figure 12: NY Pregnancy associated, not related deaths 2006-2008 and age at time of death



Source: NYS MMR

The top six causes of death representing 72% of all pregnancy-associated, not related cases were cancer (25%), external causes of accidental injury (12%), auto accidents (11%), assault (9%), disease of the circulatory system (8%) and intentional self-harm (6%) (Table 22). The external causes of accidental injury included accidental poisoning by and exposure to narcotics and psychodysleptics (8), accidental poisoning by and exposure to other and unspecified drugs, medicaments and biological substances (10), exposure to uncontrolled fire in a building or structure (7) and one unspecified fall.

Table 22. NYS Pregnancy-associated, not related deaths 2006-2008 and causes of death

Cause of death	Count	Percent
Cancer	54	25.12
Other external causes of accidental injury	26	12.09
Auto accidents	24	11.16
Assault	20	9.30
Diseases of the circulatory system	18	8.37
Intentional self-harm	12	5.58
Other obstetric conditions, not elsewhere classified	8	3.72
Symptoms, signs and abnormal clinical and laboratory findings	6	2.79
Diseases of the respiratory system	5	2.33
Endocrine, nutritional and metabolic diseases	5	2.33
Event of undetermined intent	5	2.33
Diseases of the digestive system	4	1.86
Infectious and parasitic diseases	4	1.86
Disease of the blood and blood forming organs	3	1.40
Maternal disorders predominantly related to pregnancy	3	1.40
Complications of labour and delivery	2	0.93
Congenital malformations, deformations and chromosomal abnormalities	2	0.93
Diseases of the musculoskeletal system and connective tissue	2	0.93
HDP	2	0.93
Mental and behavioural disorders due to multiple drug use and use of other psychoactive substances	2	0.93
Mental and behavioural disorders due to use of alcohol	2	0.93
Mental and behavioural disorders due to use of cocaine	2	0.93
Complications predominantly related to the puerperium	1	0.47
Diseases of the genitourinary system	1	0.47
Diseases of the nervous system	1	0.47
Pregnancy with abortive outcome	1	0.47
Total	215	100

Source: NYS MMR

IV. Summary

Maternal mortality review identified 125 pregnancy-related and 215 pregnancy-associated, not pregnancy-related deaths from 2006 to 2008.

Pregnancy-related deaths

The majority of women in the pregnancy-related deaths cohort were in their thirties (55% were 30-39 years old) and on average they were two years older when compared to women in the 2009 live births cohort.

Black women comprised 46% of the pregnancy-related deaths cohort, followed by White (18%) and Asian (10%). The majority of women were non-Hispanic (60%); 19% of women were Hispanic and for 21% the ethnicity was unknown. Almost half of them were at an unhealthy weight: 30% were obese, that is a BMI of 30 or more; and 15% were overweight (BMI from 25 to 30). The most common health insurance coverage was Medicaid (45%) and private insurance (34%).

The largest proportion of pregnancy-related deaths occurred among women with no previous live births (29.6%). As the number of previous live births increased, the number of deaths decreased. Hospital clinics were the most common facility providing prenatal care (46%), followed by private offices (20%), and high risk clinics (13%). Obstetricians were the most common prenatal care providers (67%). Only 20% of pregnancy-related deaths were referred for high-risk care and most of them (88%) followed up on these referrals and received high-risk care.

A quarter of the women in pregnancy-related deaths cohort received adequate prenatal care as defined by Kotelchuck's graduated index of prenatal care, 27% received intermediate and 6% received intensive prenatal care. More than a third of cases received no prenatal care or had missing information.

One third of women in the pregnancy-related deaths cohort had no documented risk factors. Ten percent of women in the pregnancy-related death cohort smoked during pregnancy and 6% used illicit drugs. The majority of the pregnancy-related deaths (78%) had no prior hospitalizations during the index pregnancy. When documented, hospitalizations occurred in the 2nd (39%) and 3rd trimesters (39%) of the pregnancy.

The majority of the women in the pregnancy-related deaths cohort (76%) delivered at a level 3 hospital or at a Regional Perinatal Center. Cesarean sections represented 63% of the deliveries with half of them being emergent. Normal vaginal deliveries constituted the minority of deliveries (17%). Over 12% of women died undelivered. However, 70% of the reported outcomes for these pregnancies were live singleton infants.

