A blue silhouette of a pregnant woman is shown in profile, facing right. She is holding her belly with her right hand. The background is a light blue gradient with a faint image of a window with blinds.

New York State Maternal Mortality Review Report

2012-2013

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Department
of Health

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Executive Summary

A recent report released by America's Health Rankings® ranked New York State (NYS) 30th in the nation for its maternal mortality rate[1]. Although this represents an improvement over its ranking of 46th in 2010 [2], the NYS' 2013-2015 maternal mortality rate is 1.8 times the Healthy People 2020 target. Racial disparities remained significant with recent data (2013-2015) showing New York State black women are almost four times more likely to die in childbirth than white women.

Since its inception in 2010, the Maternal Mortality Review Initiative (MMR) 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 2013-2018: 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 2018.

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 provides 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 (NYPORTS).

Once maternal deaths are identified, each 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 New York State Department of Health (the Department) established an 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

- The MMR identified 62 pregnancy-related and 104 pregnancy-associated, not related deaths from 2012 to 2013.
- A 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-Hispanic, delivered in a Level 3 hospital or Regional Perinatal Center, delivered by cesarean section, and had no previous live births.
- Black and white women contributed equally to the 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 embolism (29%), hemorrhage (17.7%), infection (14.5%) and cardiomyopathy (11.3%).

- The leading causes of pregnancy-associated deaths were injury (51.9%), cancer (8.7%), generalized septicemia (5.8%), and cardiac arrhythmia (4.8%). Of the deaths caused by injuries, substance overdose (26.0%) and suicide (22.3%) were the top reported injuries.
- The care and services for 17.7% of the women in the pregnancy-related deaths cohort were deemed as not in accordance with national professionally recognized standards after review.

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 days 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 (e.g. 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 led to it; this term includes live births (vaginal deliveries and cesarean sections), spontaneous and induced abortions.

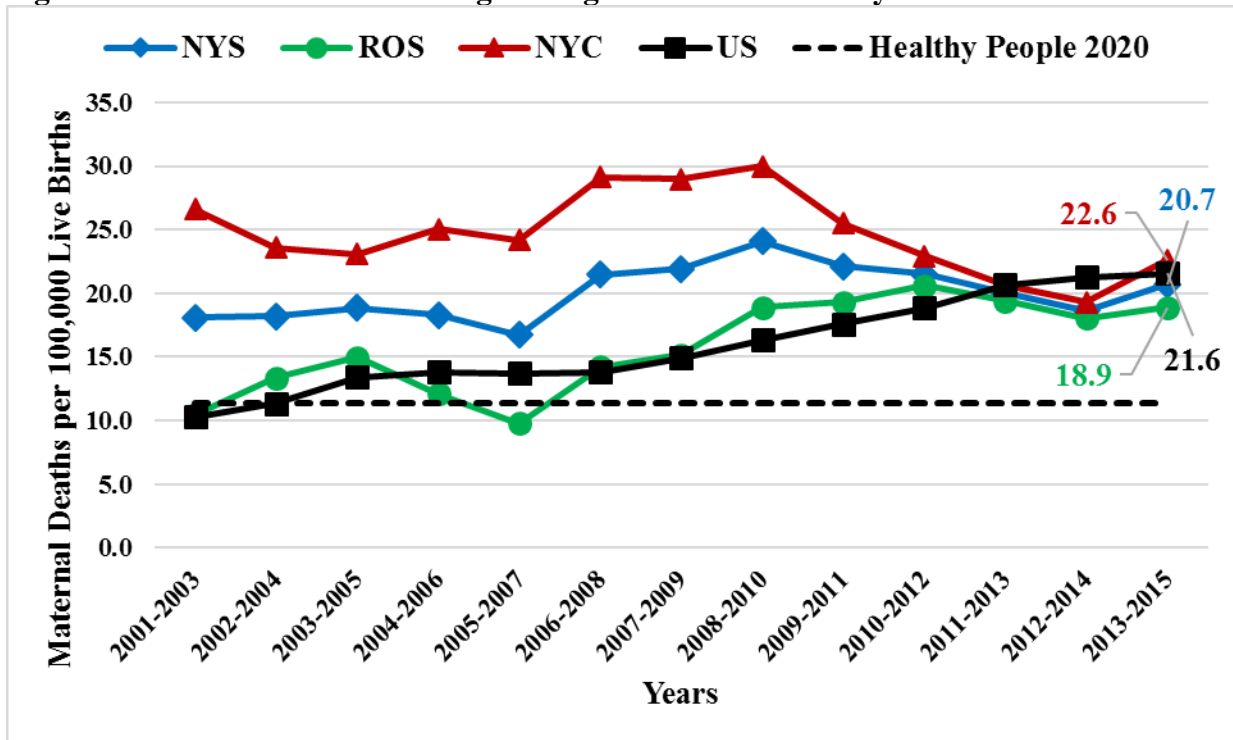
Revised graduated index of prenatal care utilization is a measure of the adequacy of prenatal care provided to a woman by healthcare providers during the prenatal period. The index is "useful for research focusing on birth outcomes and for monitoring trends in the proportion of cases with intensive use of prenatal care"[3]. It relies on case-specific prenatal care information, including the number of prenatal visits, gestational age of the newborn, and the date when prenatal care began.

I. Background

A recent report released by America’s Health Rankings® ranked New York State (NYS) 30th in the nation for its maternal mortality rate[1]. Although this represents an improvement over its ranking of 46th in 2010 [2], the NYS’ 2013-2015, maternal mortality rate of 20.7 deaths/100,000 live births is 1.8 times the Healthy People 2020 target of 11.4/100,000. Racial disparities remained significant with the 2013-2015 rate among black women (54.6/100,000) almost four times that for white women (15.3/100,000).

The maternal mortality rate in NYS peaked at 24.1 per 100,000 live births in 2008-2010 and has decreased to 18.7 per 100,000 live births in 2012-2014 (Figure 1a), but increased to 20.7 in 2013-2015. The difference in maternal mortality rates between New York City(NYC) and the Rest of the State (ROS) was smallest in 2011-2013. The difference increased in 2013-2015 with the NYC rate of 22.6 surpassing the national rate of 21.6.

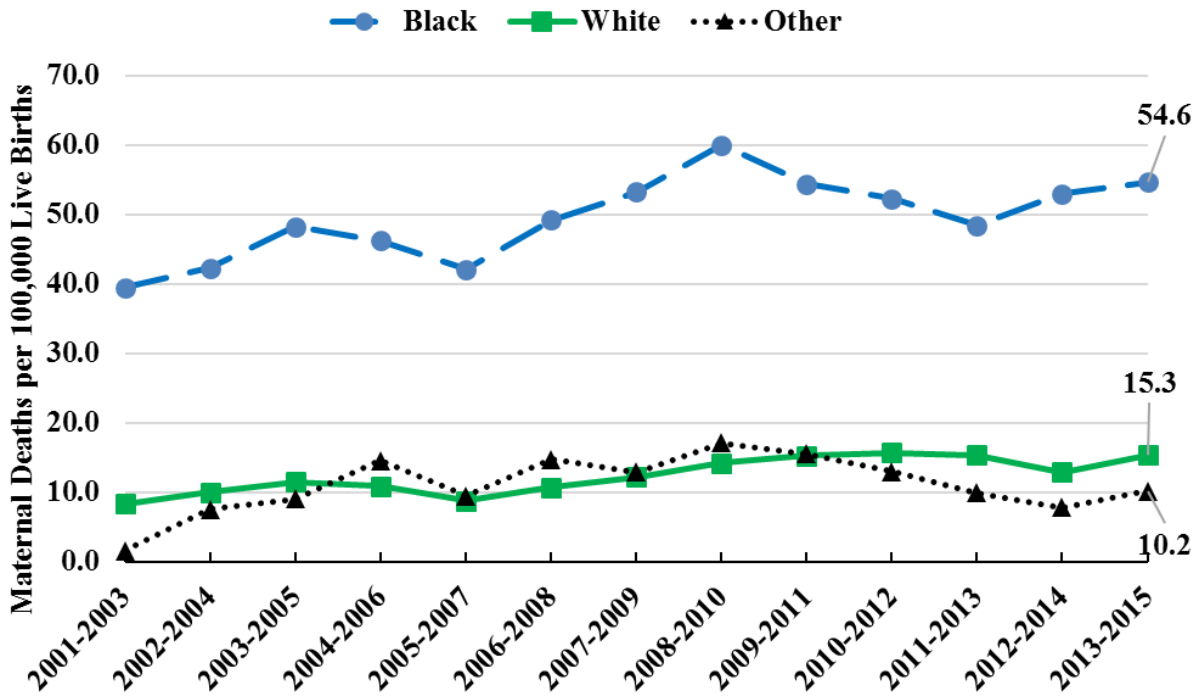
Figure 1a. NYS Three-Year Rolling Average Maternal Mortality Rate



Source: NYS Vital Statistics, CDC Wonder Database

Racial disparities in maternal deaths are persistent; the statewide black to white mortality ratio varied between 4.8 to 1 in 2005-2007 and 3.2 to 1 in 2011-2013 (Figure 1b). Most recent data showed that geographic differences are minimal. In New York City, the black to white ratio decreased from 12.2 in 2007-2009 to 3.4 in 2013-2015. This decrease in the black to white ratio was due to a slight increase in the maternal mortality rate among white women while the rate remained stable among black women (Appendix: Figure 1c). In the ROS the black to white ratio peaked in 2013-2015 at 3.9 to 1.

Figure 1b. NYS Three-Year Rolling Average Maternal Mortality Rate by Race



Source: NYS Vital Statistics

The MMR committee was convened by the Department and included representation from the following professional organizations and associations: The New York Academy of Medicine, American Congress of Obstetricians and Gynecologists (ACOG), NYS Nurses Association, NYS Association of Licensed Midwives, NYS Academy of Family Physicians, New York City Department of Health and Mental Hygiene, New York City Office of the Chief Medical Examiner, Association of Regional Perinatal Programs and Networks, NYS Office of Alcoholism and Substance Abuse, Medical Society of the State of New York, NYS Society of Anesthesiologists, Inc., NYS Dietetic Association, Greater New York Hospital Association, Healthcare Association of NYS, and Regional Perinatal Centers. 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, 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 who died within one year (365 days) from termination of pregnancy. The cases include:

- maternal death certificates linked to a live birth or a fetal death certificate;
- 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,
- 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, 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. The New York State Maternal Mortality Review Data Collection Form is available upon request.

