New Jersey Hospital Maternity Care Report Card, 2023

Methodology

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OFFICE OF HEALTHCARE QUALITY AND INFORMATICS

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Table of Contents

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 College of Obstetricians and Gynecologists.

Fulfillment of Statute

In fulfilling the statutory requirement, 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.

The 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.

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 labor and shortly after delivery (Beck et al., 2018; Sigurdardottir et al., 2017), which could be influenced by a multitude of maternal morbidities and/or delivery complications. These morbidities and complications often 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 and their 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 specifically to 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 when determining the most appropriate hospital for the patients' health care and labor and delivery needs.

In this report, NJDOH uses data collected on all hospital-based births in New Jersey 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, if the corresponding hospital's rate confidence bound is completely above the statewide rate, then a hospital's rate is deemed statistically significantly higher than the statewide rate. Conversely, if the hospital's rate confidence bound falls below the statewide rate, then the hospital's rate is statistically significantly lower than the statewide rate.

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

Obstetric Hemorrhage

Per the American College of Obstetricians and Gynecologists (ACOG), obstetric hemorrhage is a cumulative blood loss greater than 1,000 mL, regardless of the method of delivery (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 2021, about 9% of pregnancy-related deaths were attributed to hemorrhage (CDC, 2024c). According to the NJ Maternal Mortality Report 2016-2018, of the 44 cases reported, 8 (18.2%) pregnancy-related deaths were attributed to hemorrhage (Nantwi, Kraus, & Slutzky, 2022). Considering the potential negative maternal health outcomes linked to obstetric hemorrhage, health care providers are encouraged to closely assess potential risk factors and be ready to implement multidisciplinary and multifaceted guidelines to maintain hemodynamic stability and normal ranges of vital signs, 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, 2024b). 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 national rate of SMM has been steadily increasing in recent years (CDC, 2024b; Hirai et al., 2022). A recent study found that factors such as advanced maternal age, racial or ethnic minority group, cesarean delivery, and having one or more comorbidities are associated with higher risk of SMM (Fink et al., 2023). Considering the potential consequences of SMM on a birthing person's health, the CDC recommends monitoring trends and implementing interventions to improve maternal care quality (CDC, 2024b).

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 PMSS data from 2021, about 49% of pregnancy-related mortality were attributed to infections or sepsis (CDC, 2024c). Per the NJ Maternal Mortality Report 2016-2018, of the 44 cases reported, 3 (6.8%) 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 delivery (Acosta et al., 2014). Current recommendations for prevention of infections include, but are not limited to, 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 (Leth et al., 2009; 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 because of 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. The national average rate of episiotomy decreased from 12.5% in 2012 to 4.6% in 2022 (Leapfrog Group, 2023). 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 the Vital Events Registration and Information (VERI) platform. In addition to registering information about the baby, 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 Office of Healthcare 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. NJDOH collects all hospital discharges that occurred in each calendar year. Thus, a 2023 birth-related hospitalization that occurs at the end of the calendar year may be reported with 2024 discharges. 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.

Maternal Health Hospital Report Card Survey Data: The NJDOH Office of HCQI, Health Services Research (HSR) unit started collecting data from licensed birthing general acute care hospitals on key facility attributes in 2023. Data collected that are used for the Report Card dashboard include availability of lactation consultants, midwives, neonatologists, perinatologists, special care nursery (SCN), and neonatal intensive care unit (NICU). Additionally, data on hospitals' baby-friendly status as well as training of health care providers on implicit and explicit bias are collected. Details of the survey questions and metrics are found in Appendix A and B.

Hospital Patient Staffing Report Data: The NJDOH Office of HCQI, HCQA unit collects specific nurse staffing data. For the Report Card dashboard metric, the average monthly ratio of patients (frequently defined as birthing person-baby couplet) to registered professional nurse in obstetric (postpartum) care that hospitals report to NJDOH are used.