Among women in the pregnancy-related deaths cohort, hemorrhage and hypertensive disorders were the most commonly documented complications during labor and delivery and postpartum period. In addition, during postpartum period acute respiratory distress syndrome and infection were each reported in 8% of the cases.

Psychosocial assessment was conducted and reported for 26% of of the women in the pregnancy-related deaths cohort. The most frequent reported issues were noncompliance with treatment (28% of cases), depression (12%), homelessness (12%), and mental illness (9%).

The leading causes of death for women in the pregnancy-related deaths cohort were hemorrhage (23%), hypertension (23%), embolism (17%), and cardiovascular problems (10%). Deaths due to hypertension occurred over the first week after the termination of pregnancy (mean 8 days, median 5 days) while deaths due to hemorrhage, embolism and cardiovascular problems occurred much sooner (mean 3, 0.8 and 3.3 days and median 1, 1 and 1 day, respectively).

Care and services provided for 38% of the women in the pregnancy-related deaths cohort were deemed not in accordance with national professionally recognized standards or guidelines; a large percentage of the instances where care was not in accordance to standards were preventable deaths (57%). Most deficiencies were noted in the physician, midwife or resident area and included inappropriate treatment, delay in treatment administration, and incomplete diagnosis.

Pregnancy-associated deaths

There were a total of 215 pregnancy-associated deaths; 60% occurred 42 days or longer after the end of the pregnancy. With the exception of women 20 years old or younger, the pregnancy-associated deaths were evenly distributed among women of all ages. The leading causes of death representing 72% of all cases were cancer (25%), external causes such as accidental poisoning and exposure to fire (12%), motor vehicle accidents (11%), assault (9%), diseases of the circulatory system (8%), and self-harm (6%).

The findings shared in this report represent a contribution to the existing growing body of information on maternal mortality. Other states and nations share their findings from maternal mortality review data and the ensuing implications for public health action, maternal mortality surveillance and research. To date, in NYS the maternal mortality findings informed the development of the Hypertensive Disorders during Pregnancy Guidelines⁹ and point of care tools for providers.

It is anticipated that this report and the results of future MMR reports will inform the development and implementation of additional public health interventions to reduce maternal deaths in New York State.

⁹ Available online at <http://www.health.ny.gov/professionals/patients/women.htm>

Glossary of acronyms

ACOG American Congress of Obstetricians and Gynecologists

ARDS Acute respiratory distress syndrome

HD hypertensive disorders

HDP hypertensive disorders of pregnancy

ICD9 is an acronym for "International Statistical Classification of Diseases and Related Health Problems 9th Revision." This ninth edition is a publication from the World Health Organization comprising a set of codes that are used worldwide to classify diseases and injuries.

ICD10 is the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD), a medical classification list by the World Health Organization (WHO). The WHO copyrighted ICD-10 in 1990. Since then, countries around the world have adopted it to report mortality and morbidity. The United States began using it in 1999 to report mortality only. It codes for diseases, signs and symptoms, abnormal findings, complaints, social circumstances, and external causes of injury or diseases.

Maternal death is defined by the World Health Organization as “the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes.”

MMR is the Maternal Mortality Review initiative led by the New York State Department of Health.

NYC designated the five boroughs of New York City.

NYPORTS is the New York Patient Occurrence and Reporting and Tracking System, a statewide mandatory reporting system that collects information from hospitals and diagnostic treatment centers concerning adverse events defined as unintended, adverse and undesirable developments in a patient’s condition. The maternal deaths are one of the 31 occurrences reportable to NYPORTS.

NYSHIP Prevention Agenda 2013-2017: New York’s State Health Improvement Plan

PHHPC New York State Public Health and Health Planning Council

Pregnancy-related death is defined as the death of a woman while pregnant or within a year from termination of pregnancy, occurring as result of a pregnancy-related illness (i.e. preeclampsia) or as a result of an underlying illness exacerbated by the physiology of pregnancy (i.e. mitral stenosis.)

Pregnancy-associated, not related death is defined as the death of a woman while pregnant or within one year of termination of pregnancy from any cause, not as a cause of pregnancy or illness exacerbated by pregnancy (i.e. motor vehicle accident.)