The current MMR 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 nurse reviewer, the completed tool is sent to an independent obstetrician credentialed by IPRO 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 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 2012-2013 deaths.

III. Findings from the 2012-2013 Cohort

Case identification

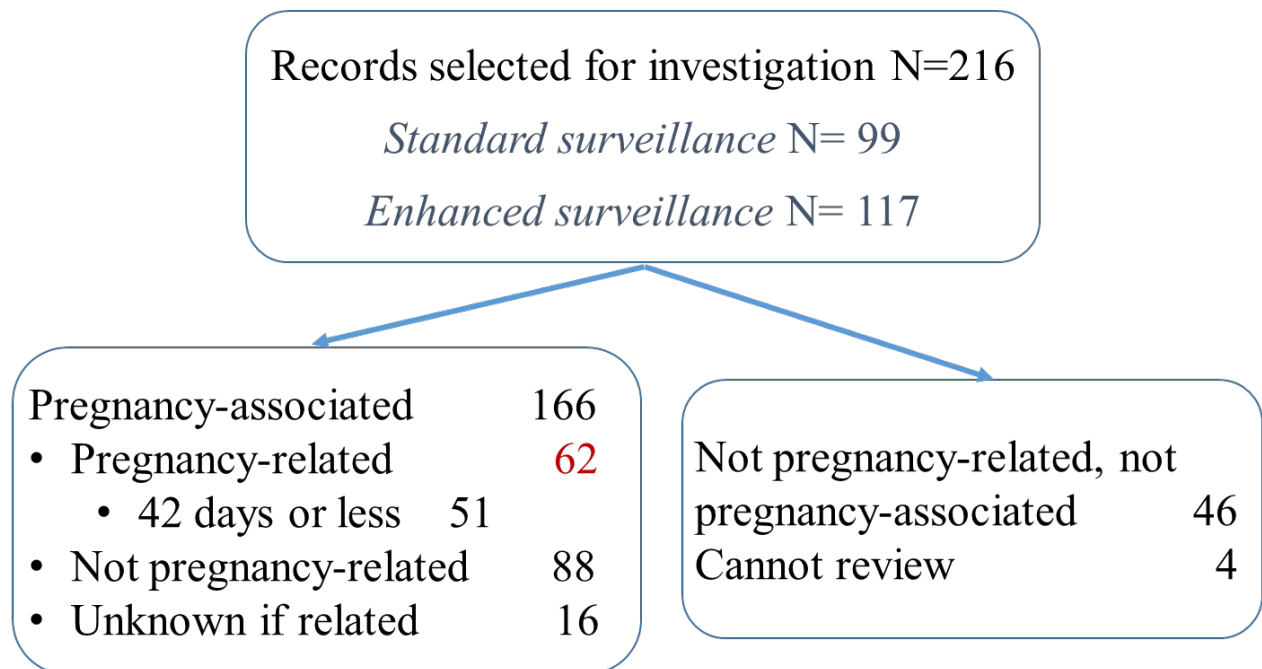
Death records of 10-55 year old females from 2012-2013 were linked to 2011-2013 birth records to identify the standard surveillance cases. Under standard surveillance, a total of 99 potential maternal deaths were identified (Figure 2).

Enhanced surveillance yielded 117 additional records of 10-55 year old females who 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 62 pregnancy-related deaths, 88 pregnancy-associated, not related deaths and 16 where it was unknown if the deaths were related to the pregnancy. Four cases could not be reviewed due to lack of information (medical records could not be obtained from the storage facility for one death and three deaths occurred outside of a hospital).

More pregnancy-related deaths were identified through standard surveillance: 48 identified through standard surveillance and 14 identified through enhanced surveillance. Most pregnancy-related deaths were maternal deaths (51 out of 62 deaths).

Figure 2. NYS surveillance of pregnancy associated deaths, 2012-2013



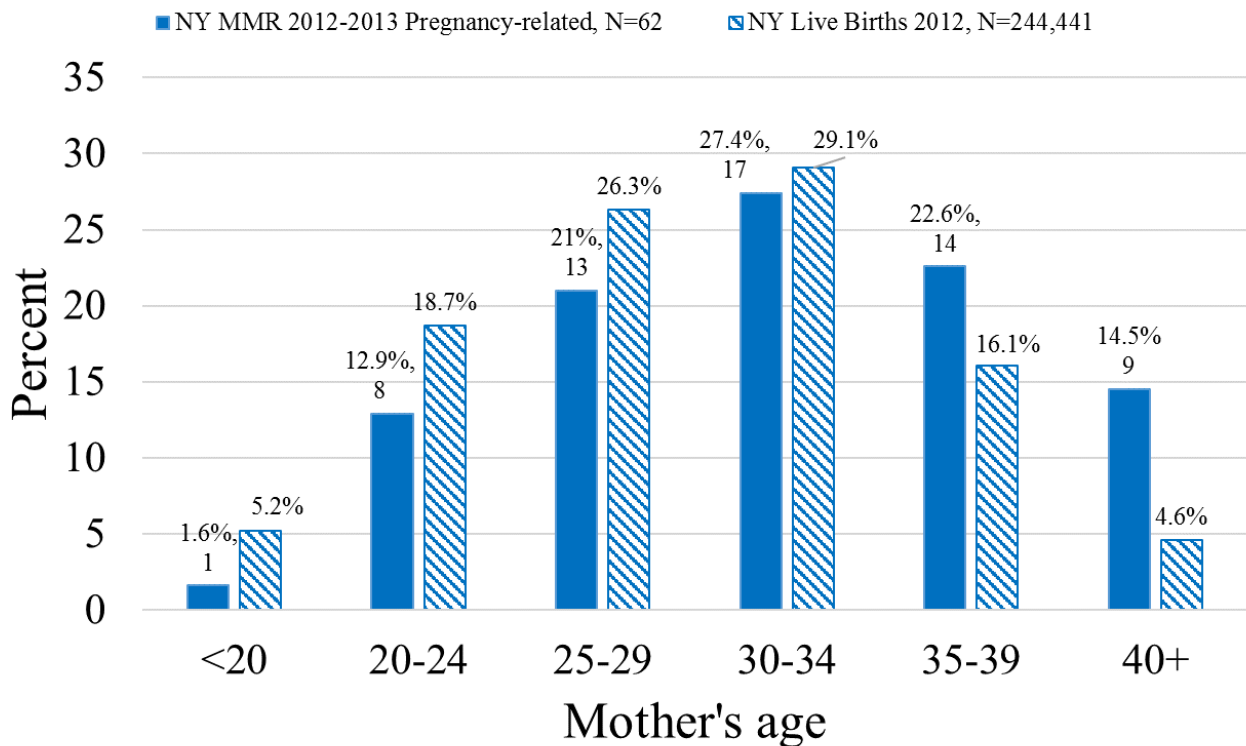
Source: NYS MMR

Pregnancy-related deaths

Demographics

Half (50%) of the 62 women in the 2012-2013 pregnancy-related death cohort were 30-39 years old. Equal percentages were 40 years or older (14.5%) and 24 years old or younger (14.5%) Women over 40 years old were overrepresented in the pregnancy-related deaths cohort. Almost fifteen percent of deaths were in women over 40 years old while only 4.6% of the births were to women over 40 years old (Figure 3, Table 1).

Figure 3. NYS live births 2012 and pregnancy-related deaths 2012-2013 by age of mother

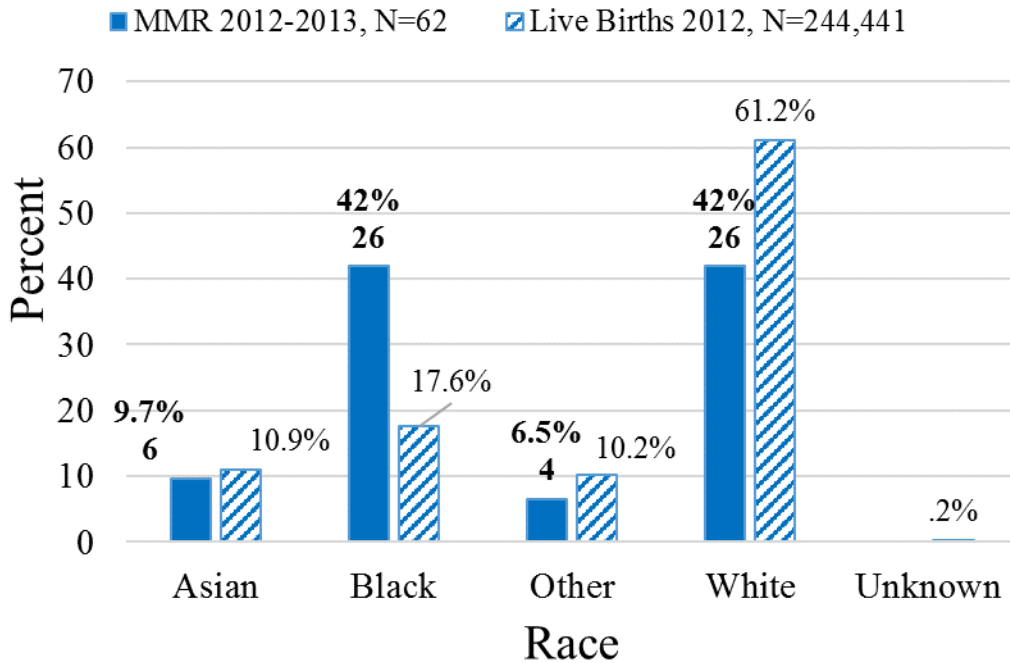


Source: NYS MMR and NYS Vital Statistics

The race distributions of live births and pregnancy-related deaths showed that black and white women contributed equally (42% of the deaths) to the pregnancy-related death cohort. Since births to black women represent only 17.6% of the live births in New York State, 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 and white women each comprised 42% of the pregnancy-related cohort, followed by Asian women (10%) and Other (6.5%). 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).

