New Jersey Hospital Maternity Care Report Card 2024

Methodology

January 2026

OFFICE OF HEALTHCARE QUALITY AND INFORMATICS

Prepared by:

Alexandra Brown, MPH
Veronica Daddio, MSc
Jordan J. Steiner, PhD, LSW, MA
Daniel Armstrong, MPH
Stephen L. Firsing III, PhD, MPA, MA
Mehnaz Mustafa, MPH, MSc

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 used 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 hospital, risk-adjusted rates of delivery-associated complications were calculated. "Risk-adjusted" rates reflect the birthing person's health conditions as well as their social, demographic, and economic statuses. Risk adjustment is the process of statistically accounting for differences in a patient population that influence health care outcomes (Lane-Fall & Neuman, 2013). The risk adjustment process facilitates a fair comparison across hospitals whose patient populations can be very diverse. In this report, risk-adjusted rates were expressed as ratios of expected complications (i.e., hemorrhage, severe maternal morbidity (SMM), and infection) to observed complications multiplied by the statewide complication rate. Statistical significance was assessed by whether the statewide rate crossed the range between the lower and upper bounds of the confidence limits. A difference was 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 was completely above the statewide rate, then a hospital's rate was deemed statistically significantly higher than the statewide rate. Conversely, if the hospital's rate confidence bound fell below the statewide rate, then the hospital's rate was statistically significantly lower than the statewide rate.

The measures assessed in this report and accompanying dashboards include risk adjusted outcomes such as, obstetric hemorrhage, severe maternal morbidity (SMM) with transfusion, post-admission infection, and obstetric procedure rates including third- and fourth-degree perineal lacerations, and episiotomy. Each measure is discussed in more detail in the following sections of this report.

Risk Adjusted Outcomes

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.

Obstetric Procedure Rates

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 Gynecologists, 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 3.4% in 2024 (Leapfrog Group, 2025). 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 include birth records reported through the Vital Events Registration and Information (VERI) platform. In addition to registering information about the baby, the EBC contains demographic information about 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 2024 birth-related hospitalization that occurred at the end of the calendar year may be reported with 2025 discharges. Moreover, NJDDCS are 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 was 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 were used for this year's report card dashboard include availability of lactation consultants, midwives, neonatologists, perinatologists, special care nursery (SCN), neonatal intensive care unit (NICU) and implementation of Alliance for Innovation on Maternal Health (AIM) bundles. Additionally, data on hospitals' baby-friendly status were 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 were used.

In summary, this report card used 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

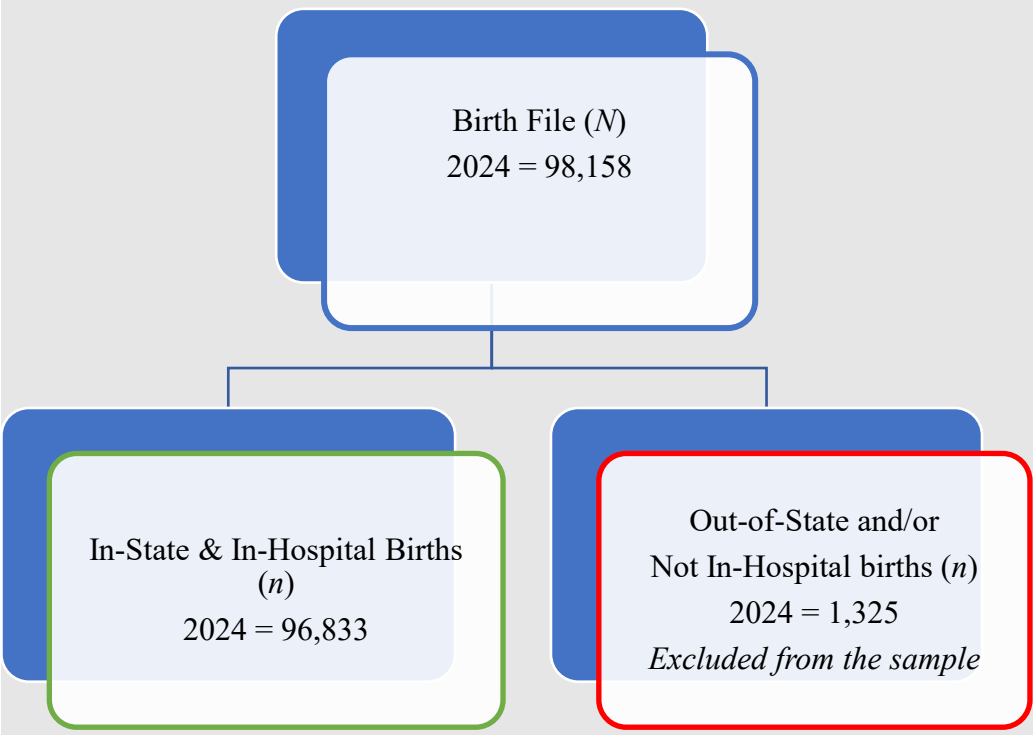
- Inclusion criteria:
  - All females who gave birth at a hospital in New Jersey
  - 12 to 65 years of age
  - First record for each patient
  - 2024 birth-related hospitalizations
- Exclusion criteria:
  - Duplicate records for same hospital delivery encounter
  - Males
  - Younger than 12 years old 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

