New Jersey

Hospital Maternity Care Report Card, 2021 & 2022

NJHealth New Jersey Department of Health
New Jersey Maternal Data Center

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Statute

Summary of the Statute

In 2018, New Jersey legislature enacted P.L. 2018, c.82, which requires the New Jersey Department of Health (NJDOH) to issue a report on hospital maternity care. Specifically, the statute states that:

1. The Commissioner of Health shall gather and compile information necessary to develop a New Jersey Report Card of Hospital Maternity Care (Report Card), as provided for in this act. The Report Card, which shall be updated annually and made available on the NJDOH website, shall be designed to inform members of the public about maternity care provided in each general hospital licensed pursuant to P.L.1971, c.136 (C.26:2H-1 et 13 seq.), so that a member of the public is able to make an informed comparison.

2. For each hospital, the Report Card shall include:
    a. the number of vaginal deliveries performed;
    b. the number of cesarean deliveries performed; and
    c. the rate of complications experienced by a patient receiving maternity care:
        i. for a vaginal delivery, which shall include the rate of maternal hemorrhage, laceration, infection, or other complication as prescribed by the Commissioner of Health; and
        ii. for a cesarean delivery, which shall include the rate of maternal hemorrhage, infection, operative complication, or other complication as prescribed by the Commissioner of Health.

3. Notwithstanding the provisions of section 2 of this act to the contrary, the commissioner shall revise or add complications or other factors to be included in the Report Card based on maternal quality indicators as may be recommended by the American Congress of Obstetricians and Gynecologists.

In fulfilling the statutory requirement, the NJDOH works closely with Nurture NJ, a multi-pronged, multi-agency initiative that aims to reduce maternal and infant mortality and morbidity and ensure equity in care and in outcomes for birthing people and infants of all ethnic groups thereby making New Jersey the safest and most equitable place in the nation to deliver and raise a baby.

A major goal of this report is to describe the methodology applied to produce important information on maternal health care provided in New Jersey by licensed birthing general acute care hospitals.

Summary of Findings

Overview of Delivery Hospitalizations for New Jersey Birthing People in 2022 and 2021

- The racial/ethnic profile of New Jersey birthing people is changing; racial and ethnic groups that are not non-Hispanic White represent 55% of all births in 2022 compared to 46% in 2000.
- In 2022, there was a slight increase (4% from 2020) in the number of delivery hospitalizations at the 48 licensed birthing general acute care hospitals, while there was a slight decrease (3.5%) reported between 2018 and 2020.
- Of all delivery hospitalizations in 2022, the rate of cesarean delivery was 32.4%, which is nearly the same as the 2021 and 2020 rates, but a 2% decrease from 2018.
- In 2022 and 2021, cesarean deliveries had higher rates of complications as compared to vaginal deliveries (rates below are per 1,000 delivery hospitalizations):
    - Obstetric hemorrhage:
        - 2022: 118 cesarean, 19.7 vaginal
        - 2021: 124.4 cesarean, 19.5 vaginal
    - Post-admission infection:
        - 2022: 26.6 cesarean, 17.9 vaginal
        - 2021: 23.6 cesarean, 16.3 vaginal
    - Severe Maternal Morbidity (SMM) with transfusion:
        - 2022: 43.3 cesarean, 12.8 vaginal
        - 2021: 43.9 cesarean, 13 vaginal
- Of all delivery hospitalizations in 2022, about 17% of delivering birthing people experienced COVID-19 infections sometime during their pregnancy, which is an increase by 8% from 2021 and 13% from 2020. Of those with COVID-19 infection, 22% were positive at the time of delivery (i.e., within two days of admission for delivery) as opposed to positive any other time during pregnancy, which is a decrease by 2% in 2021 and 38% in 2020.

Variation in Characteristics and Outcomes by Hospital

- In 2022, 15 birthing hospitals (of the 48 total) had higher rates of obstetric hemorrhage than the statewide rate of 51.7 per 1,000 delivery hospitalizations, which is a decrease from 2021, during which 18 birthing hospitals had higher rates.
- Vaginal Birth after Cesarean (VBAC) rates for all delivery hospitalizations varied by hospital, ranging from 0% to 6.8%, with a statewide rate of 2.4% in both 2022 and 2021. Episiotomy rates varied widely among hospitals, from 0.5% to 19.8%, while the statewide rates were 4.4% in 2022 and 5% in 2021.
- In 2022, 13 birthing hospitals (of the 48 total) had higher rates of SMM with transfusion than the statewide rate of 22.7 per 1,000 delivery hospitalizations, which is an increase from 2021 during which 11 birthing hospitals had higher rates.

Complication Rates by Race/Ethnicity

- Non-Hispanic Black birthing people continued having the highest rate of obstetric hemorrhage with 64.8 per 1,000 delivery hospitalizations in 2022, which is nearly the same as the 2021 rate (65.3) and an increase from the 2020 rate (62.6). Hispanic birthing people experienced obstetric hemorrhage at a rate of 53.6 per 1,000 in 2022 and 56.8 per 1,000 in 2021. The rate for non-Hispanic White birthing people was the lowest at 47.3 (2022) and 48.4 (2021) per 1,000 delivery hospitalizations.
- Non-Hispanic Black birthing people had the highest rate of SMM with transfusion at a rate of 38.5 per 1,000 delivery hospitalizations in 2022, which is about the same as the 2021 rate (38.8) and an increase from the 2020 rate of 36.5. Hispanic birthing people had the second highest rate of 26.4 (2022) and 27.5 (2021) per 1,000 delivery hospitalizations. The lowest rate was for non-Hispanic White birthing people at 16.3 (2022) and 15.8 (2021) per 1,000 delivery hospitalizations.
- Non-Hispanic Asian birthing people had the highest rate of post-admission infection at a rate of 28.9 per 1,000 delivery hospitalizations in 2022, which is an increase from 2021 (25.1) and 2020 (25.4); with the second highest being non-Hispanic Black (26.7) birthing people in 2022 and Hispanic (24.4) birthing people in 2021; and the lowest rate was non-Hispanic White birthing people at 14.2 (2022) and 13 (2021) per 1,000 delivery hospitalizations.
- Non-Hispanic Asian birthing people had the highest rate of third- and fourth-degree perineal lacerations without instrument with 3.8 per 100 delivery hospitalizations in 2022, which is almost the same as the 2021 (4.1) and 2020 (3.4) rates; followed by non-Hispanic Black birthing people with a rate of 3.5 (2022) and 2.7 (2021) per 1,000 delivery hospitalizations; and the lowest rate was non-Hispanic White birthing people at about 1.5 per 1,000 delivery hospitalizations in both 2022 and 2021.
- Non-Hispanic Asian birthing people had the highest rate of episiotomy with 10.3 per 100 delivery hospitalizations in 2022, which is a decrease from the 2021 (11.3) and 2020 (11.6) rates; with the second highest being non-Hispanic White (4.6) in 2022 and Other/Multi-race birthing people (5.9) in 2021; and the lowest rate was non-Hispanic Black birthing people at 1.8 (2022) and 2.3 (2021) per 100 delivery hospitalizations.

Nulliparous, Term, Singleton, Vertex (NTSV) Surgical/Cesarean Births

- The rate of Nulliparous (first time birthing people), with a Term (37 or more completed weeks of gestation), Singleton (one fetus), in a Vertex position (head-first presentation of the fetus), or NTSV, delivered by surgical/cesarean section in New Jersey decreased from 30.3% in 2016 to 24.3% (in 2022) and 24.9% (in 2021). Correspondingly, the percentage of birthing acute care hospitals in New Jersey that achieved the U.S. Department of Health and Human Services Healthy People 2030 target of 23.6% or fewer NTSV surgical/cesarean births increased from 16% in 2016 to 44% (in 2022) and 42% (in 2021). Please see the table below for additional details.