A majority of women in the pregnancy-related deaths cohort were non-Hispanic (72.6%). Eleven percent of women were Hispanic and for 10%, the ethnicity was unknown (Appendix, Table 2).

Figure 4: NYS live births 2012 and pregnancy-related deaths 2012-2013, 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 most women (70.9%) and almost half of them were employed during the index pregnancy (45.2%, Table 1). Occupation was known for 82.3% of women in the pregnancy-related death cohort. The occupations most frequently reported included service/housekeeper/child care (14.5%), professionals (11.3%), and homemaker (9.7%) (Table 1).

The pregnancy-related death cohort was comprised of women of all levels of educational attainment. Almost a third of the women graduated from high school (29%) followed by women with 8 years or less of school (14.5%), women who completed 9th-12th grade but no diploma (12.9%) and women with Bachelor’s degree (12.9%). Women with other advanced education (some college, Associate, Master or Doctorate degrees) represented less than one fifth of the cohort (19.3%) (Table 1).

The majority of women in the pregnancy-related death cohort were on Medicaid (67.7%) with far fewer on private insurance (22.3%) (Table 1).

Primary language was reported as English for most women in the pregnancy-related death cohort (64.5%). Primary language was unknown for 12.9% and another language for the remaining 22.3%.

There was an even distribution between women in the pregnancy-related cohort who were single 48.4% and women who were married 48.4%. Marital status was unknown for the remaining 3.2% of the cohort.

Table 1. NYS pregnancy-related deaths 2012-2013 and maternal demographic characteristics

Pregnancy-related deaths, N=62	Count	Percent
Age at death in years		
<20	1	1.6
20-24	8	12.9
25-29	13	21.0
30-34	17	27.4
35-39	14	22.6
40+	9	14.5
Employment		
Unemployed	16	25.8
Employed	28	45.2
Unknown	18	29.0
Occupation		
Unemployed	18	29.0
Service/Housekeeper/Childcare	9	14.5
Professional/Management	7	11.3
Homemaker	6	9.7
Other	5	8.2
Sales/Administrative support	4	6.5
Student	2	3.2
Unknown	11	17.7
Education		
8 th grade or less	9	14.5
9 th -12 th grade, no diploma	8	12.9
High school graduate or GED	18	29.0
Some college credit, but no degree	5	8.1
Associate degree	2	3.2
Bachelor degree	8	12.9
Master degree	3	4.8
Doctorate/professional degree	2	3.2
Unknown	7	11.3
Health insurance		
Medicaid	42	67.7
Private insurance	14	22.6
CHAMPUS/TRICARE	1	1.6
Self pay	1	1.6
Unknown	4	6.5

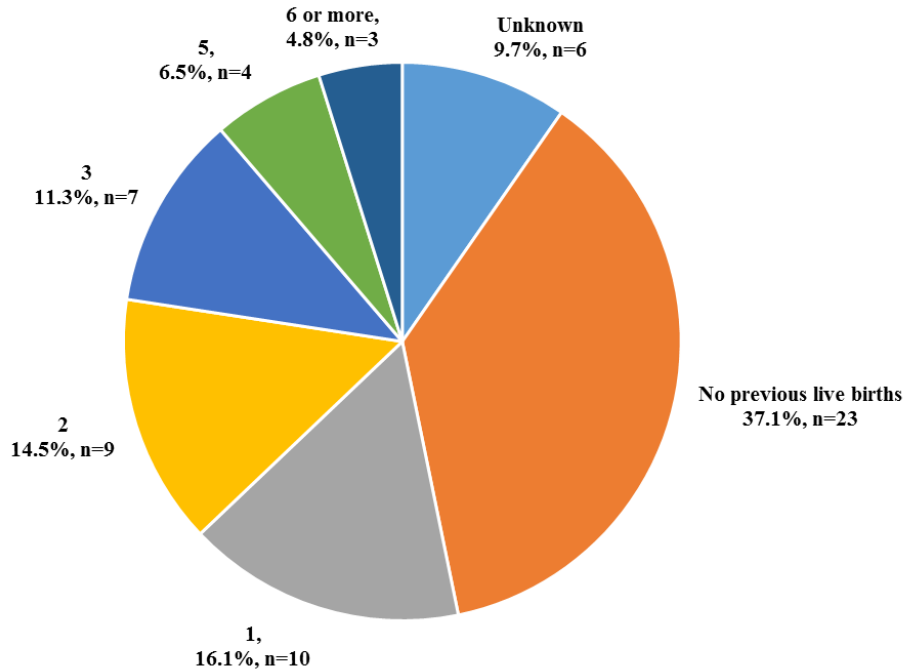
Source: NYS MMR

Prenatal history

Previous live births

Thirty-seven percent (37%) 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 43 of the 62 women in the pregnancy-related death cohort. In most of the cases, only one facility was reported as providing prenatal care (59.7%); in 9.7% of cases two health care facilities were reported and the facility was unknown or was not reported for the remaining 30.7% of the cases. Hospital clinics were the most common facility providing prenatal care (64.9%) followed by private offices (24.3%) and neighborhood health centers (8.1%) (Table 4).

Table 4. NYS pregnancy-related deaths 2012-2013 and number and types of facilities providing prenatal care

Number of facilities	Count of cases	Percent of total, N=62	Specific source	Count of cases
Unknown	12	19.4%		
None	7	11.3%		
One	37	59.7%	Hospital clinic	24
			Neighborhood health center	3
			High-risk clinic	1
			Private office	9
Two	6	9.7%	Hospital clinic	5
			Neighborhood health center	1
			High-risk clinic	3
			Private office	2

Source: MMR Database

In the pregnancy-related death cohort, 22.6% of cases reported only one prenatal care provider; two providers were reported for 27.4% of the cases and three providers for 14.5%. No provider was reported for almost 6.5% of the cases. Provider information was unknown for 29% (18 out of 62) of the women in the cohort. Seven percent of the cohort had no prenatal care provider (6.5%, 4 out of 62). Obstetricians were the most common prenatal care providers (75%, 30 out of 40) followed by midwives (30.0%, 12 out of 40), perinatologists (22.5%, 9 out of 40) and nurse practitioners (22.5%, 9 out of 40) (Table 5).

The 17 pairs of providers for the cases with two prenatal care providers included an obstetrician working with a perinatologist (1 pair), an obstetrician working with a midwife (5 pairs), an obstetrician working with a nurse (3 pairs), or an obstetrician working with other specialty (5 pairs). Two pairs included a perinatologist working with a nurse or other specialty; one pair consisted of a family medicine physician working with a midwife (Appendix Table 5a). The 9 triads of providers for the cases with three prenatal care providers included 8 triads of an obstetrician working with a nurse or a midwife and a perinatologist. Only one triad did not include an obstetrician (Appendix Table 5a).

Six of the 62 cases received high-risk referrals. A total of 11 (17.7%) received high-risk care but only 5 of them had referrals documented in their records.

Table 5. NYS pregnancy-related deaths 2012-2013 and number and type of prenatal care providers

Number of providers reported	Count of cases	Percent of total, N=62	Specific source	Count of cases
Unknown	18	29.0%		
None	4	6.5%		
One provider	14	22.6%	Obstetrician	8
			Midwife	4
			Perinatologist	2
Two providers	17	27.4%	Obstetrician	14
			Midwife	6
			Nurse practitioner	4
			Perinatologist	3
			Family practice	1
			Other Resident	6 1
Three providers	9	14.5%	Obstetrician	8
			Nurse practitioner	5
			Perinatologist	4
			Midwife	2
			Other Cardiologist	8 1
			Dietician	1
			Physician assistant	1
Resident	1			
Diabetic educator	1			

Source: NYS MMR

Data was missing on the trimester of initiation of prenatal care for 25.8% (16) of the women in the pregnancy-related death cohort and on the number of prenatal visits for 24.2% (15).

The revised graduated index of prenatal care utilization[3] 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, over a third of women received adequate prenatal care (23, Table 6). Under a quarter of women were classified as intermediate (15), meaning that prenatal care was initiated during the first or second trimester but the number of visits was less than recommended. Only two women had intensive care, which means they had more visits than generally recommended. Eight percent (5) of women started prenatal care late and/or received fewer visits than recommended. They were classified in the inadequate prenatal care category. Three percent of the cases were classified as having no prenatal care because the number of visits was zero (2). For nearly a quarter (15) 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 2012-2013 and prenatal care utilization

Prenatal care	Count of cases	Percent
Adequate	23	37.1
Intermediate	15	24.2
Intensive	2	3.2
Inadequate	5	8.1
No prenatal care	2	3.2
Unknown	15	24.2
Total	62	100

Source: NYS MMR

A list of medication taken prenatally was reported for 51 out of the 62 women in the pregnancy-related death cohort. Of those with medications reported, almost twenty percent had one medication (19.6%, 10, Appendix: Table 7a). Two and three medications were reported for a quarter of women respectively. Most frequently reported medications were prenatal vitamins (29.0%), dietary supplements (21%) and antihypertensive drugs (8.6%). Other medications listed were antibiotics (4.9%), anticoagulants (4.3%), iron (4.3%), insulin (3.1%), inhalers (2.5%), narcotics (2.5%), oral hypoglycemic (2.5%), analgesics, antidepressants, and antifungals (1.9% each) (Appendix: Table 7b). The top four reasons for using the medications listed were pregnancy (36.7%), hypertension (8%), diabetes (5.6%), infection, sickle cell, supplements and urinary tract infections (3.7% each) (Appendix: Table 7c).

Provider-identified Risk Factors

There were no risk factors documented for 15% of the women in the pregnancy-related death cohort. Nearly one third of the women had one risk factor and a quarter had two risk factors (Table 8). On average 2.6 risk factors were reported for each woman. Obstetric history, defined as history of induced and/or spontaneous terminations of pregnancy, previous cesarean births and incompetent cervix, was the most frequent risk factor in the pregnancy-related death cohort (Table 10). Hematologic, cardiac, hypertension and pulmonary were the next most reported risk factors. Detailed counts are presented in Appendix: Table 9.

Except for cardiac risk, the highest occurring risk factors were documented mostly for black women. Cardiac risk was almost equally documented for both black and white women. Psychiatric disorders were documented more frequently for white women (Table 10). Hispanic women had noticeably fewer risk factors documented. (Table 10).