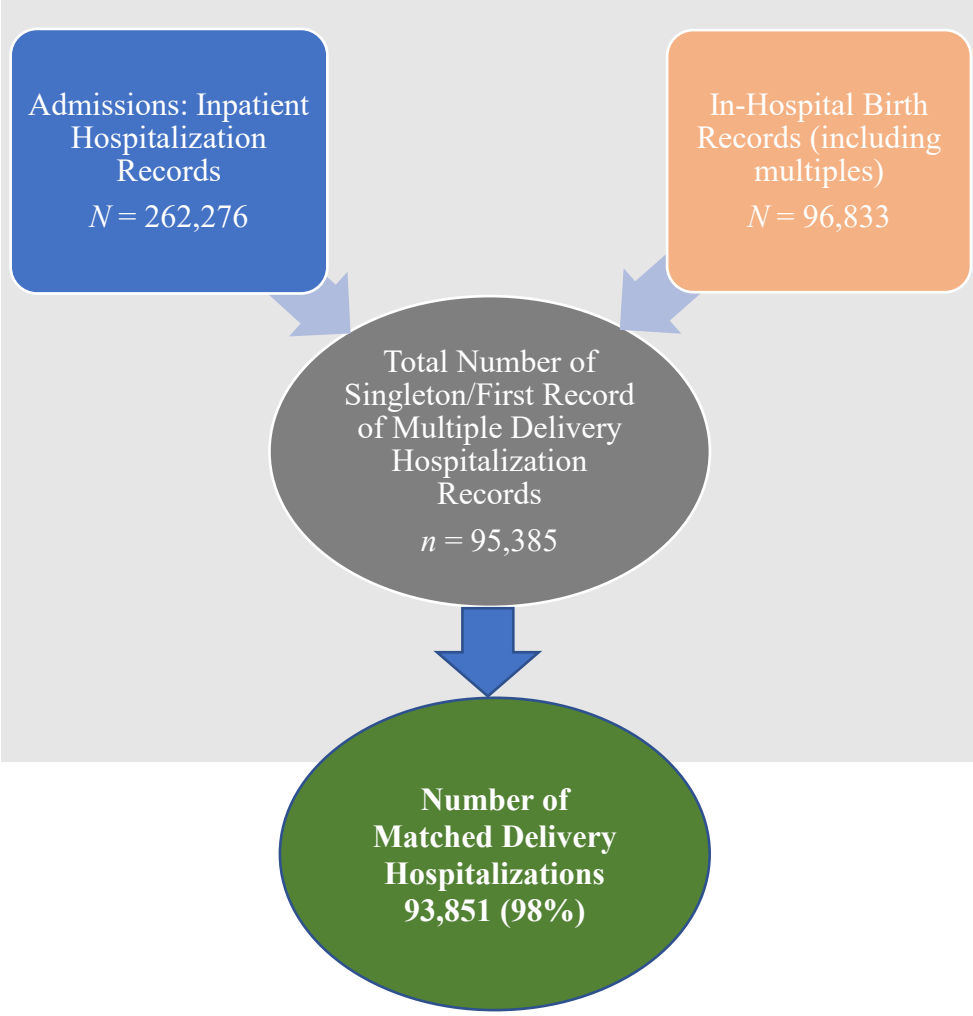
Previous studies, which assessed the accuracy of information obtained from birth certificates compared with that in hospital discharge data records, showed that a combination of the two data sources can help reduce missing information and may allow for better identification of maternal and infant outcomes (Heins et al., 2023; Lydon-Rochelle et al., 2005).

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. Birthing people who were admitted in late December 2024 and discharged in 2025 were linked to 2025 birth discharges with late 2024 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, 96,833 in-hospital deliveries, out of the 98,158 New Jersey births that occurred in 2024, were identified from EBC records (see Figure 1 above). These deliveries comprised singleton and multiple births. Of 95,385 singleton or first record of multiple births, 93,851 were successfully matched to hospital discharge records (n = 262,276) for a match rate of 98% (see Figure 2 above). Inability to match all records are due to multiple factors, such as large discrepancies in the reported identifying variables and incidences of non-reported discharge records for some 2024 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

Risk Adjusted Outcomes

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 was 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). The referenced coding schema was updated by the CDC on May 15, 2024, and was applied to the full year of 2024 (1/2024-12/2024) data for the purpose of this analysis. As the SMM outcome relies on diagnosis and procedure codes available in hospital discharge records only, the sample population analyzed for this outcome was limited to those with a matched delivery record (N = 93,851).

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 were used to identify all cases of delivery-associated infections that occurred during the delivery hospitalization. Additionally, only cases of infection that were not present on admission are included to eliminate instances of pre-admission infections from the final analysis.

Obstetric Procedure Rates

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

Perineal laceration associated with delivery was 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 has been 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), were included in the rate calculation of this complication to account for the variable distribution of overweight babies among 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 Gynecologists, 2015), only vaginal delivery hospitalizations excluding those with shoulder dystocia were included in the rate calculation of this complication.

Risk Factors for Delivery-Associated Complications

The observed complication rate for each hospital was estimated by the number of patients that experienced a complication during the delivery hospitalization divided by the total number of delivery hospitalizations at risk for that complication in that hospital during the same period. However, this observed complication rate does not provide a fair assessment of the quality of care provided by the hospital (or providers), because it does not account for the differences in its patient population. When assessing outcomes, it is important to account for differences in patient characteristics and risk factors. For example, a hospital that serves a larger number of patients with health-related risk factors, such as cardiac or respiratory diseases, would be expected to have higher rates of complications than a hospital that serves a lower number of patients with health-related risk factors.