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

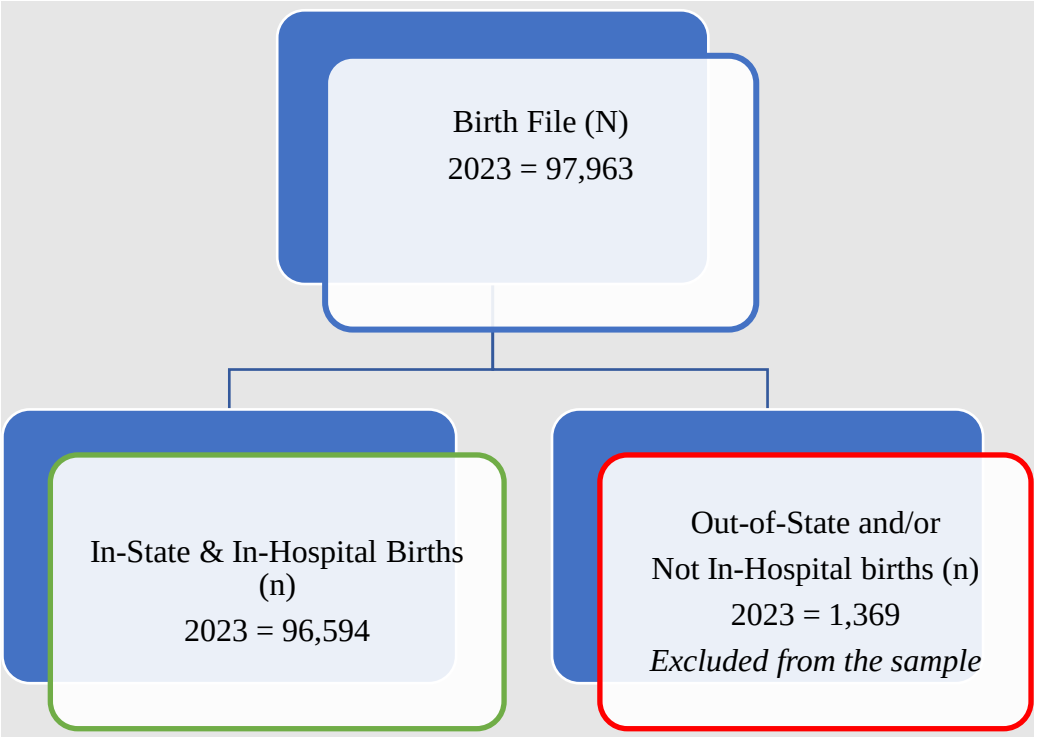
Inpatient Hospitalization Data

- Inclusion criteria
  - All females who gave birth at a hospital in New Jersey
  - 12 to 65 years of age
  - First record for each patient
  - 2023 birth-related hospitalizations
- Exclusion criteria
  - Duplicate records for same hospital delivery 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