Table 8. NYS pregnancy-related deaths 2012-2013 and number of provider-identified risk factors

Number of risk factors	Number of cases
0	9 (14.5%)
1	18 (29.0%)
2	15 (24.2%)
3	9 (14.5%)
4	4 (6.5%)
5	2 (3.2%)
6	3 (4.8%)
8	1 (1.6%)
10	1 (1.6%)
137 risk factors reported	62 pregnancy-related cases

Source: NYS MMR

Table 10. NYS pregnancy-related deaths 2012-2013 and documented provider-identified risk factors by race and ethnicity

Risk factor category	Race				Ethnicity			Total N, % of maternal deaths
	Black	White	Asian	Other	Hispanic or Latino	Not Hispanic	Unknown	
Obstetric history	20	13	4	1	6	30	2	38, 61.3%
Hematologic	12	3	0	1	1	14	1	16, 25.8%
Cardiac	5	4	0	2	2	5	4	11, 17.7%
Hypertension	8	2	0	1	1	7	3	11, 17.7%
Pulmonary	6	4	1	0	4	7	0	11, 17.7%
Endocrine	6	4	0	0	0	6	4	10, 16.1%
Metabolic	5	2	1	1	3	5	1	9, 14.5%
Psychiatric disorder	2	5	0	0	3	4	0	7, 11.3%
Neurologic	2	3	0	0	0	5	0	5, 8.1%
Epilepsy/seizure	2	1	0	0	0	3	0	3, 4.8%
Other	22	14	3	3	3	33	6	42, 67.7%
Total	90	55	9	9	23	119	21	163*

Note: *Obstetric history was augmented from chart notes for 26 cases raising the total number of risk factors from 137 to 163.

Source: NYS MMR

Substance use

Substance use during pregnancy was infrequently reported. The seven women reported to have smoked prior to pregnancy continued to smoke during pregnancy. Of the seven women reported to have used alcohol prior to pregnancy, two continued during pregnancy.

Illicit drug use was noted for eight women prior to pregnancy and five of them continued during pregnancy. Drug dependency was reported for one woman who reported using drugs prior and during the pregnancy.

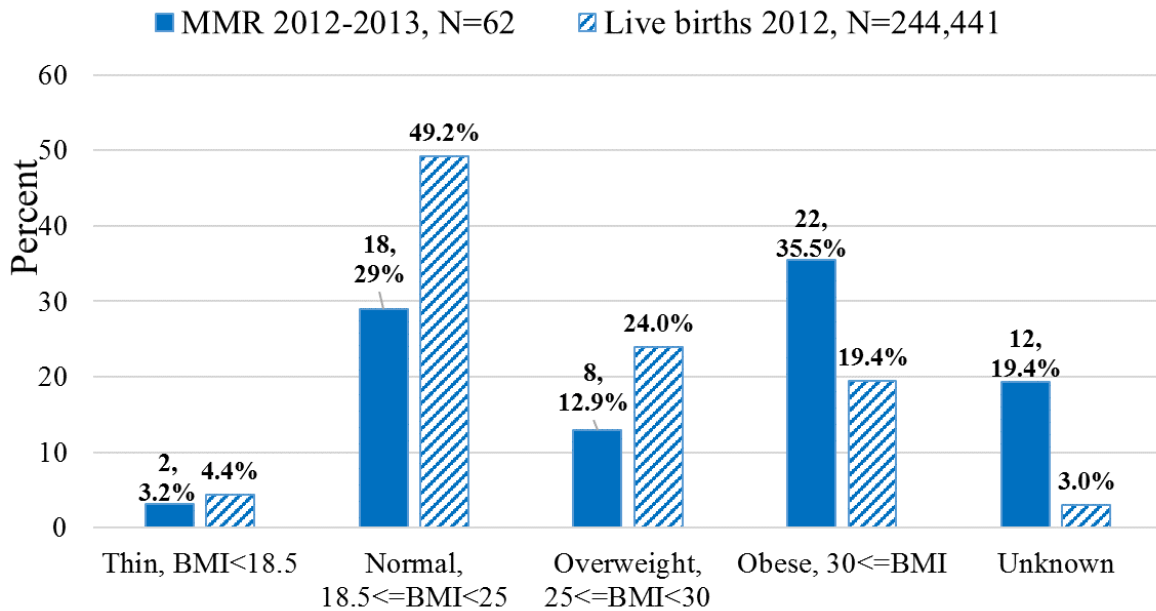
Weight status

Pre-pregnancy weight and height were available for 50 women in the pregnancy-related deaths cohort. Almost half of the cohort consisted of women with an unhealthy weight (35.5% were obese and 12.9% were overweight). A comparison with all women with live births in 2012

shows that obesity is almost twice (35.5% vs 19.4%) as prevalent in women in the pregnancy-related death cohort (Figure 6). These differences in weight status were significant ($p < .0001$).

The 22 women classified in the obese group had very high BMIs. BMI was known for 19 out of the 22 women and for these the average was 38.8 and median 38.3. The remaining 3 were classified as obese based on the physician’s notes found in the medical chart.

Figure 6. NYS live births 2012 and pregnancy-related deaths 2012-2013 by mother’s pre-pregnancy body mass index



Source: NYS MMR and NYS Vital Statistics

Intrapartum medical history

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

In most cases (59.7%, 37) the delivery or TOP occurred at a level 3 hospital (16, 25.8%) or a Regional Perinatal Center (21, 33.9%). A quarter of the deliveries or TOP occurred at level 1 or level 2 hospitals (Level 1: 7, 11.3% and Level 2: 10, 16.1%).

Type of delivery

More than half of the cases (66.1%, 41) were cesarean deliveries: emergent (32.3%, 20), followed by unscheduled non-emergent (16.1%, 10), elective scheduled (11.3%, 7) and peri- or post-mortem (6.5%, 4) (Table 11a). Half of all cesarean deliveries were emergent (48.8%, 20/41). Women with normal spontaneous vaginal deliveries (NSVD) represented 21% (13) of the pregnancy-related death cohort. Women who died prior to delivery represented 9.7% (6) of the women in the cohort. Type of delivery was unknown for one woman in the cohort (only the death record was available for review).

Table 11a. NYS pregnancy-related deaths 2012-2013 and type of delivery

Type of delivery	Count	Percent
Undelivered	6	9.7
NSVD	13	21.0
Cesarean section: elective/scheduled	7	11.3
Cesarean section: unscheduled non-emergent	10	16.1
Cesarean section: emergent	20	32.3
Cesarean section: peri- or post-mortem	4	6.5
Vaginal Birth After Cesarean (VBAC)	1	1.6
Unknown	1	1.6
Total	62	100%

Source: NYS MMR

The most frequent indications for cesarean delivery were fetal intolerance, maternal disease, malpresentation and preeclampsia. Indications were not reported for 10 of the 41 cesarean sections. Two indications were reported for seven cesarean deliveries and three for five cesarean deliveries. (Table 11b).

Table 11b. NYS pregnancy-related deaths 2012-2013 and indication for cesarean section delivery

Indication for Cesarean section	Count	Percent
Fetal intolerance	14	29.2
Maternal disease	11	22.9
Malpresentation	7	14.6
Preeclampsia	7	14.6
Hemolysis, Elevated Liver enzymes and low Platelet count (HELLP)	4	8.3
Failure to progress	2	4.2
Chorioamnionitis	1	2.1
Multiple gestation	1	2.1
Placental issues	1	2.1
Total	48	100%

Source: NYS MMR

Obstetric complications during labor and delivery

Table 12. NYS Pregnancy-related deaths 2012-2013 and complications during labor and delivery

Type of complication	Count	Percent
Hypertensive disorders	Preeclampsia	16
	HELLP syndrome	3
	Eclampsia	1
	Hypertension	7
	27	30
Gestational diabetes mellitus	9	10
Premature rupture of membranes	5	5.6
Amniotic fluid embolism	4	4.4
Fetal growth restriction	4	4.4
Hemorrhage	4	4.4
Chorioamnionitis	3	3.3
Prolonged rupture of membranes	3	3.3
Oligohydramnios	2	2.2
Polyhydramnios	1	1.1
Postmaturity	1	1.1
Premature labor	1	1.1
Uterine rupture	1	1.1
Other	25	2.8
Total	90	100

Source: NYS MMR

Twenty percent of the women in the pregnancy related death cohort did not have any obstetric complications reported during labor and delivery (19.4%, 12/62, not shown). More than a third of women had one complication (24, 38.7%), a quarter had two complications (16, 25.8%), nearly 10% had three complications (6, 9.7%) and four complications were reported for 6.5% (4, 6.5%). Among the 50 women with complications, the most frequently reported were related to hypertensive disorders (30%, 27) and gestational diabetes (10%, 9) (Table 12).

Over half of women in the pregnancy-related deaths cohort had no placental complications reported (32, 51.6%). The most frequent placental complication reported was manual removal of placenta (24, 38.7%) (Table 13).

Most cases had only one type of anesthesia for labor and delivery. Only four cases had two types administered. General anesthesia was the most frequent type administered (38.3% of the cases), followed by epidural (29.8% of the cases) and spinal (21.3% of the cases) (Appendix: Table 14).

Blood transfusions were noted in 32 cases; three women needed transfusions intrapartum, two prenatally, and 25 postpartum. Two women needed blood transfusions intrapartum and postpartum. (data not shown).