To assess the quality of maternal health care provided by New Jersey hospitals that perform deliveries, NJDOH uses risk adjustment to estimate complication rates. Risk adjustment is the process of statistically accounting for differences in a patient population that influence health care outcomes (Lane-Fall & Neuman, 2013). 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 hospitals that serve healthier patients. Risk adjustment was performed using statistical regression modeling, an indirect method of standardization. A mixed effects stepwise logistic regression model was fitted for each complication, and risk factors were added to control for their contribution to the complication (Lane-Fall & Neuman, 2013). For each complication, the selected risk factors were identified based on literature review and expert consultations using the principles of appropriateness, viability (sufficient number of events), and data availability. The fitted model was used to obtain the predicted number of complications for each hospital, which was then used to compare against the observed number of complications for each hospital. Additional details about the statistical risk adjustment methodology are provided in the subsequent section of this report.

The risk factors used in this report included birthing people's socio-demographic characteristics (e.g., race/ethnicity, age, health insurance coverage, educational attainment, marital status) as well as clinical and obstetric factors (e.g., parity [number of live births], method of delivery, body mass index, prenatal care) (see Table 1). Clinical comorbidities (e.g.,

diabetes; hypertension; chronic liver, respiratory, cardiac, and renal diseases; placental disorders) as well as behavioral factors associated with increased risk of complications (e.g., tobacco use, alcohol, and illicit substance use) were also included (see Table 1). These risk factors were obtained from ICD-10-CM diagnosis codes as reported through the hospitalization database and the information in the EBC. The specific measure algorithms for the factors included in this report can be found in the Measure Algorithms document which is located on the NJDOH Maternal Health Hospital Report Card website.

In this report:

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

Table 1. List of Covariates Considered for Analysis

	Values/Categories
Sociodemographic Characteristics	
Race/Ethnicity[1,2,3]	Non-Hispanic White Non-Hispanic Black Hispanic Non-Hispanic Asian Other/Multi-race
Maternal Age[1,2,3]	Years
Educational Status[1,2,3]	College/College+ (*Some College/Associate's, Bachelor's, and Graduate Degree*) High School/Less than High School
Health Insurance Coverage[1,2,3]	Private Insurance Medicaid Self-Pay/Charity Care/Other
Marital Status[1,2,3]	Married Not Married
Clinical & Obstetric Factors / Comorbidities	
Method of Delivery[1,2,3]	Vaginal *(with and without instrument)* Cesarean *(Primary, Repeat)*
Parity[1,2,3]	Nulliparous Multiparous
Gestational Age[1,3]	Premature (*before 37 weeks of gestation)* Mature (*after 37 weeks of gestation)*
Plurality[1,2 3]	Singleton Multiples
NTSV (Nulliparous, Term, Singleton, Vertex)[1,2]	NTSV NTSV Risk Unknown Non-NTSV
Diabetes Mellitus (Gestational & Preexisting)[1,3]	Yes/No

Hypertension (Gestational & Preexisting)[1,3]	Yes/No
Cardiac Disease (Pre-existing)[1,3]	Yes/No
Renal Disease (Pre-existing)[1,2,3]	Yes/No
Respiratory Disease (Pre-existing)[1,2,3]	Yes/No
Placental Disorders (Placenta Abruption, Previa and /or Accreta)[1,2,3]	Yes/No
Uterine Disorders (Uterine ruptured and/or Uterine atony)[1,2,3]	Yes/No
HIV status[1,3]	Positive/Negative
Prenatal Care Utilization[2,3]	Early (*First Trimester*) Late/None (*None, Second, or Third Trimester*)
Pre-pregnancy Body Mass Index (BMI)[1,2,3]	Underweight (*Below 18.5*) Normal (*18.5 - 24.9*) Overweight (*25.0 - 29.9*) Obese (*30.0 and above*)
Precipitous Labor (Less than 3 hours)[1,2,3]	Yes/No
Prolonged Labor (≥ 20 hours)[1,2,3]	Yes/No
Infant Birthweight[1,2,3]	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)[1,2,3]	Yes/No
Epidural or Spinal Anesthesia[1,2,3]	Yes/No
Shoulder Dystocia[1,2]	Yes/No
Premature Rupture of Membranes (PROM)[1,2]	Yes/No
Admission to Intensive Care Unit (ICU)[1,2,3]	Yes/No Maternal admission to ICU anytime during delivery hospitalization
Arrested Progress of labor[1,2,3]	Yes/No Arrested active phase of labor; hypotonic uterine dysfunction or uterine inertia during latent phase of labor
Preexisting Anemia[1,2,3]	Yes/No
Preeclampsia[1,2,3]	Yes/No
Infection-Chorioamnionitis[1,3]	Yes/No
Transfer status (birthing people transferred from another facility) prior to delivery[1,2,3]	Yes/No
Drug Use[3]	Yes/No
Alcohol Use[2]	Yes/No
Tobacco Use[1,3]	Yes/No

Composite Variables (Combination of 2 or more individual variables)	
Uterine or Placental Disorders[1,2,3]	Yes/No
Method of Delivery and Hemorrhage[3]	Cesarean/Hemorrhage Cesarean Vaginal/Hemorrhage Vaginal
Parity and Prolonged Labor[1,2,3]	Nulliparous/Prolonged Labor Multiparous/Prolonged Labor Nulliparous Multiparous
Method of Delivery and Prolonged Labor[1,2,3]	Cesarean/Prolonged Labor Cesarean Vaginal/Prolonged Labor Vagina;
Method of Delivery and Placental/Uterine Disorder[1,2]	Cesarean/Placental Uterine Disorder Cesarean Vaginal/Placental Uterine Disorder Vaginal
Pre-existing Chronic Disease: Cardiac, Renal, Respiratory, Liver, HIV (any of the listed conditions)[1,2,3]	Yes/No
Drug or Alcohol Use[3]	Yes/No

NOTE: Variables significant in simple logistic regression models for each outcome were considered for inclusion in stepwise regression models. Refer to the Statistical Analysis section below for further information on variable selection.