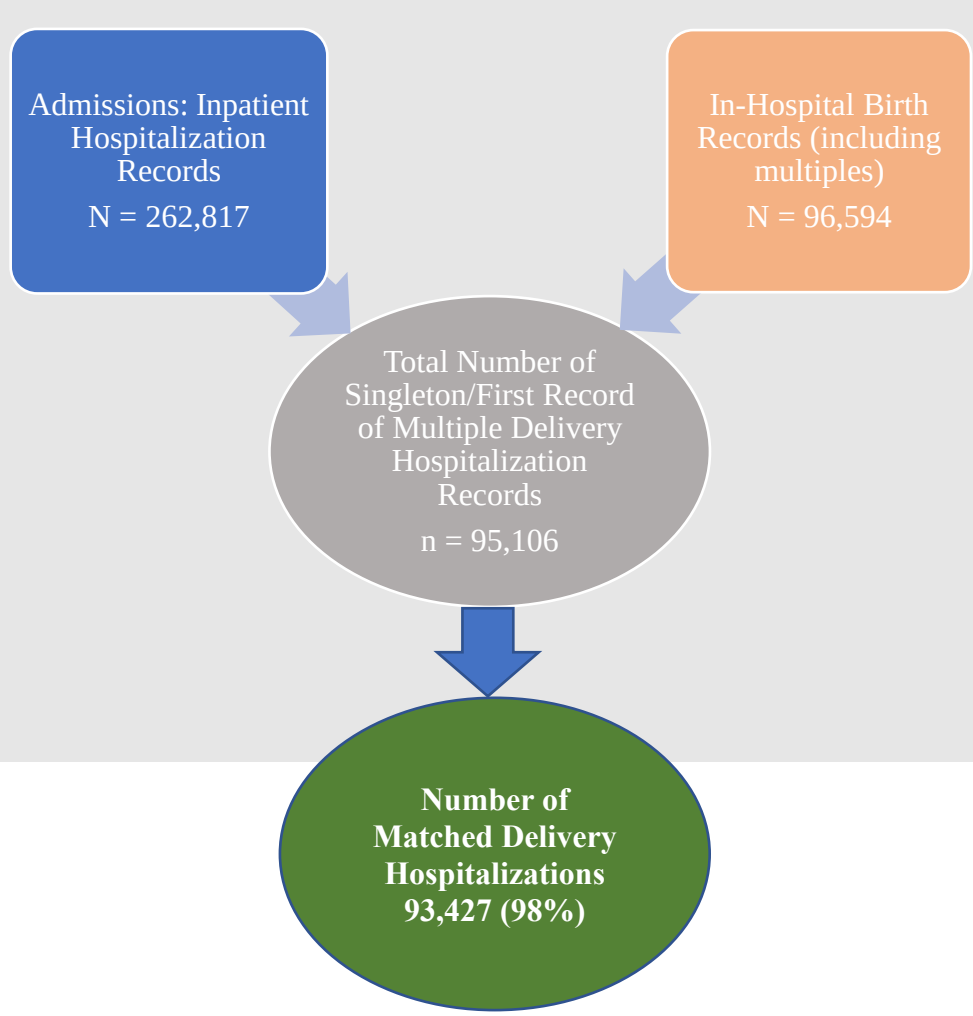
Data Matching

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, medical record number, date of discharge, zip code
(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 2023 and discharged in 2024 by linking 2024 birth discharges with late 2023 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, 96,594 in-hospital deliveries, out of the 97,963 New Jersey births that occurred in 2023, were identified from EBC records (see Figure 1 above). These deliveries comprised singleton and multiple births. Of 95,106 singleton or first record of multiple births, 93,427 were successfully matched to hospital discharge records (n=262,817) for a match rate of 98% (see Figure 2 above). 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 2023 deliveries. However, as no pattern in key sociodemographic and clinical characteristics of the unlinked records as compared to linked records was seen, it was concluded that there was no systematic bias introduced.

Once the analytic file was created, the next steps included identifying, defining, and reviewing the required reportable measures as suggested in the statute, namely: obstetric hemorrhage, post-admission infections, third- and fourth-degree perineal laceration, episiotomy, 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 EBC data is used to determine the amount of maternal blood loss (hemorrhage) during the delivery hospitalization.

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, 2024a). The algorithm identifies 21 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 21 indicators were identified using ICD-10-CM diagnosis codes and procedure codes as prescribed by the CDC (CDC, 2024a).

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 (see corresponding Measure Algorithms document) along with information from EBC (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 corresponding Measure Algorithms document). 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 corresponding Measure Algorithms document). 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. 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 (see below *Statistical Analysis: Risk Adjustment*).

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) (Table 1). 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 EBC. 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
Substance Use	Yes/No
Alcohol Use	Yes/No
Tobacco Use	Yes/No

Statistical Analysis

Risk Adjustment

Characteristics of population served varied 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 (e.g., 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. Rates that are within hospitals' confidence intervals were considered non-significant.

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 Appendix C-E, the odds ratio represents how likely a patient is to develop complications compared to a patient in the reference group. For example, Appendix C shows that a delivering birthing person is almost seven times (odds ratio = 6.82) as likely to experience an obstetric hemorrhage after surgical/cesarean birth 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 = 1.94) compared with that of a birthing person who is multiparous (Appendix D).

Limitations

There are potential limitations associated with the use of data collected from the EBC and hospital discharge records (Andrews et al., 2015; Snowden et al., 2021). Limitations for determining the mandated complications are described below.

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 appears to be no universal system of timing and manner of measuring the quantity of blood loss (ACOG Committee Opinion, 2019). Facilities may use estimated blood loss (EBL) or quantitative blood loss (QBL), and, therefore, a variation in the methods of recording blood loss volume may result in difficulties to compare hemorrhage rates 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.