ROS designates all the counties in New York State except the five boroughs of New York City.

SPARCS is the Statewide Planning and Research Cooperative System, a comprehensive data reporting system established in 1979 as a result of cooperation between the health care industry and government. Initially created to collect information on discharges from hospitals, SPARCS currently collects patient level detail on patient characteristics, diagnoses and treatments, services, and charges for every hospital discharge, ambulatory surgery patient, and emergency department admission in New York State.

SPDS is the Statewide Perinatal Data System. This is the electronic maternal and newborn data collection and analysis system established and maintained by the Department of Health which includes the data elements, organized in modules, which comprise the New York State

Certificate of Live Birth for births occurring in New York State outside of New York City, or the New York City Certificate of Live Birth for births occurring in New York City, and other data elements which relate to maternal and newborn health and care in hospitals and free-standing birthing centers.

Surveillance:

- **Standard surveillance** cases consist of female deaths linked to a live birth and there is less than a year between the two events.
- **Enhanced surveillance** cases consist of female death records not linked to a live birth certificate that occurred within a year after a hospitalization with indication of pregnancy (SPARCS), or an obstetric cause of death or pregnancy at time of death were indicated on the death certificate. NYPORTS cases not captured under standard surveillance are also included in the enhanced surveillance. The hospital records with indication of pregnancy from SPARCS are identified using a broad list of ICD-9 codes for pregnancy related diagnosis and procedure codes (list available upon request).

V. Appendix

Composition of NYS Maternal Mortality Review Committee

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Table 2. NYS pregnancy-related deaths 2006-2008 by race and ethnicity of mother

		Count	Percent
Race, N=125	Asian	12	9.60
	Black	57	45.60
	Native Hawaiian or Other Pacific Islander	1	0.80
	Other	10	8.00
	Unknown	22	17.60
	White	23	18.40
Ethnicity, N=125	Hispanic or Latino	24	19.20
	Not Hispanic	75	60.00
	Unknown	26	20.80

Source: NYS MMR

Table 3. NYS Pregnancy-related deaths 2006-2008 and number of previous live births

Parity	Count	Percent
No previous live births	37	29.60
1	32	25.60
2	19	15.20
3	12	9.60
4	5	4.00
5	3	2.40
6	1	0.80
9	1	0.80
Unknown	15	12.00
Total	125	100.00

Source: NYS MMR

Table 7a. NYS Pregnancy-related deaths 2006-2008 and number of prenatal medications reported

Number of medications reported	Count of cases	Percent
1	55	57.89
2	20	21.05
3	16	16.84
4	1	1.05
5	3	3.16

Source: NYS MMR

Note: Out of 125 pregnancy-related cases, prenatal medications were reported for 95 cases.

Table 7b. NYS Pregnancy-related deaths 2006-2008 and types of prenatal medications reported

Types of medication	Frequency	Percent
Dietary supplements	45	27.78
Prenatal vitamins	38	23.46
Antihypertensive	13	8.02
Antibiotics	9	5.56
Anticoagulant	8	4.94
Insulin	7	4.32
Iron	5	3.09
Antidepressant/Anxiolytic	4	2.47
Corticosteroid	4	2.47
Thyroid/Antithyroid	4	2.47
Antihistamine	3	1.85
Bronchodilators	3	1.85
Analgesic	2	1.23
Antifungal	2	1.23
Antiviral	2	1.23
Folic acid	2	1.23
Anticonvulsants	1	0.62
Antidiarrheal	1	0.62
Antimalarial	1	0.62
Bile acid	1	0.62
Complementary/Alternative	1	0.62
Hormones	1	0.62
Immunosuppressant	1	0.62
Iron chelator	1	0.62
Narcotic (rx)	1	0.62
None	1	0.62
Tocolytics	1	0.62

Source: NYS MMR

Table 7c. NYS Pregnancy-related deaths 2006-2008 and indications for medications reported