[1]Significant ($p < 0.2$) in Hemorrhage simple logistic regression outcome models
[2]Significant ($p < 0.2$) in Infection simple logistic regression outcome models
[3]Significant ($p < 0.2$) in SMM simple logistic regression outcome models

Statistical Analysis

Risk Adjustment

The characteristics of the patient populations served varied across hospitals, which may result in variation of delivery outcomes (complications). Therefore, it was paramount to account for each hospital's patient characteristics (e.g., race/ethnicity, age) and clinical and obstetric risk factors (e.g., hypertension, diabetes, uterine disorders) with risk adjustment. Using a random intercept multivariable logistic regression analysis method, an indirect method of standardization, patient characteristics and other risk factors were controlled for their contribution to each outcome of interest (hemorrhage, SMM, and infection).

To conduct the risk adjustment, several main steps were implemented using a linked statewide analytic dataset. First, simple logistic regression (one independent/predictor and one dependent/outcome variable) analyses were performed to identify statistically significant risk factors (independent/predictor variables) (Please see Table 1 above for potential risk factors). Any factors that showed a possible statistical association (based on threshold of $p < 0.2$) with each outcome (dependent variable), were considered for more detailed analysis. The selection of variables for inclusion in the stepwise regression models considered the historical significance of the risk factor in prior years' final stepwise models, use of composite variables (combination of 2+ individual variables), and significance in simple logistic regression. To reduce collinearity (when two or more variables are highly correlated) and improve model parsimony/simplicity, composite variables were selected over respective individual variables when applicable.

Second, a backward stepwise multiple logistic regression analysis with random effects was conducted using the statewide linked dataset. This approach refined the list of risk factors (independent/predictor variables) by excluding those that were not significant ($p > 0.05$) in each iteration until all risk factors remained significant ($p < 0.05$). A mixed effects logistic regression model with random intercept was then built, incorporating the significant risk factors (independent/predictor variables) identified in the previous analysis. Separate models were constructed for each outcome (dependent variable) to identify which risk factors (independent/predictor variables) were significantly associated with each outcome. 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 outcome identified in each model are presented in Tables 2a-4b. Each list includes only those factors that were statistically significant in predicting the complication under investigation with p values of 0.05 or less.

The third step in the risk adjustment process involved calculating the total observed cases of each outcome by hospital using the analytic dataset. This was followed by estimating the total expected (predicted) cases for each hospital based on the predictive dataset generated from the final multiple regression model described in the previous step. The predicted number was then compared to the observed cases to create the adjustment factor. This adjustment factor was applied to the statewide complication rate to develop a risk-adjusted rate for each hospital.

The fourth step was to calculate risk adjusted hospital rates and 95% confidence intervals for each hospital using the following formula (Kahn & Sempos, 1989):

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

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

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

A description of the terms in the formulas above are listed below:

- ***Observed*:** The number of birthing people with an outcome (e.g., SMM) at a hospital in a given year.
- ***Expected*:** The number of predicted birthing people with an outcome at a hospital in a given year, which was generated using multiple logistic regression analysis with random effects model that included the list of significant factors associated with the outcome. For example, SMM factors are listed in Appendix E.
- ***Statewide Rate*:** The statewide rates for outcomes can be found on the Maternal Health Hospital Report Card public website following the annual publication.

In the final step, each hospital's rates were compared to the statewide rates:

- Rates with confidence intervals entirely above the statewide average were considered significantly higher.
- Rates with confidence intervals entirely below the statewide average were considered significantly lower.
- Rates with confidence intervals that included the statewide average were considered not significantly different.

The odds ratios were derived from the coefficients and are used to compare the relative importance of the risk factors in predicting complications (outcomes) during delivery. For each of the risk factors identified in Appendix C-E, the odds ratio represents how likely a patient is to develop a complication compared to a patient in the reference group. For example, Appendix C

shows that a delivering birthing person is over five times (odds ratio = 5.56) 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 a surgical/cesarean birth or a placental or uterine disorder. In another example, the odds of developing post-admission infection during the delivery hospitalization for a delivering birthing person who is nulliparous is two times (odds ratio = 2.08) compared to that of a birthing person who is multiparous (Appendix D).

Limitations

Despite the significance of the results of this analysis, several limitations should be acknowledged. Although simple logistic and stepwise regression modeling remains a common tool for variable selection, these methods can potentially introduce systemic biases related to estimated characteristics of the study population (i.e., parameter estimates) (Harrel, 2001; Heinze & Dunkler, 2017; Gilholm, et al., 2025; Sun et al., 1996). Additionally, the inclusion of risk factors that have a low prevalence in the patient population, like maternal smoking, can lead to inflated standard errors and model convergence issues (Gilholm, et al., 2025; Maher et al., 2024). In an effort to minimize any bias from variable selection, potential covariates were identified for stepwise regression based on data availability and clinical relevance, with preference given to composite variables. Third, 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). The limitations for determining the mandated complications are described below.

Obstetric Hemorrhage

Hemorrhage rates should be considered carefully. Although they are calculated using a nationally recognized standard definition based on reported quantity of blood loss, hospitals differ in their methods for timing and manner of measuring the quantity of blood loss (ACOG Committee Opinion, 2019). Some facilities may use estimated blood loss (EBL) while others use quantitative blood loss (QBL). This variation in practice may limit the comparability of hemorrhage rates across 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 with 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 hospitals, although it is noted that since the first report card (2016), 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 both general infection as well as quality of maternal care. Additionally, it is recognized that most delivery-associated infections are diagnosed and treated post-discharge from the hospital (Yokoe et al., 2001). However, 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 unintentionally lead to higher rates of cesarean births (Friedman et al., 2015). Given the current stated goals of reducing cesarean rates in New Jersey, 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 New Jersey. Interpretation of episiotomy rates should therefore be conducted within the context of the other reported metrics.