Year	Percentage of Birthing Acute Care Hospitals in NJ achieving the Healthy People 2030 target of 23.6 or fewer NTSV surgical births (per 100 live births)	NJ statewide rate of NTSV surgical births (per 100 live births)
2022	44%	24.3
2021	42%	24.9
2020	35%	25.9
2019	33%	26.7
2018	20%	27.8
2016	16%	30.3

Key Recommendations

In collaboration with New Jersey Maternal and Infant Health Innovation Authority:

- Further research will be needed to understand the mechanisms that contribute to obstetric hemorrhage, post-admission infections, and Severe Maternal Morbidity (SMM) at the hospital level;
- Variation in outcomes between hospitals highlight the need to encourage the use of standardized practice guidelines, such as the adoption of a standard measure for Quantitative Blood Loss (QBL) to ensure accuracy of data;
- Based on the statistically significant risk-adjusted complication rates (i.e., SMM, post-admission infections, obstetric hemorrhage) among birthing people who experienced cesarean deliveries, it is important to identify the modifiable risk factors that contribute to cesarean delivery through carefully designed research studies; and
- Disparities in outcomes by race/ethnicity and other maternal indicators should be considered in combination with findings from the New Jersey Maternal Mortality Review Committee and policy recommendations should be made in alignment with the Nurture NJ strategies.

While there is a wealth of research and proven methodologies to improve maternal outcomes, the current report highlights the continuing need for improvement in New Jersey. For example, nulliparous status is found to be associated with an increased risk of complications. This suggests that labor and delivery management guidelines may be developed and adopted to address the differences in labor progression and outcomes between nulliparous and multiparous birthing people.

Background

An increasing body of literature documents childbirth as a significant life event that can be both positive and traumatic depending on the birthing person's experience during delivery (Berg et al., 2003; Elmir et al., 2010), which could be influenced by a combination of multiple factors and experiences during or shortly after delivery. These morbidities and complications require various levels of intervention from non-invasive (e.g., medication taken by mouth or intravenously) to invasive (e.g., blood transfusion) interventions to save both the birthing person's life and her child's life. To fully understand and reduce maternal morbidities and delivery complications, there is a need for consistent measurement, collection, analysis, and dissemination of data related to specifically address labor and delivery. Availability of good quality health care data that allows the construction of performance metrics to support quality improvement efforts is fundamental. Patients and their physicians can use these metrics to inform their discussion in determining the best hospital for the patients' health care and labor and delivery needs.

In this report, NJDOH uses data collected on all hospital-based births as reported through the Electronic Birth Certificate (EBC) system. The EBC data were complemented by matching records with hospitalization discharge records from each of the hospitals where births occurred. This process also allowed capture of additional maternal health characteristics that were not included in the EBC.

To account for the differences in patients served by each birthing facility, risk-adjusted rates of delivery-associated complications were calculated. "Risk-adjusted" rates reflect the birthing person's health conditions including their social, demographic, and economic statuses. The risk-adjustment process allows for fair comparison across hospitals whose patient populations can be very diverse. Risk-adjusted rates are expressed as ratios of expected complications to observed complications multiplied by the statewide complication rate. Statistical significance is assessed by whether the statewide rate crosses the range between the lower and upper bounds of the confidence limits. A difference is considered "statistically significant" when the statewide rate falls outside the confidence limits estimated for the hospital rate. As an example, a hospital's rate is statistically significantly higher than the statewide rate if the corresponding hospital's rate confidence bound is completely above the statewide rate. By comparison, the hospital's rate is statistically significantly lower than the statewide rate when the statewide rate falls above the corresponding hospital confidence bound.

The measures assessed in this report are obstetric hemorrhage, post-admission infection, third- and fourth-degree perineal lacerations, episiotomy, and Severe Maternal Morbidity (SMM) with transfusion. In the following sections of this report, each measure is discussed in more detail.

Obstetric Hemorrhage

Per the American Congress of Obstetricians and Gynecologists (ACOG), obstetric hemorrhage is a cumulative blood loss greater than 1,000 mL regardless of the method of delivery (i.e., vaginal or cesarean birth) or blood loss accompanied by signs or symptoms of hypovolemia within 24 hours after the birth process (Committee on Practice Bulletins-Obstetrics, 2017). However, blood loss greater than 500 mL in a vaginal delivery is abnormal and should be investigated and managed (Committee on Practice Bulletins-Obstetrics, 2017). Obstetric hemorrhage is common among birthing people during delivery or post-delivery secondary to uterine atony, genital tract trauma (i.e., vaginal or cervical lacerations), uterine rupture, retention of placental tissue, or maternal coagulation disorders (Committee on Practice Bulletins-Obstetrics, 2017). According to the Centers for Disease Control and Prevention (CDC) Pregnancy Mortality Surveillance System (PMSS) data from 2017-2019, about 12% of pregnancy-related mortality were attributed to hemorrhage (CDC, 2021). Per NJ Maternal Mortality Report 2016-2018, of the 44 cases reported, eight pregnancy-related deaths were attributed to hemorrhage (Nantwi, Kraus, & Slutzky, 2022). Considering the potential negative maternal outcomes linked to obstetric hemorrhage, health care providers are encouraged to closely assess for potential risk factors and be ready to implement multidisciplinary and multifaceted guidelines to maintain hemodynamic stability while identifying and treating the cause of blood loss in cases where it occurs (Committee on Practice Bulletins-Obstetrics, 2017).

Severe Maternal Morbidity (SMM)

The CDC refers to SMM as a list of unexpected outcomes of labor and delivery that result in significant short- or long-term consequences to a birthing person's health (CDC, 2017). This list of unexpected outcomes of labor and delivery (morbidities) encompasses a continuum of health conditions including life-threatening and disabling diseases, organ dysfunction and/or receipt of invasive therapy, during labor and/or after delivery (Firoz et al., 2013). The 2014 SMM report published by the CDC showed a steady national increase in SMM. It is argued that certain demographic factors (e.g., increasing maternal age), chronic disease and increasing rate of cesarean deliveries may have contributed to the rise in SMM rates (Martin et al., 2017). Considering the potential consequences of SMM on a birthing person's health, the CDC recommends identifying the underlying factors of SMM and designing interventions to target them with the goal of improving the quality of maternal care.

Post-admission Infections

Bacterial infections that occur during labor or the puerperium (period of approximately six weeks following childbirth) usually have a good prognosis when identified and treated promptly. However, occasionally they can become severe and result in morbidity or rarely mortality (Cantwell et al., 2011). According to the CDC Pregnancy Mortality Surveillance System (PMSS) data from 2017 to 2019, about 14% of pregnancy-related mortality were attributed to infections (CDC, 2021). Per the NJ Maternal Mortality Report 2016-2018, of the 44 cases reported, three pregnancy-related deaths were attributed to infection (Nantwi, Kraus, & Slutzky, 2022). Beyond the immediate effects of the infection, long-term complications can include chronic pelvic pain, fallopian tube blockage or infertility (WHO, 2015). Factors that can lead to infections include

pre-existing maternal conditions, such as diabetes or obesity, as well as conditions that may arise during labor, such as premature rupture of the membranes and cesarean birth (Acosta et al., 2014). Current recommendations for prevention of infections include judicious use of prophylactic antibiotics (Committee on Practice Bulletins-Obstetrics, 2018b). While most postpartum infections are diagnosed after the patient is discharged from the hospital (Yokoe et al., 2001), the current report only includes those diagnosed during the initial delivery hospitalization.