Indication	Frequency	Percent
Pregnancy	74	49.01
Hypertension	12	7.95
Infection	10	6.62
Diabetes	7	4.64
Asthma	5	3.31
DVT	4	2.65
Lupus	4	2.65
Anemia	3	1.99
Maternal Cardiac Disease	3	1.99
Thyroid	3	1.99
Unknown	3	1.99
Allergies	2	1.32
Beta thalassemia	2	1.32
Immuno Suppressant	2	1.32
Pain management	2	1.32
Stool softener	2	1.32
Contraceptive	1	0.66
Depression	1	0.66
Rash during 10/3/2008 prenatal visit	1	0.66
Sickle Cell Pain	1	0.66
Anticoagulant	1	0.66
Cholestasis	1	0.66
Depression	1	0.66
History of prior clots	1	0.66
Prescribed for abnormal vaginal discharge and itching	1	0.66
Psych D/O	1	0.66
Seizures	1	0.66
Supplement	1	0.66
Vitamins	1	0.66

Source: NYS MMR

Table 9. NYS Pregnancy-related deaths 2006-2008 and provider-identified risk factor categories

Risk factor category	Count, %
Hematologic	29, 19%
Anemia	14
Sickle cell disease	7
Other hematologic	6
Coagulation disorder	1
Iron deficiency anemia	1
Hypertension	26, 17%
Cardiac	20, 13%
Other cardiac	11
Mitral valve prolapsed	4
Congenital heart defect	3
Cardiac I or II	1
Cardiac III or IV	1
Pulmonary	13, 9%
Asthma	9
Other pulmonary	2
Tuberculosis	2
Endocrine	12, 8%
Thyroid disorder	6
Type I diabetes	3
Type II diabetes	1
Other endocrine	2
Psychiatric disorder	8, 5%
Other	44, 29%
Other	17
History of embolism	6
Uterine abnormality or incompetent cervix	6
Homeless	4
Other neurologic	4
History of drug addiction	2
Rh sensitized	2
Epilepsy/seizure disorder	1
Renal disease	1

Source: NYS MMR

Table 14. NYS Pregnancy-related deaths 2006-2008 and number and types of anesthesia for labor and delivery

How many types of anesthesia administered	Count	Percent
Unknown	6	4.80
0	28	22.40
1	83	66.40
2	8	6.40
Types of anesthesia reported	Count	Percent
General	37	29.13
Epidural	32	25.20
None	28	22.05
Spinal	22	17.32
Unknown	3	2.36
IV/IM or oral analgesia/sedation	2	1.57
Combined Spinal Epidural Anesthesia	1	0.79
Local	1	0.79
Other	1	0.79

Source: NYS MMR

Table 15. NYS Pregnancy-related deaths 2006-2008 and pregnancy outcomes

Pregnancy outcomes	Number of cases it was reported	Percent
Live delivery: singleton	89	69.53
Undelivered (died pregnant)	13	10.16
Stillborn(s)	8	6.25
Ectopic pregnancy	4	3.13
Live delivery: multi fetal gestation	3	2.34
Spontaneous abortion	3	2.34
Induced abortion	3	2.34
Live delivery and stillbirth (multiple gestation)	2	1.56
Unknown	2	1.56
Missing	1	0.78
Total	128	100

Source: NYS MMR

Table 16b. NYS Pregnancy-related deaths 2006-2008: Postpartum complications by type of delivery

Type of delivery	Number of complications reported				
	1	2	3	5	Total N, %
Missing	0	1	0	0	1 1.2
Undelivered	1	0	1	0	2 2.5
NSVD	10	6	2	0	18 22.2
Operative vaginal delivery	0	0	0	1	1 1.2
C-section: elective/scheduled	9	2	0	0	11 13.6
C-section: unscheduled non-emergent	5	4	5	0	13 16.0
C-section: emergent	13	14	4	0	31 38.3
Other	2	1	0	0	3 3.7
Total N, %	40 49.4	28 34.6	12 14.8	1 1.2	81 100.00

Source: NYS MMR

Table 17. NYS Pregnancy-related deaths 2006-2008 and type of delivery for women who received blood products postpartum

Type of delivery	Count of cases	Percent
Missing	1	1.82
Undelivered	2	3.64
NSVD	11	20.00
Operative vaginal delivery	1	1.82
C-section: elective/scheduled	9	16.36
C-section: unscheduled non-emergent	8	14.55
C-section: emergent	20	36.36
Other	3	5.45
Total	55	100