References

Acosta, C. D., Kurinczuk, J. J., Lucas, D. N., Tuffnell, D. J., Sellers, S., Knight, M., & United Kingdom Obstetric Surveillance System. (2014). Severe maternal sepsis in the UK, 2011-2012: A national case-control study. *PLoS medicine*, *11*(7), e1001672. doi.org/10.1371/journal.pmed.1001672

American College of Obstetricians and Gynecologists (ACOG) Committee Opinion. (2019). Quantitative blood loss in obstetric hemorrhage. 134(6): e150-156. https://www.acog.org/clinical/clinical-guidance/committee-opinion/articles/2019/12/quantitative-blood-loss-in-obstetric-hemorrhage

American College of Obstetricians and Gynecologists (ACOG). (2006). ACOG Practice Bulletin: Clinical Management Guidelines for Obstetrician-Gynecologists Number 76, October 2006: postpartum hemorrhage. *Obstetrics and gynecology*, *108*(4), 1039–1047.

Andrews RM. (2015). Statewide Hospital Discharge Data: Collection, Use, Limitations, and Improvements. *Health Serv Res*, Suppl 1(Suppl 1), 1273-99. doi: 10.1111/1475-6773.12343.

Beck CT, Watson S, Gable RK. (2018). Traumatic Childbirth and Its Aftermath: Is There Anything Positive? *J Perinat Educ*, *27*(3),175-184. doi: 10.1891/1058-1243.27.3.175.

Buppasiri, P., Lumbiganon, P., Thinkhamrop, J., & Thinkhamrop, B. (2014). Antibiotic prophylaxis for third- and fourth-degree perineal tear during vaginal birth. *The Cochrane database of systematic reviews*, (10), CD005125.doi.org/10.1002/14651858.CD005125.pub4

Callaghan, W. M., Creanga, A. A., & Kuklina, E. V. (2012). Severe maternal morbidity among delivery and postpartum hospitalizations in the United States. *Obstetrics and gynecology*, *120*(5), 1029–1036. doi.org/10.1097/aog.0b013e31826d60c5

Cantwell, R., Clutton-Brock, T., Cooper, G., Dawson, A., Drife, J., Garrod, D., Harper, A., Hulbert, D., Lucas, S., McClure, J., Millward-Sadler, H., Neilson, J., Nelson-Piercy, C., Norman, J., O'Herlihy, C., Oates, M., Shakespeare, J., de Swiet, M., Williamson, C., … Springett, A. (2011). Saving Birthing people' Lives: Reviewing maternal deaths to make birthing peoplehood safer: 2006-2008. The Eighth Report of the Confidential Enquiries into Maternal Deaths in the United Kingdom. *BJOG : an international journal of obstetrics and gynaecology*, *118 Suppl 1*, 1–203. doi.org/10.1111/j.1471-0528.2010.02847.x

Centers for Disease Control and Prevention (CDC). (2024a, May 15). *Identifying Severe Maternal Morbidity (SMM).* https://www.cdc.gov/maternal-infant-health/php/severe-maternal-morbidity/icd.html?CDC_AAref_Val=https://www.cdc.gov/reproductivehealth/maternalinfanthealth/smm/severe-morbidity-ICD.htm

Centers for Disease Control and Prevention (CDC). (2024b, May 15). *Severe Maternal Morbidity*. https://www.cdc.gov/maternal-infant-health/php/severe-maternal-morbidity/index.html

Centers for Disease Control and Prevention (CDC). (2024c, November 14). *Pregnancy Mortality Surveillance System (PMSS).*

https://www.cdc.gov/maternal-mortality/php/pregnancy-mortality-surveillance/?CDC_AAref_Val=https://www.cdc.gov/reproductivehealth/maternal-mortality/pregnancy-mortality-surveillance-system.htm

Committee on Practice Bulletins-Obstetrics. (2017). ACOG Practice Bulletin No. 183 Summary: Postpartum Hemorrhage. *Obstetrics and gynecology*, *130*(4), 923–925. doi.org/10.1097/AOG.0000000000002346

Committee on Practice Bulletins-Obstetrics. (2018a). ACOG Practice Bulletin No. 198: Prevention and Management of Obstetric Lacerations at Vaginal Delivery. *Obstetrics and gynecology*, *132*(3), e87–e102. doi.org/10.1097/AOG.0000000000002841

Committee on Practice Bulletins-Obstetrics. (2018b). ACOG Practice Bulletin No. 199: Use of Prophylactic Antibiotics in Labor and Delivery. *Obstetrics and gynecology*, *132*(3), e103–e119. doi.org/10.1097/AOG.0000000000002833

Fink, D. A., Kilday, D., Cao, Z., Larson, K., Smith, A., Lipkin, C., Perigard, R., Marshall, R., Deirmenjian, T., Finke, A., Tatum, D., Rosenthal, N. (2023). Trends in Maternal Mortality and Severe Maternal Morbidity During Delivery-Related Hospitalizations in the United States, 2008 to 2021. *JAMA Netw Open, 6*(6), e2317641. doi:10.1001/jamanetworkopen.2023.17641