Third- and Fourth-Degree Perineal Lacerations

Vaginal and perineal trauma often occur during vaginal birth, either spontaneously or secondarily from an episiotomy, which is a surgical incision of the perineum to enlarge the opening for passage of the baby during delivery. Third- and fourth-degree perineal lacerations are severe tears of the vagina and perineum that also may involve tissues of the anus (Royal College of Obstetricians and Gynaecologists, 2007, 2015). Short-term consequences of these lacerations may include pain and infection (Buppasiri et al., 2014; Fitzpatrick et al., 2005), while potential long-term complications include incontinence and fistula formation (Guise et al., 2007). While lacerations during vaginal birth are not completely avoidable, there are measures that can help avoid or lessen their severity. The ACOG has compiled a set of recommendations to mitigate the risk of obstetric lacerations, including the avoidance of routine episiotomy (Committee on Practice Bulletins-Obstetrics, 2018a).

Episiotomy

An episiotomy is a surgical incision of the perineum to enlarge the posterior aspect of the vagina and is generally performed during the second stage of labor. National rates of episiotomy have been decreasing, with approximately 12% of vaginal deliveries including an episiotomy in 2012 (Committee on Practice Bulletins-Obstetrics, 2018a). Current recommendations are to restrict the use of this procedure, including in specific clinical situations, such as shoulder dystocia and operative vaginal delivery for which there is insufficient evidence of benefit of the procedure (Committee on Practice Bulletins-Obstetrics, 2018a).

Methods

Data Sources

Electronic Birth Certificate (EBC) Data: The NJDOH Office of Vital Statistics and Registry (OVSR) has been collecting data on all live births in New Jersey since 1966. Data in this report includes birth records reported through both the Vital Information Platform (VIP) and Vital Events Registration and Information (VERI) platform in 2021, and VERI in 2022. In addition to registering information about the child, EBC contains demographic information including the birthing person's age, race, ethnicity, education status, health insurance status, and health status as well as information about both previous and current pregnancy, including parity and method of delivery.

Inpatient Hospital Discharge Data: The NJDOH Division of Health Care Quality and Informatics (HCQI), Health Care Quality Assessment (HCQA) unit has been collecting data on hospital encounters via the New Jersey Hospital Discharge Data Collection System (NJDDCS) since 1980. As of 2004, the NJDDCS includes emergency, inpatient, outpatient, and same day

surgery discharges. A hospital discharge record contains demographic; geographic; International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) diagnosis and procedure codes; hospital charges; discharge statuses; types of services provided; and other data elements. The NJDOH collects all hospital discharges that occurred in each calendar year. Thus, a 2022 and 2021 birth-related hospitalization that occurs at the end of the calendar year may be reported with 2023 and 2022 discharges, respectively. Moreover, NJDDCS is hospital encounter data where a patient (in this case, a birthing person) could have multiple hospitalizations within the same calendar year. For the purposes of this report, only the first birth-related encounter is included.

The Report Card uses maternal information reported in the EBC and additional data elements from hospital discharge records by matching each birthing person's information with their corresponding hospital discharge clinical information reported through ICD-10-CM diagnosis and procedure codes.

Summary of Steps to Create Analytic File

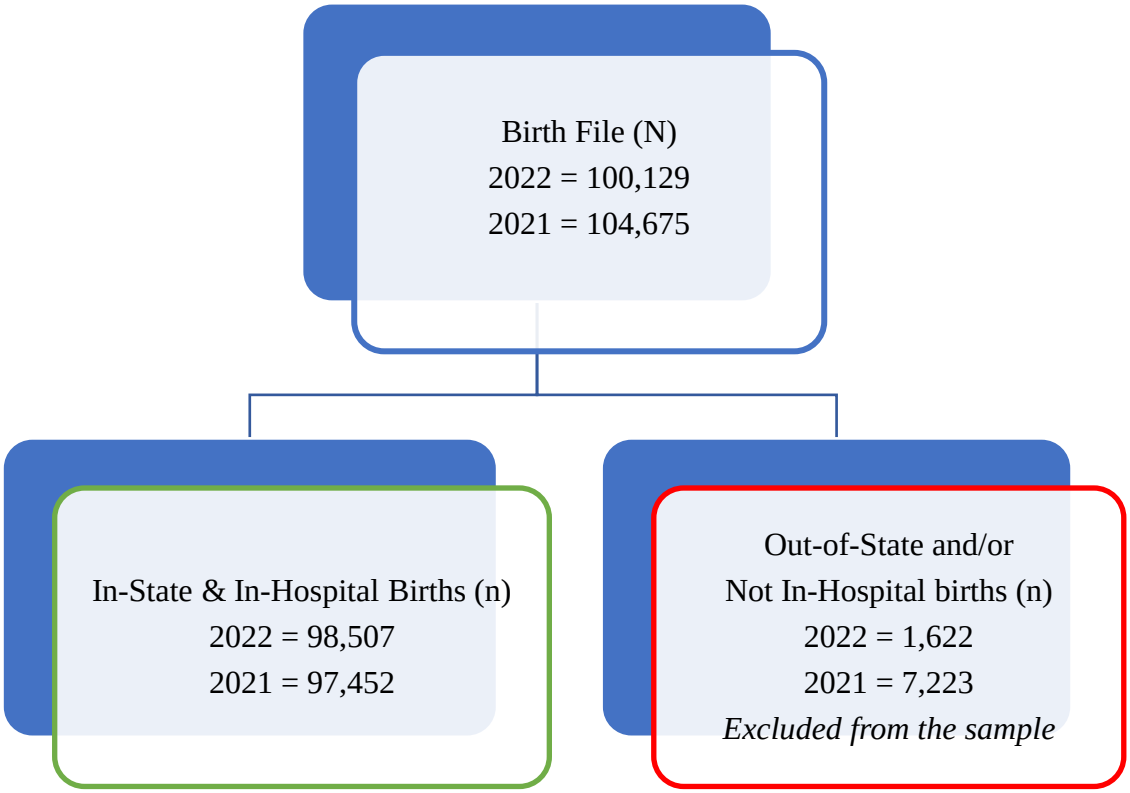
Inpatient Hospitalization Data

- Inclusion criteria
  - All females who gave birth at a hospital in New Jersey
  - 12 to 65 years of age
  - First record for each patient
  - 2021 birth-related hospitalizations
- Exclusion criteria
  - Duplicate records for same encounter
  - Males
  - Younger than 12 years old or older than 65 years old
  - Same-day surgery, emergency room (ER) outpatient or other outpatient discharges

Electronic Birth Certificate Data

- Inclusion criteria
  - All New Jersey hospital births
    - In cases of multiple births, select only one record
- Exclusion criteria
  - All out-of-state births
  - Births in freestanding birthing centers, home, clinic/doctor's office, other/unspecified location
  - Multiple babies to same birthing person except the first record