Post-admission 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.*

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. For instance, 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 a baby; 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. Current recommendations are to limit routine use of episiotomy; clinical judgement may determine appropriate use (Committee on Practice Bulletins-Obstetrics, 2018a). As such, rates of episiotomy vary greatly among hospitals in NJ. Interpretation of episiotomy rates should therefore be conducted within the context of the other reported metrics.

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Appendix A: Maternal Health Hospital Report Card Survey

1. Is your health care facility currently designated as a "Baby-Friendly Hospital" by the organization, Baby-Friendly USA, Inc.?
    - Yes
    - No
2. Does your health care facility have lactation consultants available for patients?
    - Yes
    - No
3. Does your health care facility employ midwives who are available for patients?
    - Yes
    - No
4. Does your health care facility partner with organizations that have midwives who are available for patients?
    - Yes
    - No
5. Does your health care facility have neonatologists/perinatologists available at all times (24/7) for patients?
    - Yes
    - No
6. Does your health care facility have a Neonatal Intensive Care Unit (any level) available for patients?
    - Yes
    - No
7. Does your health care facility have a Special Care Nursery available for patients?
    - Yes
    - No
8. Does your health care facility implement an explicit and implicit bias training program for both health care professionals who provide perinatal treatment and care to birthing people as well as supportive services staff members who interact with birthing people?
    - Yes
    - No

Appendix B: Report Card Metrics Associated with Survey Questions

Metric: Recognition as Baby-Friendly Hospital • Yes to survey question 1 • No to survey question 1
Metric: Lactation Consultants Available • Yes to survey question 2 • No to survey question 2
Metric: Midwives Available • Yes to survey question 3 or 4 • No to survey question 3 and 4
Metric: Neonatologist/Perinatologists Available 24/7 • Yes to survey question 5 • No to survey question 5
Metric: SCN and/or NICU Available • Yes to survey question 6 • No to survey question 6 • Yes to survey question 7 • No to survey question 7
Metric: Implements Explicit and Implicit Bias Training • Yes to survey question 8 • No to survey question 8

Appendix C: Risk Factors Identified for Obstetric Hemorrhage in 2023

Patient Risk Factors	Logistic Regression Results		
	Coefficient	Odds Ratio	P-value
Demographic Factors			
Race/Ethnicity			
Non-Hispanic Asian	-0.08	0.92	0.15
Hispanic	0.09	1.01	0.02
Non-Hispanic Black	0.11	1.12	0.02
Other/Multi-race	-0.14	0.86	0.15
Non-Hispanic White	*Ref.*		
Maternal Age	0.03	1.03	<0.0001
Clinical & Obstetric factors/Comorbidities			
Method of Delivery			
Cesarean and No Placental or Uterine Disorders	1.92	6.82	<0.0001
Cesarean with Placental or Uterine Disorders	3.42	30.61	<0.0001
Vaginal with Placental or Uterine Disorders	2.38	10.85	<0.0001
Vaginal and No Placental or Uterine Disorders	*Ref.*		
Nulliparous			
Yes	0.24	1.27	<0.0001
No	*Ref.*		
Diabetes Mellitus			
Yes	0.09	1.09	0.02
No	*Ref.*		
Pre-pregnancy Body Mass Index (BMI)			
Overweight/Obese	0.14	1.15	<0.0001
Underweight	-0.13	0.88	0.29
Normal	*Ref.*		
Induction of Labor			
Yes	0.34	1.41	<0.0001
No	*Ref.*		
Infant Birthweight			
Low Birthweight	-0.05	0.95	0.32
Overweight	0.52	1.68	<0.0001
Normal Birthweight	*Ref.*		
Infection-Chorioamnionitis			
Yes	0.52	1.67	<0.0001
No	*Ref.*		
Preexisting Anemia			
Yes	0.21	1.24	<0.0001
No	*Ref.*		
Preeclampsia			
Yes	0.18	1.20	0.007
No	*Ref.*		
ICU Admission			
Yes	0.81	2.24	<0.0001
No	*Ref.*		