Table 13. NYS pregnancy-related deaths 2012-2013 and placental complications

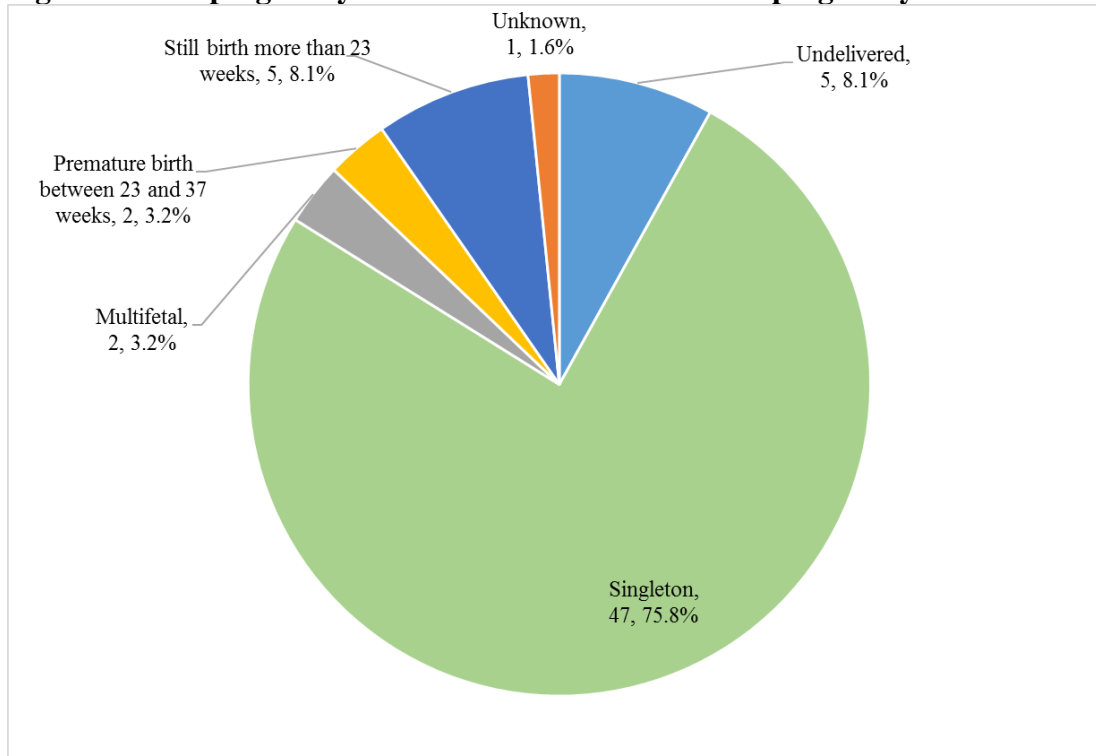
Placental complications reported	Count of cases, Percent of Total	Type of complication	Count
Yes	30, 48.4%	Manual removal of placenta	24
		Abruptio placenta	1
		Percreta, increta or accrete	3
		Previa	1
		Other – unrelated	2
No	32, 51.6%		
Total	62, 100%		

Source: NYS MMR

Pregnancy outcomes

The most frequent pregnancy outcome was a live singleton baby (75.8%). Women who died while still pregnant and were undelivered, and stillbirths represented 8% of the cohort each. (Figure 7, Appendix: Table 15).

Figure 7. NYS pregnancy-related deaths 2012-2013 and pregnancy outcomes



Source: NYS MMR

Postpartum history

Postpartum complications

In contrast with the complications reported during labor and delivery, the reported postpartum complications are more extensive and point to a wide array of health issues. The most frequently reported postpartum complication was cardiopulmonary arrest/collapse (43.6%), followed by hemorrhage (29%), disseminated intravascular coagulation (16.1%), embolism (14.5%) and sepsis (14.5%). A quarter of the cases had no postpartum complications reported (n=16) and postpartum complications were unknown for two of pregnancy-related cases (Table 16a).

Among the women in the pregnancy-related death cohort with reported postpartum complications (60), most of the complications occurred in women with cesarean deliveries. Out of the 9 women with one complication, 7 had cesarean deliveries. Out of the 12 women with two complications, 9 had cesarean deliveries. Out of the 23 women with 3 or more complications, one third of the women had normal vaginal deliveries while the remaining two thirds had cesarean deliveries (Appendix: Table 16b).

Table 16a. NYS Pregnancy-related deaths 2012-2013 and postpartum complications

Complications	Number of cases	Percent of cases
Cardiopulmonary arrest/collapse	27	43.6
Hemorrhage	18	29.0
Disseminated intravascular coagulation	10	16.1
Embolism	9	14.5
Sepsis/ septic shock	9	14.5
Infection	8	12.9
Acute respiratory distress syndrome	7	11.3
Cardiomyopathy	7	11.3
Hypertensive disorders	6	9.7
Preeclampsia	1	
HELLP	1	
Hypertension	4	
Shock (hemorrhagic, hypovolemic)	6	9.7
Congestive heart failure	2	3.2
Other	10	16.1
No complications	16	25.8
Unknown	2	3.2

Source: NYS MMR

Blood transfusions were administered postpartum for 25 women in the pregnancy-related death cohort. Transfusions were administered mainly for women who had cesarean deliveries (20) (Appendix: Table 17).

Psychosocial assessment

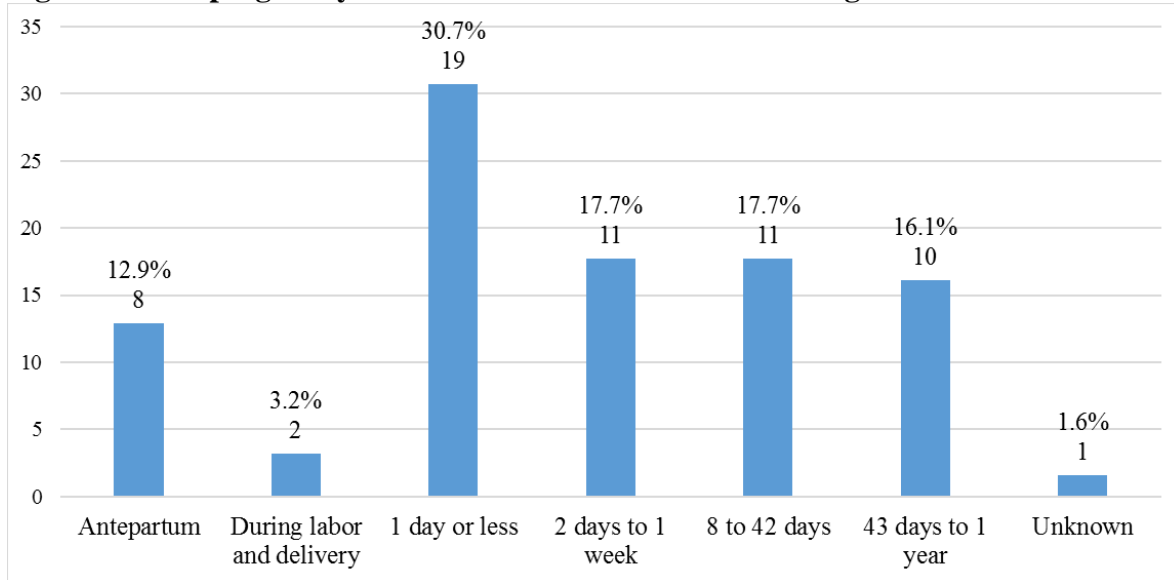
The psychosocial assessment section of the MMR form collects information on a variety of psychosocial issues identified by the woman's health care team and are noted on the woman's prenatal or intrapartum medical records.

The psychosocial assessment was completed for the majority of women in the pregnancy-related deaths cohort (38, 61.3%). The number of issues identified ranged from 1 to 11; the most common number of issues was 1 for 17 women, followed by 2 for 10 women; and 6 women had 3 issues identified. The most frequently reported issues were bereavement/family support (26), mental illness (14), not compliant with treatment (13), and need for financial support (8). Domestic violence occurring prior to pregnancy or anytime was identified in 6 cases (data not shown).

Timing of death

Half of the pregnancy-related deaths occurred within a week of the end of the pregnancy (48.4%, 30, Figure 8). The largest proportion of deaths occurred the day after the end of pregnancy.

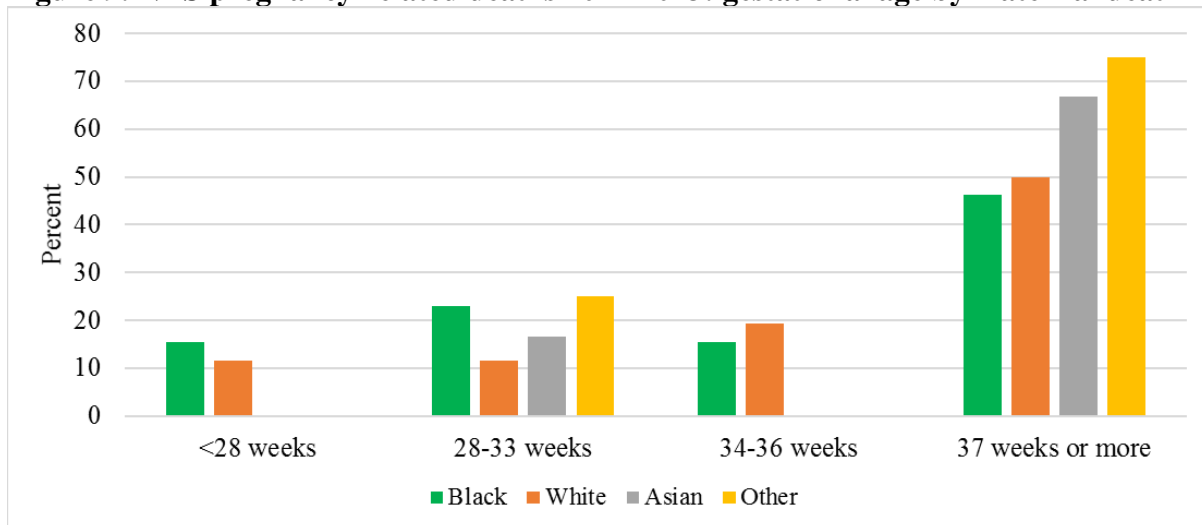
Figure 8. NYS pregnancy-related deaths 2012-2013 and timing of death



Source: NYS MMR

Women with full term pregnancies represented the largest proportion of deaths in every racial group (Figure 9).

Figure 9. NYS pregnancy-related deaths 2012-2013: gestational age by maternal death



Source: NYS MMR

MMR causes of death

Table 18. NYS Pregnancy-related deaths 2012-2013 and MMR cause of death

MMR cause of death	Count	Percent
Embolism (not cerebral)	18	29.0
Hemorrhage	11	17.7
Infection	9	14.5
Cardiomyopathy	7	11.3
Hypertensive disorders	6	9.7
Cardiovascular problems	4	6.5
Cardiac arrest/failure, not otherwise specified (NOS)	2	3.2
Hematopoietic (sickle cell, thalassemia, idiopathic thrombocytopenic purpura (ITP))	2	3.2
Intracerebral hemorrhage (not associated with pregnancy-induced hypertension (PIH))	2	3.2
Pulmonary problems	1	2
Total	62	100.00

Source: NYS MMR

The four leading MMR causes of death were embolism (29%), hemorrhage (17.7%), infection (14.5%) and cardiomyopathy (11.3%) (Table 18).