Figure 1. Birth File Inclusion & Exclusion Criteria



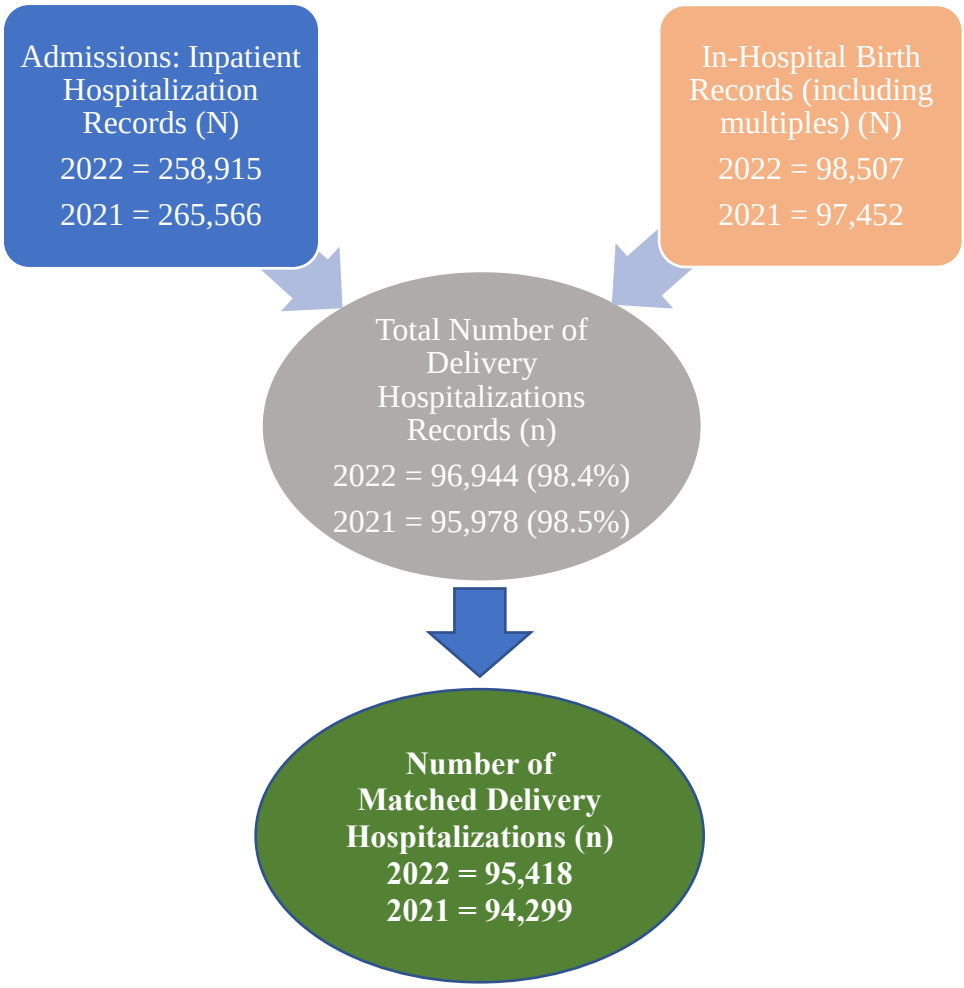
Data Matching

Inpatient delivery hospitalizations and birth certificates records were matched using an algorithm of identifying variables:

(1) Patient level variables (*Birthing people*): First and last name, date of birth, Social Security Number, medical record number, date of admission and discharge
(2) Patient level variable (*Newborn*): Date of birth
(3) Hospital level variable: Hospital code

In cases of multiple births, each infant's birth certificate was matched to the same birthing person's hospital discharge record to ensure that only the delivery hospitalization was selected for the purposes of analysis. Each matched record represents a delivery where at least one live birth occurred. The team accounted for birthing people who were admitted in late December 2022 and discharged in 2023 by linking 2023 birth discharges with late 2022 birth certificates. Similarly, birthing people who were admitted in late December 2021 and discharged in 2022 were captured by linking 2022 birth discharges with late 2021 birth certificates.

Figure 2. Summary of Data Matching Process: EBC to Inpatient Hospitalization Records



Study Population

As part of the process to obtain data to analyze, the team identified 98,507 (2022) and 97,452 (2021) in-hospital deliveries out of the 100,129 (2022) and 104,675 (2021) New Jersey births. These deliveries were comprised of all records including singleton and multiple births. Of the 98,507 (2022) and 97,452 (2021) in-hospital deliveries identified, 96,944 (2022) and 94,978 (2021) deliveries were successfully matched to hospital discharge records for a match rate of 98.5% (2021) and 98.4% (2022). Inability to match all records is due to multiple factors, such as large discrepancies in the reported identifying variables and incidences of non-reported discharge records for some 2022 and 2021 deliveries. However, as no pattern in key characteristics of the unlinked records as compared to linked records was seen, it was concluded that there was no systematic bias introduced by proceeding with the current analyses. To identify the number of delivering birthing people, the first record for each singleton birth or first record of multiple births (e.g., twins, triplets) was used in creating the preliminary analysis file to obtain 95,418 (2022) and 94,299 (2021) linked records.

Once the analytic file was created, the next steps included identifying, defining, and reviewing the required reportable measures as suggested in the statute, namely: hemorrhage (obstetric hemorrhage), laceration (third- and fourth-degree perineal laceration), episiotomy, infections (post-admission infections) and other complications (where SMM is used as proxy).

Identification of Delivery-associated Complications

Obstetric Hemorrhage

The ACOG standard defines hemorrhage as blood loss of greater than 1,000 mL regardless of the method of delivery (i.e., vaginal or cesarean birth) or blood loss accompanied by signs or symptoms of hypovolemia within 24 hours. The maternal blood loss amount reported in cubic centimeter (cc) in the birth certificate data is used to determine the amount of maternal blood loss (hemorrhage) during the delivery hospitalization. There are several caveats when using the above information to identify obstetric hemorrhage. First, there is no specified time period for the blood loss; it is assumed that all hospitals are measuring blood loss during the same time period during the hospitalization. Second, the method of blood loss measurement may not be performed similarly across all facilities; some may use a quantified blood loss measurement method while others may report estimated blood loss. Lastly, there is no specification whether signs of hypovolemia were present, which could aid in the final determination of a true diagnosis of hemorrhage.

Severe Maternal Morbidity as proxy for "Other Complications"

SMM events were identified during delivery hospitalizations using an algorithm developed by researchers at the CDC (CDC, 2017). The algorithm identifies 18 indicators of SMM that represent either life threatening conditions (such as eclampsia or acute renal failure) or procedure codes for life-saving procedures (such as blood transfusion, ventilation, or hysterectomy). The 18 indicators were identified using ICD-10-CM diagnosis codes and procedure codes as prescribed by the CDC (CDC, 2017).

In addition to the above algorithm, to ensure the most conservative estimate of SMM, hospitalizations with a length of stay less than the 90th percentile as calculated separately for vaginal, primary, and repeat cesarean deliveries (Callaghan et al., 2012) were excluded. All SMM hospitalizations associated with in-hospital mortality or transfer-in or -out of the delivery facility, as well as those associated with procedure codes were included, regardless of length of stay. In-hospital death was identified via the discharge status specifying the patient as "expired." Additionally, transfers were identified using both discharge status and admission source information.

Post-admission Infections

A comprehensive list of ICD-10-CM diagnosis codes, presented in Appendix A of this report, along with information from electronic birth certificate (presence of intrapartum infections and clinical chorioamnionitis) data are used to identify all cases of delivery-associated infections that occur during the delivery hospitalization. Additionally, only cases of infection that are not present on admission are included to eliminate instances of pre-admission infections from the final analysis.