Firoz, T., Chou, D., von Dadelszen, P., Agrawal, P., Vanderkruik, R., Tunçalp, O., Magee, L. A., van Den Broek, N., Say, L., & Maternal Morbidity Working Group. (2013). Measuring maternal health: focus on maternal morbidity. *Bulletin of the World Health Organization*, *91*(10), 794–796. doi.org/10.2471/BLT.13.117564

Fitzpatrick, M., & O'Herlihy, C. (2005). Short-term and long-term effects of obstetric anal sphincter injury and their management. *Current opinion in obstetrics & gynecology*, *17*(6), 605–610. doi.org/10.1097/01.gco.0000191901.69320.a0

Friedman, A. M., Ananth, C. V., Prendergast, E., D'Alton, M. E., & Wright, J. D. (2015). Evaluation of third-degree and fourth-degree laceration rates as quality indicators. *Obstetrics and gynecology*, *125*(4), 927–937. doi.org/10.1097/AOG.0000000000000720

Gilholm, P., Lister, P., Irwin, A., Harley, A., Raman, S., Schlapbach, L. J., & Gibbons, K. S. (2025). Comparison of Random Forest and Stepwise Regression for Variable Selection Using Low Prevalence Predictors: A Case Study in Paediatric Sepsis. *Maternal and Child Health Journal*, *29*(5), 604–613. https://doi.org/10.1007/s10995-025-04038-1

Groutz, A., Hasson, J., Wengier, A., Gold, R., Skornick-Rapaport, A., Lessing, J. B., & Gordon, D. (2011). Third- and fourth-degree perineal tears: prevalence and risk factors in the third millennium. *American journal of obstetrics and gynecology*, *204*(4), 347.E1–347.E4. doi.org/10.1016/j.ajog.2010.11.019

Guise, J. M., Morris, C., Osterweil, P., Li, H., Rosenberg, D., & Greenlick, M. (2007). Incidence of fecal incontinence after childbirth. *Obstetrics and gynecology*, *109*(2 Pt 1), 281–288. doi.org/10.1097/01.AOG.0000254164.67182.78

Harrel, F. E. Jr. (2001). Regression modeling strategies: With applications to Linear models, logistic regression and survival analysis. *Springer Science + Business Media*

Heins, S., Grigorescu V., Predmore, Z., Zhou, A., Hoch, E., Smith, S. (2023). State Medicaid Linkages for Maternal Health Research. Office of the Assistant Secretary for Planning and Evaluation, U.S. Department of Health and Human Services. aspe.hhs.gov/sites/default/files/documents/147eac15e9e1a004d5650a400d4fcf51/state-medicaid-data-linkages.pdf

Heinze, G., & Dunkler, D. (2017). Five myths about variable selection. *Transplant International*, *30*(1), 6–10. 10.1111/tri.12895

Hirai, A.H., Owens, P.L., Reid, L.D., Vladutiu, C.J., & Main, E.K. (2022). Trends in Severe Maternal Morbidity in the US Across the Transition to *ICD-10-CM/PCS* From 2012-2019. *JAMA Netw Open*, 5(7):e2222966. doi:10.1001/jamanetworkopen.2022.22966

Hogan, V. K., Lee, E., Asare, L. A., Banks, B., Benitez Delgado, L. E., Bingham, D., Brooks, P. E, Culhane, J., Lallo, M., Nieves, E., Rowley, D. L., Karimi-Taleghani, P. H., Whitaker, S., Williams, T. D. & Madden-Wilson, J. (2021). *The Nurture NJ Strategic Plan*. The State of New Jersey, Trenton, NJ. nurturenj.nj.gov/wp-content/uploads/2021/01/20210120-Nurture-NJ-Strategic-Plan.pdf

Kahn, H., & Sempos, C. (1989). Statistical Methods in Epidemiology. Oxford University Press.

Lagrew, D., McNulty, J., Sakowski, C., Cape, V., McCormick, E., & Morton, C. H. (2022). *Improving Health Care Response to Obstetric Hemorrhage, a California Maternal Quality Care Collaborative Toolkit.* California Maternal Quality Care Collaborative. https://www.cmqcc.org/sites/default/files/HEMToolkit_03252022%20Errata%207.2022%20%282%29.pdf

Lane-Fall, MB. & Neuman, MD. (2013). Outcomes measures and risk adjustment. *Int Anesthesiol Clin*, 51(4):10-21. doi: 10.1097/AIA.0b013e3182a70a52.

Leapfrog Group. (2025). State of Maternity Care in U.S. Hospitals: The Leapfrog Group 2025 Report on Trends. https://www.leapfroggroup.org/sites/default/files/Files/MaternityCare-report-2025-FINAL_1.pdf

Leth, R.A., Moller, J.K., Thomsen, R.W., Uldbjerg, N. and Norgaard, M. (2009). Risk of selected postpartum infections after cesarean section compared with vaginal birth: A five-year cohort study of 32,468 women. *Acta Obstetricia et Gynecologica Scandinavica*, *88*, 976-983. doi.org/10.1080/00016340903147405

Lydon-Rochelle, M. T., Holt, V. L., Cárdenas, V., Nelson, J. C., Easterling, T. R., Gardella, C., & Callaghan, W. M. (2005). The reporting of pre-existing maternal medical conditions and complications of pregnancy on birth certificates and in hospital discharge data. *American journal of obstetrics and gynecology*, *193*(1), 125–134. doi.org/10.1016/j.ajog.2005.02.096

Maher, G. M., McKernan, J., O'Byrne, L., Walsh, B. H., Corcoran, P., Greene, R. A., & McCarthy, F. P. (2024). Predicting admission to neonatal care unit at Mid-pregnancy and Delivery using data from a General Obstetric Population. *Maternal and Child Health Journal*, 1–11.