Appendix D: Risk Factors Identified for Post-admission Infection in 2023

Patient Risk Factors	Logistic Regression Results		
	Coefficient	Odds ratio	P-value
Demographic Factors			
Race/Ethnicity			
Non-Hispanic Asian	0.71	2.04	<0.0001
Hispanic	0.73	2.08	<0.0001
Non-Hispanic Black	0.54	1.72	<0.0001
Other/Multi-race	0.38	1.47	<0.01
Non-Hispanic White	*Ref.*		
Maternal Age	-0.03	0.97	<0.0001
Clinical & Obstetric factors/ Comorbidities			
Method of Delivery & Prolonged Length of Labor (> or = 20 hours)			
Cesarean, No Prolonged labor	0.42	1.53	<0.0001
Cesarean, Prolonged labor	0.66	1.93	<0.001
Vaginal, Prolonged labor	0.88	2.42	<0.0001
Vaginal, No Prolonged labor	*Ref.*		
Pre-pregnancy Body Mass Index (BMI)			
Overweight/Obese	-0.12	0.89	0.01
Underweight	-0.38	0.68	0.02
Normal	*Ref.*		
Induction of Labor			
Yes	0.44	1.56	<0.0001
No	*Ref.*		
Premature Rupture of Membranes (PROM)			
Yes	0.70	2.02	<0.0001
No	*Ref.*		
Epidural or Spinal Anesthesia			
Yes	1.07	2.92	<0.0001
No	*Ref.*		
Nulliparous			
Yes	0.66	1.94	<0.0001
No	*Ref.*		
Arrested Progress of labor			
Yes	0.91	2.48	<0.0001
No	*Ref.*		
Infant Birthweight			
Low Birthweight	-0.16	0.85	0.06
Overweight	0.30	1.35	<0.001
Normal Birthweight	*Ref.*		
ICU admission			
Yes	0.94	2.56	<0.0001
No	*Ref.*		

Appendix E: Risk Factors Identified for SMM with Transfusion in 2023

Patient Risk Factors	**Logistic Regression Results**		
	Coefficient	Odds Ratio	P-value
Demographic Factors			
Race/Ethnicity			
Non-Hispanic Asian	0.32	1.38	<0.001
Hispanic	0.21	1.24	<0.01
Non-Hispanic Black	0.29	1.34	<0.001
Other/Multi-race	0.17	1.18	0.24
Non-Hispanic White	*Ref.*		
Maternal Education			
College/College+ (Some College/Associate's, Bachelor's, and Graduate Degree)	-0.18	0.83	<0.001
High School/Less than High School	*Ref.*		
Clinical & Obstetric factors / Comorbidities			
Method of Delivery			
Cesarean and No Postpartum Hemorrhage	0.92	2.53	<0.0001
Cesarean with Postpartum Hemorrhage	2.74	15.55	<0.0001
Vaginal with Postpartum Hemorrhage	3.34	31.09	<0.0001
Vaginal and No Postpartum Hemorrhage	*Ref.*		
Infection-Chorioamnionitis			
Yes	0.68	2.43	<0.0001
No	*Ref.*		
Gestational Age			
Premature (before 37 weeks of gestation)	0.46	1.59	<0.0001
Mature (after 37 weeks of gestation)	*Ref.*		
Nulliparous			
Yes	0.12	1.13	0.01
No	*Ref.*		
Pre-pregnancy Body Mass Index (BMI)			
Overweight/Obese	-0.19	0.82	0.0002
Underweight	0.001	1.00	0.99
Normal	*Ref.*		
Preexisting Cardiac Disease			
Yes	0.47	1.60	<0.01
No	*Ref.*		
Preexisting Renal Disease			
Yes	0.52	1.68	0.03
No	*Ref.*		
Prenatal Care Initiation			
No care obtained/Prenatal care initiated late	0.19	1.21	<0.0001
Prenatal care initiated during first trimester	*Ref.*		
Uterine or Placental disorders			
Yes	0.78	2.18	<0.0001
No	*Ref.*		
Arrested Progress of Labor			
Yes	0.25	1.28	<0.001
No	*Ref.*		
Preexisting Anemia			

Yes	0.82	2.28	<0.0001
No	*Ref.*		
Preeclampsia			
Yes	0.65	1.93	<0.0001
No	*Ref.*		
ICU admission			
Yes	2.67	14.39	<0.0001
No	*Ref.*		