Third- and Fourth-degree Perineal Laceration (*vaginal birth only*)

Perineal laceration associated with delivery is divided into two categories: third- and fourth-degree perineal lacerations differentiated by those with and without instrument. To identify perineal lacerations, the Agency for Health care Research and Quality (AHRQ) Patient Safety Indicator PSI 18 and PSI 19 definitions and associated ICD-10-CM diagnosis codes, as well as the occurrence of a third- or fourth-degree perineal laceration as reported in the electronic birth certificate data were used (see Appendix A). Perineal laceration is associated with having a large baby (Groutz et al., 2011; Vale de Castro et al., 2016), therefore in addition to the AHRQ PSI guidelines, vaginal delivery hospitalizations excluding those with overweight babies (those weighing greater than 4,000 grams) are included in the rate calculation of this complication to account for the variable distribution of overweight babies in our NJ delivery hospitalizations.

Episiotomy (*vaginal birth only*)

To identify episiotomy, the associated ICD-10-CM procedure code, 0W8NXZZ, was used (see Appendix A). To account for providers that may follow the guideline to use episiotomy for management of shoulder dystocia (Royal College of Obstetricians and Gyneacologists, 2015), only vaginal delivery hospitalizations excluding those with shoulder dystocia are included in the rate calculation of this complication.

Risk Factors for Delivery-Associated Complications

The observed complication rate for a measure in each facility is estimated as the number of patients that experienced the complication during the delivery hospitalization divided by the total number of delivery hospitalizations at risk for that complication in that facility during the same time period. However, this observed complication rate does not provide a fair assessment of the quality of care provided by the facility or providers, because it does not account for potential risk factors present prior to hospitalization. When assessing outcomes, it is important to account for differences in patient characteristics; for example, hospitals (facilities) that serve a larger share of patients with pre-existing health conditions, such as cardiac or respiratory diseases, would be expected to have higher rates of complications.

To perform a fairer assessment of the quality of maternal health care provided by NJ hospitals that perform deliveries, NJDOH uses risk-adjustment to estimate complication rates. Risk adjustment is a method to account for the pre-delivery risk factors of each patient that may affect health care outcomes and improve comparability of results. In doing so, hospitals that serve more high-risk patients will not be at a disadvantage when their estimated rates are presented side-by-side with facilities that serve healthier patients. Risk adjustment is performed using statistical regression modeling - an indirect method of standardization. A mixed effects stepwise logistic regression model was fitted for the outcome of interest, and risk factors that were controlled for included social, demographic and pre-hospitalization risk factors. For each reported outcome, the selected risk factors were identified based on a literature review and expert consultations using the principles of appropriateness, viability (i.e., sufficient number of events) and data availability. The fitted model was used to obtain the predicted number of complications for each hospital, which is then used to compare against the observed number of complications for each hospital. Further details on the statistical risk adjustment methodology are provided in the following section.

The pre-delivery risk factors used in the statistical models include birthing people's socio-demographic characteristics (e.g., race/ethnicity, age, health insurance coverage, educational attainment, marital status), and clinical and obstetric factors (e.g., parity, method of delivery, body mass index, prenatal care) (see Table 1 below). We also adjusted for clinical comorbidities (e.g., diabetes; hypertension; chronic liver, respiratory, cardiac and renal diseases; placental disorders) as well as behaviors associated with increased risk of complications (e.g., tobacco use, alcohol and illicit substance use) (Table 1). These factors were obtained from ICD-10-CM diagnosis codes as reported through the hospitalization database and the information in the electronic birth certificate. A report, which assessed the validity of information obtained from birth files compared with that in hospital discharge data, shows that a combination of the two data sources is most accurate (Lydon-Rochelle et al., 2005). In this report:

- A complication is considered if documented by a corresponding diagnosis code, or if it was identified on the birth file; and
- Method of delivery is defined as specified by the Agency for Health care Research and Quality Inpatient Quality Indicator 33 to identify primary and repeat cesarean deliveries.

Table 1. List of Covariables Considered for Analysis

	Values/Categories
Sociodemographic Characteristics	
Race/Ethnicity	Non-Hispanic White Non-Hispanic Black Hispanic Non-Hispanic Asian Other/Multi-race
Maternal Age	Years
Educational Status	College/College+ (Some College/Associate's, Bachelor's, and Graduate Degree) High School/Less than High School
Health Insurance Coverage	Private Insurance Medicaid Self-Pay/Charity Care Other
Marital Status	Married Not Married
Clinical & Obstetric Factors / Comorbidities	
Method of Delivery	Vaginal *(with and without instrument)* Cesarean *(Primary, Repeat)*
Parity	Nulliparous Multiparous
Gestational Age	Premature - *before 37 weeks of gestation* Mature - *after 37 weeks of gestation*
Diabetes Mellitus (Gestational & Preexisting)	Yes/No
Hypertension (Gestational & Preexisting)	Yes/No

Chronic Disease: Cardiac, Renal, Respiratory, Liver	Yes/No
Placental Disorders (Placenta Abruptio, Previa and /or Accreta)	Yes/No
Uterine ruptured and/or Uterine atony	Yes/No
HIV status	Positive/Negative
Prenatal Care Utilization	Early (First Trimester) Late/None (None, Second, or Third Trimester)
Pre-pregnancy Body Mass Index (BMI)	Underweight (Below 18.5) Normal (18.5 - 24.9) Overweight (25.0 - 29.9) Obese (30.0 and above)
Length of Labor	Precipitous Labor (Less than 3 hours) Prolonged Labor (Greater than or equal to 20 hours)
Infant Birthweight	Low birthweight less - *than 2,500 grams* Normal-birthweight - *between 2,500 grams and 4,000 grams* Overweight (macrosomia) - *over 4,000 grams*
Induction of Labor (Labor induction is the process or treatment that stimulates childbirth and delivery)	Yes/No
Epidural or Spinal Anesthesia	Yes/No
Shoulder Dystocia	Yes/No
Premature Rupture of Membranes (PROM)	Yes/No
Admission to Intensive Care Unit (ICU)*	Yes/No *Maternal admission to ICU anytime during delivery hospitalization
Arrested Progress of labor*	Yes/No *Arrested active phase of labor; hypotonic uterine dysfunction or uterine inertia during latent phase of labor
Preexisting Anemia	Yes/No
Preeclampsia	Yes/No
Infection-Chorioamnionitis	Yes/No
Transfer status (birthing people transferred from another facility) prior to delivery	Yes/No
COVID-19 positive status at time of delivery*	Yes/No *COVID-19 PCR test positive two days prior or after date of admission OR ICD-10 code U07.1 on delivery discharge bill
Substance Use	Yes/No
Alcohol Use	Yes/No
Tobacco Use	Yes/No

*Data source: Communicable Disease Reporting and Surveillance System (CDRSS), New Jersey Department of Health

Statistical Analysis

Risk Adjustment

Population served varies across hospitals, which may result in variation of delivery outcomes. Therefore, to ensure each NJ birthing facility gets a fair assessment, it is paramount to account for each hospital's patient characteristics (race/ethnicity, age, etc.) and clinical and obstetric risk factors (e.g., hypertension, diabetes, uterine disorders) using risk adjustment. Using a random intercept multivariable logistic regression analysis method, an indirect method of standardization, researchers can control for patient characteristics and other risk factors that may affect birth outcomes.