Nantwi, A.K., Kraus, R.N., & Slutzky, C.B. (2022). New Jersey Maternal Mortality Report 2016-2018. Retrieved from https://www.nj.gov/health/fhs/maternalchild/documents/New%20Jersey%20Maternal%20Mortality%20Report%202016-2018.pdf

Royal College of Obstetricians and Gyneacologists. (2007, March). *The Management of Third- and Fourth- Degree Perineal Tears: Green-top Guideline No.29*.

Royal College of Obstetricians and Gyneacologists. (2015, June). *The Management of Third- and Fourth-Degree Perineal Tears: Green-top Guideline No. 29*. (3rd ed.). https://www.rcog.org.uk/media/5jeb5hzu/gtg-29.pdf

SAS Institute Inc. (2017). *SAS/STAT® 14.3 User's Guide: High-Performance Procedures. Cary, NC:* SAS Institute Inc.

Sigurdardottir VL, Gamble J, Gudmundsdottir B, Kristjansdottir H, Sveinsdottir H, Gottfredsdottir H. (2017). The predictive role of support in the birth experience: A longitudinal cohort study. *Women Birth, 30*(6), 450-459. doi: 10.1016/j.wombi.2017.04.003

Snowden, J. M., Lyndon, A., Kan, P., El Ayadi, A., Main, E., & Carmichael, S. L. (2021). Severe maternal morbidity: a comparison of definitions and data sources. *American journal of epidemiology*, *190*(9), 1890-1897.

Sun, G. W., Shook, T. L., & Kay, G. L. (1996). Inappropriate use of bivariable analysis to screen risk factors for use in multivariable analysis. *Journal of Clinical Epidemiology*, *49*(8), 907–916.

Vale de Castro Monteiro, M., Pereira, G. M., Aguiar, R. A., Azevedo, R. L., Correia-Junior, M. D., & Reis, Z. S. (2016). Risk factors for severe obstetric perineal lacerations. *International urogynecology journal*, *27*(1), 61–67. doi.org/10.1007/s00192-015-2795-5

World Health Organization (WHO). (2015, September 28). WHO recommendations for prevention and treatment of maternal peripartum infections. https://www.who.int/publications/i/item/9789241549363

Yokoe, D. S., Christiansen, C. L., Johnson, R., Sands, K., Livingston, J., Shtatland, E. S....Platt, R. (2001). Epidemiology of and Surveillance for Postpartum Infections. *Emerging Infectious Diseases, 7(5),* 837-841. https://doi.org/10.3201/eid0705.010511.

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. Has your health care facility implemented any Alliance for Innovation on Maternal Health (AIM) Patient Safety Bundles?[1] (Please select all that apply)

	Implemented w/in previous 24 months	Implementing currently
Cardiac Conditions in Obstetric Care		
Postpartum Discharge Transition		
Perinatal Mental Health Conditions		

[1] The specific AIM bundles listed in this survey metric are a focus of the NJDOH Division of Family Health Services (FHS), Maternal Health Innovation (MHI) grant. This list is not exhaustive of all AIM Bundles available, and found here: https://saferbirth.org/patient-safety-bundles/

Appendix B: Report Card Metrics Associated with Survey Questions

Report Card 2024 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: Implementation of AIM Bundles

- Yes to survey question 8, by checking *Implemented within previous 24 months* and/or *Implementing currently* for AIM bundles ***Cardiac Conditions in Obstetric Care*** and/or ***Postpartum Discharge Transition*** and/or ***Perinatal Mental Health Conditions***
- No to any of the three above AIMS bundles listed (survey question 8)

Appendix C: Risk Factors Identified for Obstetric Hemorrhage in 2024

Patient Risk Factors	**Logistic Regression Results**		
	Coefficient	Odds Ratio	*P*-value
Demographic Factors			
Race/Ethnicity			
Non-Hispanic Asian	0.02	1.02	0.733
Hispanic	0.23	1.26	<0.0001
Non-Hispanic Black	0.18	1.20	<0.001
Other/Multi-race	0.07	1.07	0.499
Non-Hispanic White	*Ref.*		
Maternal Age	0.03	1.03	<0.0001
Clinical & Obstetric Factors/Comorbidities			
Method of Delivery & Placental or Uterine Disorders			
Cesarean and No Placental or Uterine Disorders	1.72	5.56	<0.0001
Cesarean with Placental or Uterine Disorders	3.08	21.72	<0.0001
Vaginal with Placental or Uterine Disorders	1.72	5.56	<0.0001
Vaginal and No Placental or Uterine Disorders	*Ref.*		
Nulliparous			
Yes	0.28	1.32	<0.0001
No	*Ref.*		
Singleton Birth			
No	1.40	4.06	<0.0001
Yes	*Ref.*		
Pre-pregnancy Body Mass Index (BMI)			
Overweight/Obese	0.16	1.18	<0.0001
Underweight	-0.03	0.97	0.787
Normal	*Ref.*		
Prolonged Labor			
Yes	0.31	1.36	0.010
No	*Ref.*		
Induction of Labor			
Yes	0.30	1.35	<0.0001
No	*Ref.*		
Infant Birthweight			
Low Birthweight	-0.34	0.71	<0.0001
Overweight	0.67	1.95	<0.0001
Normal Birthweight	*Ref.*		
Epidural or Spinal Anesthesia			
Yes	0.10	1.11	0.004
No	*Ref.*		
Shoulder Dystocia			
Yes	0.33	1.39	0.008
No	*Ref.*		
Infection-Chorioamnionitis			
Yes	0.58	1.78	<0.0001
No	*Ref.*		
Preexisting Anemia			
Yes	0.21	1.23	<0.0001