Selected maternal characteristics were explored for the leading MMR causes of death (Table 19). Black women had the highest number of deaths for embolism and white women had the largest numbers of deaths from hemorrhage. Embolism deaths were distributed uniformly across age groups (except for women less than 20 years old). Hemorrhage deaths were uniformly distributed across age groups of those women 25 years of age and older. Half of the women in the embolism, infection and cardiomyopathy groups were overweight or obese.

Cesarean delivery was the most common mode of delivery for all four leading MMR causes of death and most deliveries resulted in live infants. Deaths due to embolism and hemorrhage occurred very soon after delivery (within 2 days). Death due to infection occurred over the first two weeks after the termination of pregnancy (mean 14.9 days, median 10 days) while deaths due to cardiomyopathy occurred during the month following delivery (mean 30.8 and median 29 days) (Table 19).

Table 19. NYS pregnancy-related deaths 2012-2013, leading MMR causes of death, selected characteristics of mother, type of delivery, timing of death and pregnancy outcome

Characteristics		Embolism	Hemorrhage	Infection	Cardiomyopathy
		N=18	N=11	N=9	N=7
Race	Black	8	2	4	2
	White	7	6	3	4
	Asian	1	3	1	0
	Other	2	0	1	1
Age	<20	0	0	1	0
	20-24	4	0	1	1
	25-29	4	2	0	1
	30-34	3	3	3	4
	35-39	4	3	3	0
	40+	3	3	1	1
BMI	BMI<18.5 Thin	1	1	0	0
	18.5<=BMI<25 Normal	3	4	3	2
	25<=BMI<30 Overweight	3	1	1	1
	BMI>=30 Obese	7	1	5	3
	Unknown	4	4	0	1
Type of delivery	Cesarean section	15	7	5	4
	Undelivered	1	2	0	1
	NSVD	1	1	4	2
	VBAC	0	1	0	0
	Unknown	1	0	0	0
Timing of death after end of pregnancy in days*		1.6	1.5	14.9	30.8
Mean, median		1.0	1.0	10.0	29.0
Pregnancy outcome	Live baby, singleton	13	8	8	6
	Live babies, twins	1	0	0	0
	Undelivered	1	1	0	1
	Premature, 23 weeks	1	0	1	0
	Stillbirth 23 weeks	1	2	0	0

Source: NYS MMR

Note: *Four cases with unusual circumstances were removed from calculation of timing of death: three embolism deaths occurred 25, 62 and 130 days after delivery and one infection death occurred 123 days after delivery.

Assessment of care

Care and services provided in 17.7% 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 (7 out of 8 deaths, 87.5%). By comparison, only 2.2% (1 out of 8) 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 2012-2013, assessment of care relative to standards of care and number of deficiencies noted

Care according to standards N=45			Care not in accordance to standards, N=11		
Deficiencies	Count of cases	Percent	Deficiencies	Count of cases	Percent
0	28	62.2	0	None	
1	4	8.9	1	None	
2	9	20.0	2	1	9.1
3	3	6.7	3	1	9.1
4	1	2.2	4	2	18.2
5	0		5	4	36.4
6	0		6	3	27.3

Source: NYS MMR

Cases where care was not in accordance with standards had at least 2 areas of deficiency identified. Two thirds of cases had 5 and 6 deficiencies documented, respectively. In contrast, for most of the cases with care in accordance with standards (62.2%), there were no deficiencies documented (Table 21).

The Physician, Midwife or Resident (n=10) and System (n=10) had the most deficiencies, followed by Nursing (n=7), Hospital (n=4) and Support Services (n=4). A review of the comments on Physician deficiencies reported that, in nine of the ten pregnancy-related deaths where there was a Physician deficiency noted, there was a failure in recognizing the condition and getting timely treatment; in 5 cases, there was a delay in the administration of treatment; and in 2 cases, there was a break in communication. One example was the failure to recognize maternal hemorrhage and to treat it timely and aggressively.

The comments on System deficiencies referred to protocols not in place or not being followed (n=7), inadequate resources (n=3, ICU beds, supplies), or inadequate staff level and education (n=2). Examples of System deficiencies included unavailability of ICU beds, and unavailability of thrombolytic agents for timely administration.

Nursing deficiencies included not following protocols (n=4) and breaks in communication (n=4). Another Nursing deficiency reported was failure to recognize the severity of the condition (n=3). Examples of Nursing deficiencies included not following the escalation policy, not reaching out to the attending physician, and failure to recognize postoperative infection.

Timeliness (n=4) was the main deficiency noted in Support Services. Examples included delays in obtaining x-rays and availability and timely replacement of blood products. Communication (n=4) was the main deficiency noted for Hospitals. Examples of Hospital deficiencies included poor communication between services and interpreter not available for translation.

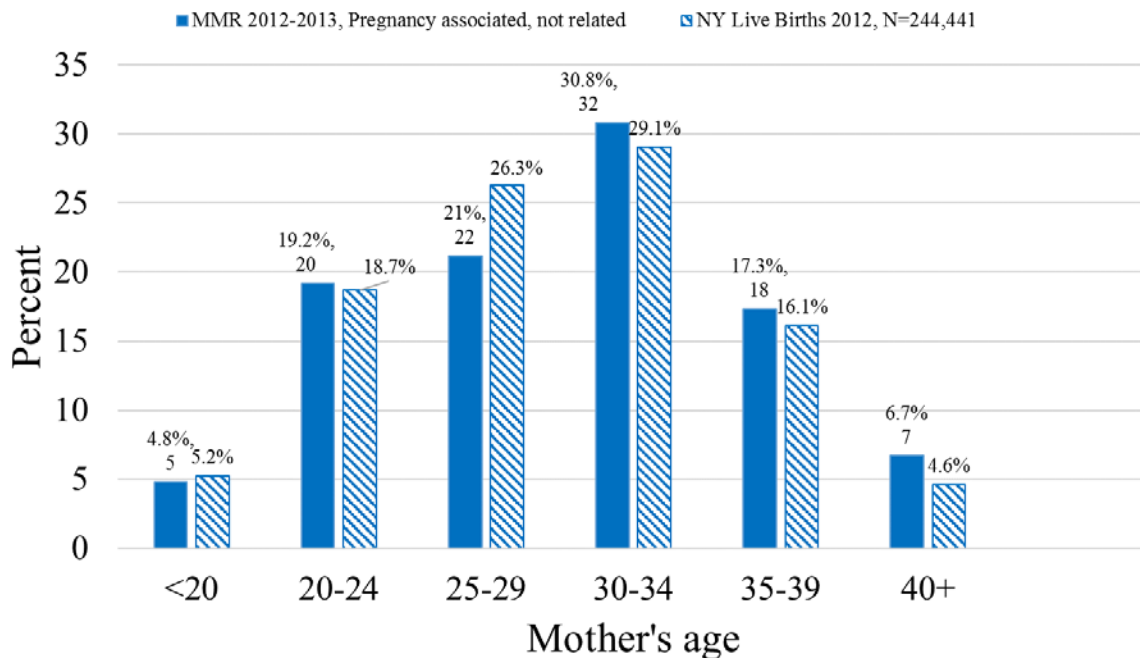
Patient deficiencies were recorded for a quarter of the pregnancy-related cases (n=15). The most frequent Patient deficiency reported was patient not following treatment or recommendations. Examples of patient non-compliance with treatment included patient not seeking prenatal care, continuing to smoke, using alcohol and drugs during pregnancy, and discontinuing antiseizure medication for fear that it would harm the baby.

Pregnancy-associated, not related deaths

A total of 104 pregnancy-associated maternal deaths, not related to the pregnancies were ascertained through death records linked to birth records (48.1%), inpatient (13.5%) and outpatient (32.7%) hospital records with an indication of pregnancy (list of ICD codes available upon request). A small percent (5.8%) were unlinked deaths.

The ages of women in the pregnancy-associated death cohort were similar to those of women with live births in 2012 (Figure 12, Appendix Table 22).

Figure 12: NYS live births 2012 and pregnancy associated, not related deaths 2012-2013 by mother's age



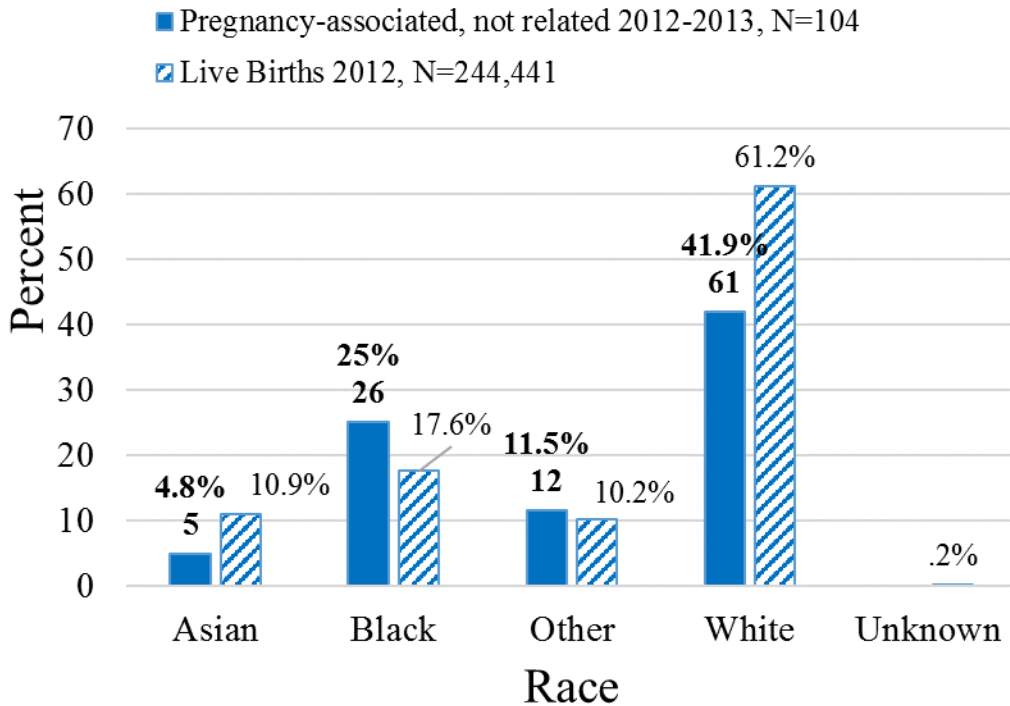
Source: NYS MMR and NYS Vital Statistics

The women in the pregnancy-associated death cohort were mostly white (58.7%, 61). Black women represented a quarter of this cohort (25.0%, 26). Asian and American Indian or Alaska Natives represented small percentages of these deaths (4.8% and 1.9%, respectively). About ten percent were of other races (9.6%) (Appendix Table 22). When compared to the women with live births in 2012, black women were overrepresented in the pregnancy-associated not related cohort. A quarter of the pregnancy-associated deaths were to black women while births to black women represented 17.6% of all births (Figure 13).