A mixed effects stepwise logistic regression model, which included the previously discussed pre-delivery clinical factors and demographic characteristics, was fitted to the data for each category of delivery-associated complication for the periods covered in this report. The models identified the risk factors important in predicting whether a patient would experience the specific complication under investigation. The general form of the mixed effect logistic regression model for estimating the "logit" of the probability of experiencing the complication of interest is as follows (SAS Institute Inc., 2017):

$$E[Y|\gamma] = g^{-1}(X\beta+Z\gamma)$$

Y = (n x 1) vector of observed values of dependent variable, where n = number of observations
X = (n x p) matrix of fixed effects, where n = number of observations, p = proportion of sample elements that have a particular attribute
β = vector of regression coefficients for fixed-effects parameters
Z = (n x r) design matrix for the random effects, where n = number of observations, r = sample correlation coefficient, based on all the elements from a sample
γ = (r x 1) vector of random effects, where r = sample correlation coefficient, based on all the elements from a sample
g = differentiable monotonic link function (g^{-1} is the inverse)

The statistically significant factors for each complication identified by stepwise logistic regression models are presented in Tables 2a-4b. Each list includes only those factors that were statistically significant in predicting the class of complication under investigation with p-values of 0.05 or smaller.

These models were used to predict the number of a given complication type, which was then compared with the observed rates to create the adjustment factor. This adjustment factor was then applied to the statewide rate for the given complication type to produce the risk-adjusted rate for the hospital.

$$Risk\ Adj\ Rate = \frac{Observed}{Expected} \times Statewide\ rate$$

Ninety-five percent confidence intervals were calculated for the risk adjusted rate using the following formula (Kahn, 1989):

$$CI_{ISR} = \pm 1.96 \sqrt{\frac{(Observed/Expected)}{Expected}} \times Statewide\ rate$$

Rates with confidence intervals above the statewide rate were deemed significantly higher than the statewide rate, and conversely hospitals with confidence intervals below the statewide rate were considered to have significantly lower rates than the statewide rate.

The odds ratios are derived from the coefficients and are used to compare the relative importance of the risk factors in predicting complications during delivery. For each of the risk factors identified in Tables 2a-4b, the odds ratio represents how likely a patient is to develop complications compared to a patient in the reference group. For example, Table 2a shows that a delivering birthing person is almost seven times (odds ratio = 6.97) as likely to experience an obstetric hemorrhage after surgical/cesarean birth (primary, repeat) with no placental or uterine disorders compared to a delivering birthing person who did not have the surgical/cesarean birth or have any placental or uterine disorders. In another example, the odds of developing post-admission infection during the delivery hospitalization for a delivering birthing person who is nulliparous is about two times (odds ratio = 1.9) compared with that of a birthing person who is multiparous (Table 3a).

Table 2a. Risk Factors Identified for Obstetric Hemorrhage in 2022

Patient Risk Factors Identified	**Logistic Regression Results**		
	Coefficient	P-value	Odds Ratio
Demographic Factors			
Race/Ethnicity			
Non-Hispanic Asian	-0.06	0.31	0.94
Hispanic	0.12	0.002	1.12
Non-Hispanic Black	0.19	0.0001	1.21
Other/Multi-race	0.06	0.57	1.06
Non-Hispanic White	*Ref.*		
Maternal Age	0.03	<0.0001	1.03
Clinical & Obstetric factors/Comorbidities			
Method of Delivery			
Cesarean *(Primary, Repeat)* No Placental or Uterine Disorders	1.94	<0.0001	6.97
Cesarean *(Primary, Repeat)* with Placental or Uterine Disorders	3.49	<0.0001	33.04
Vaginal with Placental or Uterine Disorders	2.49	<0.0001	12.14
Vaginal and No Placental or Uterine Disorders	*Ref.*		
Nulliparous			
Yes	0.23	<0.0001	1.26
No	*Ref.*		
Induction of Labor			
Yes	0.33	<0.0001	1.39
No	*Ref.*		
Infant Birthweight			
Low Birthweight	-0.15	0.007	0.86
Overweight	0.58	<0.0001	1.79
Normal Birthweight	*Ref.*		
Infection-Chorioamnionitis			
Yes	0.72	<0.0001	2.05
No	*Ref.*		
Preexisting Anemia			
Yes	0.25	<0.0001	1.29
No	*Ref.*		
Preeclampsia			
Yes	0.11	0.007	1.12
No	*Ref.*		
ICU Admission			
Yes	1.01	<0.0001	2.75
No	*Ref.*		
Pre-pregnancy Body Mass Index (BMI)			
Overweight/Obese	0.12	0.0003	1.13
Underweight	-0.13	0.29	0.89
Normal	*Ref.*		

Table 2b. Risk Factors Identified for Obstetric Hemorrhage in 2021

Patient Risk Factors Identified	**Logistic Regression Results**		
	Coefficient	P-value	Odds Ratio
Demographic Factors			
Race/Ethnicity			
Non-Hispanic Asian	-0.06	0.24	0.93
Hispanic	0.16	<0.0001	1.18
Non-Hispanic Black	0.21	<0.0001	1.24
Other/Multi-race	0.14	0.15	1.15
Non-Hispanic White	*Ref.*		
Maternal Age	0.03	<0.0001	1.03
Clinical & Obstetric factors/Comorbidities			
Method of Delivery			
Cesarean *(Primary, Repeat)* No Placental or Uterine Disorders	1.92	<0.0001	6.88
Cesarean *(Primary, Repeat)* with Placental or Uterine Disorders	3.05	<0.0001	21.13
Vaginal with Placental or Uterine Disorders	2.68	<0.0001	14.68
Vaginal and No Placental or Uterine Disorders	*Ref.*		
Nulliparous			
Yes	0.32	<0.0001	1.38
No	*Ref.*		
Induction of Labor			
Yes	0.3	<0.0001	1.35
No	*Ref.*		
Infant Birthweight			
Low Birthweight	-0.14	0.009	0.86
Overweight	0.6	<0.0001	1.82
Normal Birthweight	*Ref.*		
Infection-Chorioamnionitis			
Yes	0.71	<0.0001	2.02
No	*Ref.*		
Preexisting Anemia			
Yes	0.27	<0.0001	1.32
No	*Ref.*		
Preeclampsia			
Yes	0.15	0.0002	1.17
No	*Ref.*		
ICU Admission			
Yes	1.11	<.0001	3.03
No	*Ref.*		
Pre-pregnancy Body Mass Index (BMI)			
Overweight/Obese	0.11	0.001	1.11
Underweight	-0.31	0.02	0.72
Normal	*Ref.*		

Table 3a. Risk Factors Identified for Post-admission Infection in 2022

Patient Risk Factors Identified	Logistic Regression Results		
	Coefficient	P-value	Odds ratio
Demographic Factors			
Race/Ethnicity			
Non-Hispanic Asian	0.59	<0.0001	1.82
Hispanic	0.53	<0.0001	1.70
Non-Hispanic Black	0.55	<0.0001	1.73
Other/Multi-race	0.07	0.67	1.07
Non-Hispanic White	*Ref.*		
Maternal Age	-0.02	<0.0001	0.98
Health Insurance			
Medicaid	0.20	0.001	1.22
Self-Pay/Charity Care	0.19	0.13	1.21
Private Insurance	*Ref.*		
Clinical & Obstetric factors/ Comorbidities			
Method of Delivery & Prolonged Length of Labor (> or = 20 hours)			
Cesarean, No Prolonged labor	0.46	<0.0001	1.58
Cesarean, Prolonged labor	0.99	<0.0001	2.72
Vaginal, Prolonged labor	1.16	<0.0001	3.18
Vaginal, No Prolonged labor	*Ref.*		
Pre-pregnancy Body Mass Index (BMI)			
Overweight/Obese	-0.03	0.55	0.97
Underweight	-0.46	0.01	0.63
Normal	*Ref.*		
Induction of Labor			
Yes	0.44	<0.0001	1.55
No	*Ref.*		
Premature Rupture of Membranes (PROM)			
Yes	0.63	<0.0001	1.87
No	*Ref.*		
Epidural or Spinal Anesthesia			
Yes	0.93	<0.0001	2.52
No	*Ref.*		
Nulliparous			
Yes	0.64	<0.0001	1.9
No	*Ref.*		
Arrested Progress of labor			
Yes	0.88	<0.0001	2.41
No	*Ref.*		
ICU admission			
Yes	0.89	<0.0001	2.45
No	*Ref.*		
COVID-19 Positive status at time of delivery			
Yes	0.35	0.001	1.41
No	*Ref.*		