No	*Ref.*		
Arrested Progress of Labor			
Yes	0.32	1.37	<0.0001
No	*Ref.*		
Preeclampsia			
Yes	0.17	1.19	<0.0001
No	*Ref.*		
ICU Admission			
Yes	0.95	2.59	<0.0001
No	*Ref.*		
Tobacco Use			
Yes	0.20	1.22	0.044
No	*Ref.*		

Appendix D: Risk Factors Identified for Post-admission Infection in 2024

Patient Risk Factors	**Logistic Regression Results**		
	Coefficient	Odds ratio	*P*-value
Demographic Factors			
Race/Ethnicity			
Non-Hispanic Asian	0.57	1.76	<0.0001
Hispanic	0.46	1.59	<0.0001
Non-Hispanic Black	0.34	1.41	<0.0001
Other/Multi-race	0.17	1.20	0.278
Non-Hispanic White	*Ref.*		
Health Insurance Coverage			
Charity Care/Self Pay/Other	0.26	1.31	0.021
Medicaid	0.11	1.11	0.076
Private	*Ref.*		
Marital Status			
Married	-0.21	0.81	<0.001
Not Married	*Ref.*		
Maternal Age	-0.02	0.98	<0.0001
Clinical & Obstetric Factors/ Comorbidities			
Method of Delivery & Prolonged Length of Labor (≥ 20 hours)			
Cesarean, No Prolonged labor	0.41	1.50	<0.0001
Cesarean, Prolonged labor	0.84	2.32	<0.0001
Vaginal, Prolonged labor	0.93	2.46	<0.0001
Vaginal, No Prolonged labor	*Ref.*		
Induction of Labor			
Yes	0.41	1.52	<0.0001
No	*Ref.*		
Premature Rupture of Membranes (PROM)			
Yes	0.65	1.94	<0.0001
No	*Ref.*		
Uterine or Placental Disorder			
Yes	0.33	1.38	0.003
No	*Ref.*		
Epidural or Spinal Anesthesia			
Yes	1.21	3.37	<0.0001
No	*Ref.*		
Nulliparous			
Yes	0.73	2.08	<0.0001
No	*Ref.*		
Arrested Progress of labor			
Yes	0.84	2.34	<0.0001
No	*Ref.*		
Infant Birthweight			
Low Birthweight	-0.21	0.81	0.019
Overweight	0.26	1.29	0.003
Normal Birthweight	*Ref.*		
ICU admission			
Yes	0.86	2.35	<0.0001

No	*Ref.*		
Preeclampsia			
Yes	0.19	1.22	0.001
No	*Ref.*		

Appendix E: Risk Factors Identified for SMM with Transfusion in 2024

Patient Risk Factors	**Logistic Regression Results**		
	Coefficient	Odds Ratio	*P*-value
Demographic Factors			
Race/Ethnicity			
Non-Hispanic Asian	0.23	1.26	0.009
Hispanic	0.21	1.24	0.001
Non-Hispanic Black	0.26	1.30	0.001
Other/Multi-race	0.08	1.08	0.588
Non-Hispanic White	*Ref.*		
Maternal Education			
College/College+ (Some College/Associate's, Bachelor's, and Graduate Degree)	-0.13	0.88	0.022
High School/Less than High School	*Ref.*		
Maternal Age (Categorical)			
>35 Years	0.13	1.14	0.013
<35 Years	*Ref.*		
Health Insurance Status			
Charity/Self-Pay/Other	0.32	1.38	0.011
Medicaid	0.06	1.07	0.301
Private	*Ref.*		
Marital Status			
Married	-0.16	0.85	0.004
Not Married	*Ref.*		
Clinical & Obstetric Factors / Comorbidities			
Method of Delivery & Hemorrhage			
Cesarean and No Postpartum Hemorrhage	0.84	2.32	<0.0001
Cesarean with Postpartum Hemorrhage	2.82	16.75	<0.0001
Vaginal with Postpartum Hemorrhage	3.35	28.49	<0.0001
Vaginal and No Postpartum Hemorrhage	*Ref.*		
Infection-Chorioamnionitis			
Yes	0.70	2.01	<0.0001
No	*Ref.*		
Gestational Age			
Premature (before 37 weeks of gestation)	0.45	1.56	<0.0001
Mature (after 37 weeks of gestation)	*Ref.*		
Nulliparous			
Yes	0.21	1.24	<0.0001
No	*Ref.*		
Pre-pregnancy Body Mass Index (BMI)			
Overweight/Obese	-0.22	0.80	<0.0001
Underweight	0.32	1.38	0.028
Normal	*Ref.*		
Infant Birth Weight			
Low Birth Weight	0.01	1.01	0.911
Overweight	0.22	1.25	0.007
Normal Birth Weight	*Ref.*		
Preexisting Cardiac Disease			
Yes	0.35	1.42	0.034

No	*Ref.*		
Preexisting Renal Disease			
Yes	0.96	2.62	<0.0001
No	*Ref.*		
Singleton Birth			
No	0.28	1.32	0.020
Yes	*Ref.*		
Uterine or Placental disorders			
Yes	0.90	2.47	<0.0001
No	*Ref.*		
Preexisting Anemia			
Yes	0.77	2.15	<0.0001
No	*Ref.*		
Preeclampsia			
Yes	0.63	1.88	<0.0001
No	*Ref.*		
Prolonged Labor			
Yes	0.36	1.44	0.041
No	*Ref.*		
Induction of Labor			
Yes	0.22	1.24	<0.0001
No	*Ref.*		
ICU admission			
Yes	2.31	10.07	<0.0001
No	*Ref.*		