Source: NYS MMR

Table 20. NYS Pregnancy-related deaths 2006-2008 and assessment of care relative to standards of care and preventable or not preventable death

Preventable death	Care according to standards			
	Not in accordance to standards	In accordance to standards	Missing	Total
Count of cases				
Percent of total				
Percent of preventable category				
Percent of care category				
Preventable	27	2	1	30
	21.60	1.60	0.80	24.00
	90.00	6.67	3.33	
	57.45	2.82	16.67	
Not preventable	2	42	0	44
	1.60	33.60	0.00	35.20
	4.55	95.45	0.00	
	4.26	59.15	0.00	
Unknown	16	25	4	45
	12.80	20.00	2.40	36.00
	35.56	55.56	6.67	
	34.04	35.21	50.00	
Missing	2	2	2	6
	1.60	1.60	1.60	4.80
	33.33	33.33	33.33	
	4.26	2.82	33.33	
Total	47	71	7	125
	37.60	56.80	5.60	100.00

Source: NYS MMR

Technical notes

Data collection

The MMR data collection form can be used to abstract information from up to 8 sources: death certificate, autopsy report, delivery chart, mortality admission chart, NYPORTS and root cause analysis (RCA) from NYPORTS, prenatal chart and an additional source that can be written in. No case had all 8 sources of information available for review. Only one case had 7 different sources of information available. Thirty-three percent (33%) of cases had 3 sources, followed by 4 sources (26%) and 2 sources (21%).

The most common source of information available for review was the delivery chart (86%), followed by the infant birth certificate (70%), RCA (66%), prenatal chart (50%) and mortality admission chart (28%). Autopsy reports were available in 29% of the cases and hospitals were able to provide death certificates in 26% of the cases.

Data challenges

Out of the 626 deaths identified for surveillance 251 (40%) could not be investigated due to lack of information. These records were selected for review because one of the selection criteria was positive – obstetric cause of death in the death record, pregnancy checked on the death record, indication of pregnancy in the hospital record or linked death and birth records. The practical reasons the review could not be conducted included inability to locate medical records, delivery and/or mortality charts.

Data augmentation

The completeness of the MMR record is dependent on the case documentation available for review and data abstraction. The linked database used to develop the pool of potential maternal deaths for surveillance was a natural source to augment MMR clinical records.

Thus in order to minimize the influence of missing values on the analysis and interpretation of the MMR data, the Statewide Perinatal Data System (SPDS) values were used for missing values in fields that overlap between MMR and SPDS. The fields augmented included employment, occupation, education, weight and height, marital status and prenatal care.

Employment status and occupation were augmented using information from the linked birth record thus reducing the percent of unknown on employment status from 46% to 14% and on occupation from 38% to 31%. Data augmentation with SPDS values reduced percent of unreported education from 67.2% to 48%.

Due to the large amount of missing information on the prenatal care record collected during the chart review (trimester of pregnancy when prenatal care was initiated was missing for 35%, 44/125 of the cases and number of prenatal visits was missing for 40%, 50/125 or was totally absent for 9%, 11/125 of the cases) the surveillance data was augmented using prenatal care fields from the birth record. This reduced the missing data on the trimester of the initiation of prenatal care to 23%, 29/125 and on the number of prenatal visits to 20%, 25/125; the number of women with no visits increased to 10%, 13/125.

Pre-pregnancy weight and height were available for less than half of the pregnancy-related cases (51 out of 125, 41%). Using data from the birth record and physician's notes found in the medical chart reduced the unknown values for BMI from 59% to 35%.

Proxy for weight

Body mass index (BMI) defined as weight divided by height squared was used to derive weight status (thin, normal, overweight and obese). When values on the MMR record were missing, BMI was calculated using values from the birth record. Physician's notes from the medical record on the patient's obesity status were also used when available.

Reference population

The 2009 live births file was used as a proxy for a reference population. Selected characteristics of women in the pregnancy-related cohort were compared to all women who delivered live infants. Differences in the distributions focused further analyses on factors that influenced the course of pregnancy-related deaths. The year 2009 was chosen for convenience as it was the first year when the birth files for both upstate and New York City collected the information in the same format so it simplified the development of a comprehensive state file.