Table 3b. Risk Factors Identified for Post-admission Infection in 2021

Patient Risk Factors Identified	Logistic Regression Results		
	Coefficient	P-value	Odds ratio
Demographic Factors			
Race/Ethnicity			
Non-Hispanic Asian	0.50	<0.0001	1.56
Hispanic	0.51	<0.0001	1.67
Non-Hispanic Black	0.37	<0.0001	1.45
Other/Multi-race	-0.03	0.86	0.96
Non-Hispanic White	*Ref.*		
Maternal Age	-0.01	0.0001	0.98
Health Insurance			
Medicaid	0.17	0.007	1.18
Self-Pay/Charity Care	0.36	0.001	1.43
Private Insurance	*Ref.*		
Clinical & Obstetric factors/ Comorbidities			
Method of Delivery & Prolonged Length of Labor (> or = 20 hours)			
Cesarean, No Prolonged labor	0.23	0.0001	1.26
Cesarean, Prolonged labor	0.56	0.0003	1.76
Vaginal, Prolonged labor	0.93	<0.0001	2.55
Vaginal, No Prolonged labor	*Ref.*		
Infant Birthweight			
Low Birthweight	0.06	0.46	1.06
Overweight	0.26	0.002	1.30
Normal Birthweight	*Ref.*		
Induction of Labor			
Yes	0.41	<0.0001	1.5
No	*Ref.*		
Premature Rupture of Membranes (PROM)			
Yes	0.63	<0.0001	1.89
No	*Ref.*		
Epidural or Spinal Anesthesia			
Yes	0.61	<0.0001	1.83
No	*Ref.*		
Nulliparous			
Yes	1.01	<0.0001	2.73
No	*Ref.*		
Arrested Progress of labor			
Yes	0.9	<0.0001	2.47
No	*Ref.*		
ICU admission			
Yes	0.91	<0.0001	2.48
No	*Ref.*		
COVID-19 Positive status at time of delivery			
Yes	0.45	0.004	1.58
No	*Ref.*		

Table 4a. Risk Factors Identified for Severe Maternal Morbidities with Transfusion in 2022

Patient Risk Factors Identified	**Logistic Regression Results**		
	Coefficient	P-value	Odds Ratio
Demographic Factors			
Race/Ethnicity			
Non-Hispanic Asian	0.14	0.13	1.15
Hispanic	0.14	0.03	1.15
Non-Hispanic Black	0.31	<0.0001	1.37
Other/Multi-race	0.35	0.01	1.42
Non-Hispanic White	*Ref.*		
Maternal Education			
College/College+ (Some College/Associate's, Bachelor's, and Graduate Degree)	-0.18	0.001	0.84
High School/Less than High School	*Ref.*		
Clinical & Obstetric factors / Comorbidities			
Method of Delivery			
Cesarean *(Primary, Repeat)* and No Postpartum Hemorrhage	0.94	<0.0001	2.55
Cesarean *(Primary, Repeat)* w/ Postpartum Hemorrhage	2.72	<0.0001	15.21
Vaginal with Postpartum Hemorrhage	3.37	<0.0001	28.98
Vaginal and No Postpartum Hemorrhage	*Ref.*		
Infection-Chorioamnionitis			
Yes	0.68	<0.0001	1.96
No	*Ref.*		
Gestational Age			
Premature (before 37 weeks of gestation)	0.69	<0.0001	2.01
Mature (after 37 weeks of gestation)	*Ref.*		
Nulliparous			
Yes	0.15	0.007	1.16
No	*Ref.*		
Pre-pregnancy Body Mass Index (BMI)			
Overweight/Obese	-0.19	0.0002	0.82
Underweight	0.22	0.13	1.25
Normal	*Ref.*		
Preexisting Cardiac Disease			
Yes	0.97	<0.0001	2.64
No	*Ref.*		
Preexisting Renal Disease			
Yes	0.82	<0.0001	2.28
No	*Ref.*		
Prenatal Care Initiation			
No care obtained/Prenatal care initiated late	0.16	0.002	1.18
Prenatal care initiated during first trimester	*Ref.*		
COVID-19 Positive status at time of delivery			
Yes	0.31	0.01	1.36
No	*Ref.*		

Uterine or Placental disorders			
Yes	0.78	<0.0001	2.19
No	*Ref.*		
Arrested Progress of Labor			
Yes	0.36	<0.0001	1.44
No	*Ref.*		
Preexisting Anemia			
Yes	0.85	<0.0001	2.34
No	*Ref.*		
Preeclampsia			
Yes	0.64	<0.0001	1.89
No	*Ref.*		

Table 4b. Risk Factors Identified for Severe Maternal Morbidities with Transfusion in 2021

Patient Risk Factors Identified	**Logistic Regression Results**		
	Coefficient	P-value	Odds Ratio
Demographic Factors			
Race/Ethnicity			
Non-Hispanic Asian	0.32	0.0004	1.38
Hispanic	0.26	0.0001	1.3
Non-Hispanic Black	0.33	<0.0001	1.4
Other/Multi-race	0.04	0.79	1.04
Non-Hispanic White	*Ref.*		
Maternal Education			
College/College+ (Some College/Associate's, Bachelor's, and Graduate Degree)	-0.11	0.03	0.88
High School/Less than High School	*Ref.*		
Clinical & Obstetric factors / Comorbidities			
Method of Delivery			
Cesarean *(Primary, Repeat)* and No Postpartum Hemorrhage	0.96	<0.0001	2.63
Cesarean *(Primary, Repeat)* w/ Postpartum Hemorrhage	2.73	<0.0001	15.34
Vaginal with Postpartum Hemorrhage	3.43	<0.0001	30.95
Vaginal and No Postpartum Hemorrhage	*Ref.*		
Gestational Age			
Premature (before 37 weeks of gestation)	0.71	<0.0001	2.05
Mature (after 37 weeks of gestation)	*Ref.*		
Pre-pregnancy Body Mass Index (BMI)			
Overweight/Obese	-0.12	0.01	0.88
Underweight	0.21	0.19	1.23
Normal	*Ref.*		
Prenatal Care Initiation			
No care obtained/Prenatal care initiated late	0.16	0.002	1.18
Prenatal care initiated during first trimester	*Ref.*		
COVID-19 Positive status at time of delivery			
Yes	0.61	<0.0001	1.85
No	*Ref.*		
Uterine or Placental disorders			
Yes	0.82	<0.0001	2.28
No	*Ref.*		
Arrested Progress of Labor			
Yes	0.18	0.01	1.21
No	*Ref.*		
Preexisting Anemia			
Yes	0.81	<0.0001	2.27
No	*Ref.*		
Preeclampsia			
Yes	0.76	<0.0001	2.14
No	*Ref.*		

Infection-Chorioamnionitis			
Yes	0.57	<0.0001	1.78
No	*Ref.*		
Drugs and/or Alcohol Abuse			
Yes	0.36	0.03	1.43
No	*Ref.*		

Limitations

Obstetric Hemorrhage

Hemorrhage rates should be considered carefully. While they are defined using a nationally recognized standard definition and identified using the report of quantity of blood loss, there are limitations to consider with the reported quantities. There is no standard method for measuring the quantity of blood loss because there is no universal system of timing and manner of measurement. Therefore, a variation in the methods of recording blood loss volume may be occurring between hospitals. Additionally, the new ACOG definition does not account for method of delivery (Committee on Practice Bulletins-Obstetrics, 2017). Finally, other clinical factors used to assess the clinical impact of blood loss (such as other signs of hypovolemia) are not reported. Moreover, in cases where there is a large amount of amniotic fluid or irrigation, it may be difficult to provide an exact quantity for the loss of blood (Lagrew et al., 2022). Therefore, comparing rates across hospitals should be done with these limitations in mind.