Eighteen percent of women were of Hispanic ethnicity (18.3%, 19). Nearly half of the women were not Hispanic (49.0%, 51) and ethnicity was unknown for one third of the cohort (32.7%, 34) (Appendix Table 22).

Nearly half of the women in the pregnancy-associated cohort were on Medicaid (44.2%, 46) and more than half of them had less than a Bachelor's degree (48.1%) (Appendix Table 22).

Figure 13: NYS live births 2012 and pregnancy associated, not related deaths 2012-2013 by mother's race



Source: NYS MMR and NYS Vital Statistics

The top 6 causes of death representing 71% of all pregnancy-associated, not related cases were injury (51.9%), cancer (8.7%), generalized septicemia (5.8%), and cardiac arrhythmia (4.8%) (Table 23). The injuries included substance overdose (n=14, 26.0% of injuries), suicides and intentional injuries (n=12, 22.3% of injuries), motor vehicle accidents (n=10, 18.5% of injuries), homicides (n=9, 16.7% of injuries), and undetermined or unintentional injuries (n=2, 3.7% of injuries) (Table 23).

Table 23. NYS pregnancy-associated, not related deaths 2012-2013 and causes of death

Cause of death	Count	Percent
Injury (intentional or non-intentional)	54	51.9
Cancer (benign or malignant tumor/disease), includes Genital Tract Neoplasm	9	8.7
Generalized septicemia/septic shock, septic abortion	6	5.8
Cardiac arrhythmia	5	4.8
Pulmonary problems	4	3.9
Cardiomyopathy	3	2.9
Cardiovascular problems	3	2.9
Other conditions not specified above	3	2.9
Metabolic, not pregnancy-related (includes diabetes mellitus)	2	1.9
Neurologic/neurovascular problems	2	1.9
Cardiac arrest/failure, not otherwise specified	1	1.0
Hematopoietic (sickle cell, thalassemia, Idiopathic Thrombocytopenic Purpura)	1	1.0
Intracerebral hemorrhage (not associated with Pregnancy Induced Hypertension)	1	1.0
Multiple organ/system failure, not otherwise specified	1	1.0
Other (includes encephalopathy)	1	1.0
Thrombotic (includes pulmonary embolism, not otherwise specified)	1	1.0
Gastrointestinal disorders	1	1.0
Unknown/ not otherwise specified	6	5.8
Total	104	100

Source: NYS MMR

IV. Summary

The maternal mortality review identified 62 pregnancy-related and 104 pregnancy-associated, not pregnancy-related deaths from 2012 to 2013.

Pregnancy-related deaths

The majority of women in the pregnancy-related death cohort were in their thirties (50% were 30-39 years old). Women 40 years and older were overrepresented in the pregnancy-related death cohort when compared to 2012 live births.

Black and white women contributed equally (42% of the deaths each) to the pregnancy-related death cohort. Black women are over represented in the maternal death cohort contributing 42% of deaths which is more than twice the percent of live births born to black women (17.6%). A majority of women were non-Hispanic (72.6%). The pregnancy-related death cohort was comprised of women of all levels of education. However, women with advanced education aside from Bachelor degrees (some college, Associate, Master or Doctorate degrees) represented less than one fifth of the cohort (19.3%). The majority of women were covered by Medicaid (67.7%).

The largest proportion of pregnancy-related deaths occurred among women with no previous live birth (37.1%). As the number of previous live births increased, the number of deaths decreased. Hospital clinics were the most common facility providing prenatal care (64.9%) followed by private offices (24.3%) and neighborhood health centers (8.1%). Obstetricians were the most common prenatal care providers (79%).

Over a third of the women in the pregnancy-related death cohort received adequate prenatal care as defined by the revised graduated index of prenatal care (35.5%), 22.6% received intermediate and 3.2% received intensive prenatal care. Almost a third of cases received no prenatal care or had missing information.

Fifteen percent of women in the pregnancy-related deaths cohort had no documented risk factors and for remaining women an average of 2.6 risk factors were reported. Obesity was almost twice (35.5% vs 19.4%) as prevalent in women in the pregnancy-related death cohort compared to women who had live births in 2012.

A majority of women in the pregnancy-related death cohort (59.7%) delivered at a level 3 hospital or at a Regional Perinatal Center. Cesarean sections represented 66.1% of the deliveries with half of them emergent. Normal vaginal deliveries constituted the minority of deliveries (21%). Almost ten percent of women died undelivered. However, 75.8% of the reported outcomes for these pregnancies were live singleton infants.

Among women in the pregnancy-related death cohort, hypertensive disorders (preeclampsia) and gestational diabetes mellitus were the most frequently reported complications during labor and delivery; cardiopulmonary arrest/collapse, hemorrhage, disseminated intravascular coagulation, embolism, and sepsis/septic shock were the most commonly documented complications during the postpartum period.

The psychosocial assessment was completed for the majority of women in the pregnancy-related death cohort (38, 61.3%). The most frequently reported issues were bereavement/family support (26), mental illness (14), not compliant with treatment (13), and need for financial support (8).

The four leading MMR causes of death were embolism (29%), hemorrhage (17.7%), infection (14.5%), and cardiomyopathy (11.3%). Deaths due to embolism and hemorrhage occurred very soon after delivery (within 2 days). Deaths due to infection occurred during the first two weeks after the termination of pregnancy (mean 14.9 days, median 10 days), while deaths due to cardiomyopathy occurred during the month following delivery (mean 30.8 and median 29 days).

Care and services provided for 17.7% of the women in the pregnancy-related death 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 (87.5%). Most deficiencies were noted in the physician, midwife or resident area and included failure in recognizing the condition and getting timely treatment; delay in the administration of treatment; and break in communication.

Pregnancy-associated deaths

The 104 pregnancy-associated deaths were very similar in age with the women with live births in 2012. A majority of women were white (58.7%) and a quarter were black (25.0%). Compared to the women with live births in 2012, black women were overrepresented in the pregnancy-associated deaths cohort.

The top four causes of death representing 71% of all pregnancy-associated, not related deaths were injury (51.9%), cancer (8.7%), generalized septicemia (5.8%), and cardiac arrhythmia (4.8%). Substance overdose (25.9%) and suicide (22.3%) were the top reported injuries.

Glossary of acronyms

ACOG American Congress of Obstetricians and Gynecologists

ARDS Acute respiratory distress syndrome

BMI Body Mass Index

HELLP Hemolysis, Elevated Liver enzymes and Low Platelet count.

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.

ITP idiopathic thrombocytopenic purpura

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.

NOS Not otherwise specified.

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.

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.)

PIH pregnancy-induced hypertension

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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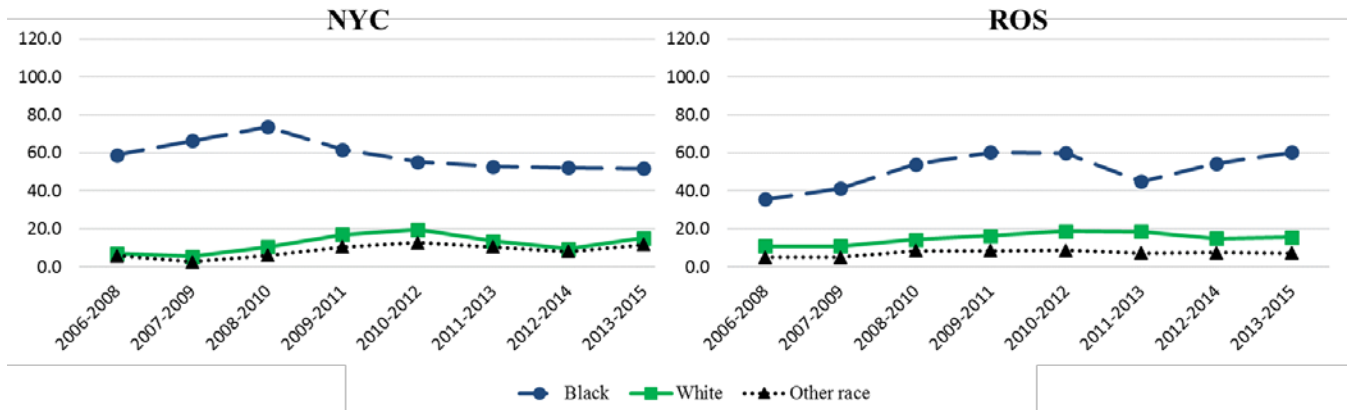
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Figure 1c. NYS three-year rolling average maternal mortality rate by race and region



Source: NYS Vital Statistics

Table 2. NYS pregnancy-related deaths 2012-2013 by race and ethnicity of mother

		Count	Percent
Race, N=62	Asian	6	9.7
	Black	26	41.9
	Other	4	6.5
	White	26	41.9
Ethnicity, N=62			
Ethnicity, N=62	Hispanic or Latino	11	17.7
	Not Hispanic	45	72.6
	Unknown	6	9.7

Source: NYS MMR

Table 3. NYS pregnancy-related deaths 2012-2013 and number of previous live births

Parity	Count	Percent
No previous live births	23	37.1
1	10	16.1
2	9	14.5
3	7	11.3
5	4	6.5
6 or more	3	4.8
Unknown	6	9.7
Total	62	100.00

Source: NYS MMR

Table 5a. NYS pregnancy-related deaths 2012-2013 and types of prenatal care providers (cases with more than one prenatal care provider)

Number of providers	Type of provider	Number of cases	Total
2	Obstetrician and midwife	5	17
	Obstetrician and nurse	3	
	Obstetrician and perinatologist	1	
	Obstetrician and other specialty	5	
	Perinatologist and nurse	1	
	Perinatologist and other specialty	1	
	Family practice and midwife	1	
3	Obstetrician, nurse and other specialty (e.g. dietician)	3	9
	Obstetrician, perinatologist and other specialty (e.g. diabetic educator)	2	
	Obstetrician, nurse and perinatologist	1	
	Obstetrician, midwife and other specialty (e.g. cardiologist)	1	
	Obstetrician, perinatologist and other specialty	1	
	Perinatologist, nurse and other specialty	1	

Source: NYS MMR

Table 7a. NYS pregnancy-related deaths 2012-2013 and number of prenatal medications reported

Number of medications reported	Count of cases	Percent
1	10	19.6
2	13	25.5
3	13	25.5
4	7	13.7
5	3	5.9
7 or more	5	9.8

Source: NYS MMR

Note: Out of 62 pregnancy-related cases, prenatal medications were reported for 51 cases.