Severe Maternal Morbidities (SMM) with Transfusion

In the transition from ICD-9-CM to ICD-10-CM coding schema, the codes specified by the CDC to identify transfusion rely on the hospital to identify the route of administration. This coding scheme does not appear to be universally used by all hospitals, which results in difficulty identifying transfusions. This results in an underestimation of the extent of transfusions in some facilities, although it is noted that since the first report of 2016 data, hospitals do appear to be addressing this concern as staff have likely become more familiar with the new coding schema. Additionally, the inclusion of transfusion, which some consider a useful proxy for determining cases of hemorrhage with other complications such as eclampsia or aneurysm implies that transfusion is a negative outcome. However, high transfusion rates may reflect an appropriate recognition and response to the underlying cause for needing a transfusion.

Post-admission Infection

Currently, there is no standard definition of "post-admission delivery-associated infection." The definition used to identify infection in the current report reflects a carefully considered list of diagnoses that reflect clinically rational and significant post-delivery genitourinary tract and other infections that represent quality of maternal care and not just a general infection. Additionally, it is recognized that most delivery-associated infections are diagnosed and treated post-discharge from the hospital (Yokoe et al., 2001). The current report examines only the *delivery hospitalization*; therefore, the rate of infection is likely underestimated.

Third- and Fourth-degree Perineal Lacerations

The use of rates of third- and fourth-degree perineal lacerations as a performance metric for maternal care has been recently questioned. A study determined that operative delivery and shoulder dystocia were the factors with greatest risk of lacerations. However, the measures to reduce lacerations, such as avoiding operative vaginal delivery, may inadvertently lead to higher rates of cesarean births (Friedman et al., 2015). Given the current stated goals of reducing cesarean rates in NJ, lacerations may be unavoidable in certain circumstances. As such,

interpretation of rates needs to be done with care and with consideration for the characteristics of the hospital's patient mix.

Episiotomy

An episiotomy is usually done to facilitate the delivery of an infant; however, the procedure confers a risk of advanced perineal tears and obstetric anal sphincter injuries (OASIS). Additionally, evidence of effectiveness of the procedure in managing shoulder dystocia is also lacking (Committee on Practice Bulletins-Obstetrics, 2018a). Current recommendations are to limit routine use of episiotomy; clinical judgement to determine appropriate use. As such, rates of episiotomy vary greatly among hospitals in NJ. This may be more a reflection of hospital culture and provider training/preference than delivery complication. As such, interpretation of episiotomy rates should be conducted within the context of the other reported metrics.

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Appendix A: Inclusion & Exclusion Criteria to Identify Reported Complications

Obstetric Hemorrhage

Denominator:

All delivery hospitalizations; stratified by method of delivery:

- Cesarean
- Vaginal – assumption that all delivery hospitalizations not identified as cesarean were vaginal deliveries

Numerator:

Maternal Blood Loss – reported as cubic centimeter (cc) in Electronic Birth Certificate (EBC) – any blood loss greater than or equal to 1,000 mL regardless of vital signs or method of delivery as Obstetric Hemorrhage

Post-admission Infection

Denominator:

All delivery hospitalizations; stratified by method of delivery:

- Cesarean
- Vaginal – assumption that all delivery hospitalizations not identified as cesarean were vaginal deliveries

Numerator:

EBC identified cases (coded response and EBC field category and name)	
Yes	Characteristics of Labor and Delivery: Intrapartum Infection
Yes	Characteristics of Labor and Delivery: Clinical Chorioamnionitis
Hospital Discharge identified cases (ICD-10 codes and diagnosis)	
O860	Infection of obstetric surgical wound
O8600	Infection of obstetric surgical wound, unspecified
O8601	Infection of obstetric surgical wound, superficial incisional site
O8602	Infection of obstetric surgical wound, deep incisional site
O8603	Infection of obstetric surgical wound, organ and space site
O8609	Infection of obstetric surgical wound, other surgical site

O8612	Endometritis following delivery
O8621	Infection of kidney following delivery
O8681	Puerperal septic thrombophlebitis
O8689	Other specified puerperal infections
O41121x	Chorioamnionitis, first trimester
O41122x	Chorioamnionitis, second trimester
O41123x	Chorioamnionitis, third trimester
O41129x	Chorioamnionitis, unspecified trimester

Note: Inclusion (specific to ICD-10 identified cases): cases in which Present on Admission 'No' included

Third- and Fourth-degree Perineal Lacerations

Denominator:

Vaginal delivery hospitalizations only; stratified by use of instrument during delivery (with vs. without instrument) as defined in U.S. Agency for Health care Research and Quality (AHRQ) PSI 18 and PSI 19

Deliveries of normal/low-birth weight babies (<4,000 grams at birth, reported in EBC)

Numerator:

EBC identified cases (coded response and EBC field category and name)	
Yes	RH Immune, Birthing people's Morbidity & Discharge Information: Third- or fourth-degree perineal laceration
Hospital Discharge identified cases (ICD-10 codes and diagnosis)	
O702	Third degree perineal laceration during delivery
O7020	Third degree perineal laceration during delivery, unspecified
O7021	Third degree perineal laceration during delivery, IIIa
O7022	Third degree perineal laceration during delivery, IIIb
O7023	Third degree perineal laceration during delivery, IIIc
O703	Fourth degree perineal laceration during delivery

Episiotomy

Denominator:

Vaginal delivery hospitalizations only (as identified via linkage of EBC to in-hospital discharge data); excluding deliveries with shoulder dystocia diagnoses (as per CMQCC* definition)

Numerator:

Hospital Discharge identified cases (ICD-10 codes and procedure)	
0W8NXZZ	Division of Female Perineum, External Approach

*CMQCC – California Maternal Quality Care Collaborative

Severe Maternal Morbidity

Denominator:

All delivery hospitalizations (as identified via linkage of EBC to in-hospital discharge data); stratified by method of delivery

- Cesarean (see definition below)
- Vaginal – assumption that all delivery hospitalizations not identified as cesarean were vaginal deliveries

Numerator:

All SMM hospitalizations associated with in-hospital mortality or transfer-in or -out of the delivery facility, as well as those associated with procedure codes were included, regardless of length of stay; hospitalizations with a length of stay less than the 90th percentile as calculated separately for vaginal, primary, and repeat cesarean deliveries (Callaghan et al., 2012) were then excluded.

The 18 indicators were identified using ICD-10-CM diagnosis codes and procedure codes as prescribed by the CDC, listed here.