Table 7b. NYS pregnancy-related deaths 2012-2013 and types of prenatal medications reported

Types of medication	Frequency	Percent
Prenatal vitamins	46	28.6
Dietary supplements	34	21.1
Antihypertensive	14	8.7
Antibiotic	8	5.0
Anticoagulant	7	4.4
Iron	7	4.4
Insulin	5	3.1
Inhalers	4	2.5
Narcotics (Rx only)	4	2.5
Oral hypoglycemic	4	2.5
Analgesic	3	1.9
Antidepressants/Anxiolytic	3	1.9
Antifungal	3	1.9
Antihistamine	2	1.2
Antinausea	2	1.2
Corticosteroid	2	1.2
Diuretic	2	1.2
Opioid addiction treatment	2	1.2
Sedatives/Hypnotics	2	1.2
Thyroid/Anti-thyroid	2	1.2
Anti-constipation	1	0.6
Antipsychotic	1	0.6
Antiviral	1	0.6
Chest pain medication	1	0.6
Muscle relaxant	1	0.6

Source: NYS MMR

Table 7c. NYS pregnancy-related deaths 2012-2013 and indications for medications reported

Indication	Frequency	Percent
Pregnancy	69*	42.6
Hypertension	13	8.0
Diabetes	9	5.6
Infection	6	3.7
Sickle cell	6	3.7
Supplement	6	3.7
Urinary tract infection	6	3.7
Anemia	5	3.1
Asthma	5	3.1
Deep vein thrombosis prophylaxis	4	2.5
Mental illness	4	2.5
Withdrawal medication	4	2.5
Heart failure	3	1.9
History of stroke	3	1.9
Gastroesophageal reflux disease	2	1.2
Nausea/vomiting	2	1.2
Anti-thrombin III deficiency	1	.6
Constipation	1	.6
Diuretic	1	.6
Premature baby for lung development	1	.6
Status post gastric bypass	1	.6
Scleroderma	1	.6
Not documented	9	5.6

*Several women had more than one medication prescribed with indication of pregnancy. There were 69 medications with indication of pregnancy prescribed for 48 of the women in the pregnancy-related death cohort.

Source: NYS MMR

Table 9. NYS pregnancy-related deaths 2012-2013 and provider-identified risk factor categories

Risk factor category	Count, % of Total
Obstetric	38, 61.3%
Termination of pregnancy (induced or spontaneous)	25
Previous cesarean	12
Uterine abnormality or incompetent cervix	7
History of premature birth	1
Hematologic	16, 25.8%
Anemia	9
Sickle cell disease	6
Coagulation disorder	1
Cardiac	11, 18.0%
Cardiomyopathy	2
Mitral valve prolapsed	2
Murmur	2
CHF	1
Congenital heart defect	1
Dilated aortic root	1
Intraarterial septal aneurysm	1
Tachycardia arrhythmia	1
Pulmonary	11, 18.0%
Asthma	7
Other pulmonary	2
Tuberculosis	2
Hypertension	11, 18.0%
Endocrine	10, 16.1%
Diabetes	6
<i>Type 2 (4), type 1(1), gestational (1)</i>	
Thyroid disorder	4
<i>Hypothyroidism (2), Hx of abnormal thyroid test (1)</i>	
Psychiatric disorders	7, 11.3%
Depression	4
Anxiety	3
Bipolar	1
Schizoaffective	1

Table 9. NYS pregnancy-related deaths 2012-2013 and provider-identified risk factor categories (continued)

Risk factor category	Count, % of Total
Neurologic	5, 8.1%
Cerebral palsy	1
Other	4
Metabolic	3, 4.8%
Fatty liver	1
Pancreatitis	1
Renal tubular acidosis	1
Other	42, 67.7%
Obesity	11
Grand multiparity	3
Homeless	3
Advanced maternal age	2
History of drug addiction	2
Rh sensitized	2
History of embolism	1
Renal disease	1
Other	17

Source: NYS MMR

Table 14. NYS pregnancy-related deaths 2012-2013 and number and types of anesthesia for labor and delivery

How many types of anesthesia administered	Count	Percent of cases, N=62
0	15	24.2
1	43	69.4
2	4	6.5
Types of anesthesia reported	Count	Percent of cases, N=47
General	18	38.3
Epidural	14	29.8
Spinal	10	21.3
Combined Spinal Epidural Anesthesia	4	8.5
Intravenous/ intramuscular or oral analgesia/sedation	2	4.3
Local	2	4.3
Other	2	4.3
Monitored Anesthesia Care	1	2.1

Source: NYS MMR

Table 15. NYS pregnancy-related deaths 2012-2013 and pregnancy outcomes

Pregnancy outcomes	Number of cases	Percent
Live delivery: singleton	47	75.8
Undelivered (died pregnant)	5	8.1
Still birth more than 23 weeks	5	8.1
Live delivery: multi fetal gestation	2	3.2
Premature births between 23 and 37 weeks	2	3.2
Unknown	1	1.6
Total	62	100

Source: NYS MMR

Table 16b. NYS pregnancy-related deaths 2012-2013: postpartum complications by type of delivery

Type of delivery	Number of complications reported				
	0	1	2	3 or more	Total N, %
Undelivered	6	0	0	0	6 10
NSVD	1	2	3	7	13 21.7
VBAC	0	0	0	1	1 1.7
Cesarean section: elective/scheduled	1	0	2	4	7 11.7
Cesarean section: unscheduled non-emergent	3	2	1	4	10 16.7
Cesarean section: emergent	2	4	6	7	19 31.7
Cesarean section: peri or post-mortem	3	1	0	0	3 6.7
Total N, %	16 26.7	9 15.0	12 20.0	23 38.3	60 100.00

Source: NYS MMR

Table 17. NYS pregnancy-related deaths 2012-2013 and type of delivery for women who received blood products postpartum

Type of delivery	Count of cases	Percent
NSVD	4	16.0
VBAC	1	4.0
Cesarean section: elective/scheduled	5	20.0
Cesarean section: unscheduled non-emergent	3	12.0
Cesarean section: emergent	11	44.0
Cesarean section: peri or post-mortem	1	4.0
Total	25	100

Source: NYS MMR

Table 20. NYS pregnancy-related deaths 2012-2013 and assessment of care relative to standards of care and preventable or not preventable death

Preventability	Care according to standards			Total
	Yes	No	Unknown	
Preventable	1, 2.2%	7, 87.5%	0	8, 12.9%
Not preventable	29, 96.7%	1, 3.3%	0	30, 48.4%
Unknown	15, 62.5%	3, 12.5%	6, 25.0%	24, 38.7%
Total	45, 72.6%	17.7%	6, 9.7%	62, 100%

Source: NYS MMR

Table 22. NYS pregnancy-associated, not related deaths 2012-2013 and maternal demographic characteristics

Pregnancy-associated, not related deaths, N=104	Count	Percent
Age at death in years		
<20	5	4.8
20-24	20	19.2
25-29	22	21.2
30-34	32	30.8
35-39	18	17.3
40+	7	6.7
Employment		
Unemployed	17	16.4
Employed	30	28.9
Unknown	57	54.8
Occupation		
Unemployed	19	18.3
Service/Housekeeper/Childcare	4	3.9
Professional/Management	12	11.5
Homemaker	2	1.9
Other	7	6.7
Sales/Administrative support	1	1.0
Student	4	3.9
Unknown	54	51.9
Education		
8 th grade or less	2	1.9
9 th -12 th grade, no diploma	13	12.5
High school graduate or GED	22	21.2
Some college credit, but no degree	10	9.6
Associate degree	3	2.9
Bachelor degree	8	7.7
Master degree	3	2.9
Doctorate/professional degree	1	1.0
Unknown	42	40.4
Health insurance		
Medicaid	46	44.2
Private insurance	23	22.1
Other government/Child Health Plus B	1	1.0
Other	5	4.8
Self-pay	2	1.9
Unknown	27	26.0

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.

Data challenges

Out of the 216 deaths identified for surveillance 46 (21.3%) were errors in the death or hospital record. Twenty-nine of them had obstetric causes of death on death certificates. Two had pregnancy check box marked as pregnant but the cause of death was not obstetric. And 15 had coding errors in the hospital discharge record (SPARCS).

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.

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 2012 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 and/or associated deaths.

1. *Explore Maternal Mortality in New York | 2016 Health of Women and Children Report*. 2017; Available from: http://www.americashealthrankings.org/explore/2016-health-of-women-and-children-report/measure/maternal_mortality/state/NY.
2. Center, N.W.s.L., *Health Care Making the Grade on Women's Health: A National and State by State Report Card*. 2010.
3. Alexander, G.R. and M. Kotelchuck, *Quantifying the adequacy of prenatal care: a comparison of indices*. Public Health Rep, 1996. 111(5): p. 408-18; discussion 419.