Louisiana Pregnancy Registry

Initial Data Report

May 1, 2023

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I. Executive Summary

Background: Birthing people in Louisiana experience some of the poorest maternal health outcomes in the country. Louisiana ranks worse than most other states on indicators like adequate pregnancy care, preterm birth, and maternal morbidity. Disparities in health outcomes exist for Black and Hispanic birthing people and babies. It is critical to understand the root causes of poor maternal health outcomes in the state, with a focus on decreasing racial disparities. Electronic health record (EHR) databases are a useful source for assessing clinical and demographic characteristics of people who give birth and experience pregnancy loss in Louisiana because they allow for outcome ascertainment and longitudinal follow-up and pose fewer barriers to clinical research and public health surveillance.

Methods: The Louisiana Pregnancy Registry is an EHR-based registry containing clinical data on 71,181 patients aged 11-54 who had a live birth, stillbirth, spontaneous abortion, or ectopic pregnancy between January 2016 and January 2023. The registry encompasses a total of 91,457 unique pregnancies. Retrospective cohort analyses were performed at the pregnancy and patient levels to assess maternal health indicators related to prenatal and postpartum/interpregnancy care; severe maternal morbidity and labor/delivery complications; pre-pregnancy and prenatal conditions; and the ongoing COVID-19 pandemic. All patients had age data available, while the majority had race, ethnicity, and payer type data.

Results: The racial makeup of the registry was 44% non-Hispanic white, 38% non-Hispanic Black, 11% Hispanic, 2% Asian American or Pacific Islander (AAPI), and <1% American Indian. The median age of patients at first recorded pregnancy between January 2016 and January 2023 was 29 (25-33) [11-54]. More than half of pregnancies in the registry (54%) were covered by Medicaid. 81% of pregnancies resulted in a live birth, 17% in miscarriage, 2% in ectopic pregnancy, and <1% in stillbirth. Two percent of deliveries in the registry were associated with a severe maternal morbidity, or about 214 per 10,000 deliveries. Seventy-five percent of pregnancies were characterized by a timely prenatal visit, and 74% of pregnancies were characterized by a timely postpartum visit. Twenty-eight percent of pregnancies were associated with a prenatal or postpartum diagnosis of a mental health condition. Twelve percent of live births were preterm. We identified racial disparities for over 20 indicators. Finally, results suggest the COVID-19 pandemic may have had an impact on healthcare utilization trends during pregnancy.

Conclusions and Recommendations: Data from the Louisiana Pregnancy Registry may be leveraged to conduct timely surveillance of critical and topical trends like delivery-associated complications and access to prenatal care; lead data-only, pragmatic clinical outcomes research; develop prevention programs; and make recommendations to inform local or statewide policy changes. The desired outcomes of such work are to improve the quality of care and social support for pregnant people; reduce maternal morbidity and mortality; and reduce disparities in outcomes. Future informatics efforts should focus on linkage of maternal and child EHR data, integration of Vital Records to evaluate mortality rates, and geographic expansion beyond the southeast portion of the state. Future research efforts should focus on streamlining and funding internal processes to intake external requests to obtain summary or individual-level data from the Pregnancy

Registry. Project-specific data summaries and extracts may strengthen grant proposals, facilitate academic research (e.g. practicums, dissertations), and support retrospective cohort studies.

II. Introduction

Data Infrastructure

The Louisiana Pregnancy Registry is a source of health data on pregnant and birthing people in the state. The pregnancy registry aggregates data from participating health systems to enable large-scale analysis of maternal health indicators. Currently, Ochsner Health System and Tulane Health System contribute data to the pregnancy registry. The pregnancy registry is coordinated by the Louisiana Public Health Institute (LPHI) and led by a committee of partners working in maternal and child health.

Established in 2014 with funding from the Patient-Centered Outcomes Research Institute (PCORI), the Patient Centered Clinical Research Network (PCORnet®) is a national, integrated research network that draws clinical data from more than 30 million patients across the country. The Research Action for Health Network, or REACHnet, includes EHR data from almost 10 million patients from partner health systems in Louisiana and Texas. The REACHnet Coordinating Center is based at LPHI. All health systems that contribute data to PCORnet must standardize their EHR data in conformance with the PCORnet Common Data Model (CDM), which provides rules and guidelines for data quality and completeness. The Louisiana Pregnancy Registry contains abstracted and standardized medical chart data from two health systems that have a presence in southeast Louisiana, Tulane Medical Center and Ochsner Health. The registry currently includes data on 91,457 pregnancies and 71,181 patients from January 2016 through January 2023.

The data in the registry are classified and stored as limited datasets with actual dates and zip codes; however, there is no additional identifiable patient health information. This project received IRB approval from Sterling IRB on June 24, 2022.

Team Structure and Acknowledgements

LPHI serves as the project manager and convener for the New Orleans Pregnancy registry as well as the technical partner that administers the common data model infrastructure upon which the pilot registry is built. The LPHI team consisted of staff members Kristie Bardell, Tom Carton, Elizabeth Crull, Shelina Davis, Daniele Farrisi, Anna Legrand, Beth Nauman, Arien Ragster, Erica Spears, and Tulane University practicum student Megan Jacobs.

Strategy for the pregnancy registry is determined by a steering committee. Initial steering committee members were:

- Suzan Carmichael, Stanford University
- Veronica Gillispie-Bell, LA Perinatal Quality Collaborative and Ochsner Health
- Lisa Richardson, Institute for Women and Ethnic Studies
- Kathy Seligman, NOLA4Women
- Denese Shervington, Institute for Women and Ethnic Studies
- Maeve Wallace, Tulane University

Strategy for the Louisiana Pregnancy was also informed by an advisory panel of community partners that was engaged to inform operations and increase understanding of community needs. The advisory panel informed the initial set of indicators produced from the registry that are included in this report. Advisory Panel members included:

- Robin Gruenfeld, March of Dimes
- Stacey Holman, Touro Infirmary
- Chantell Reed, New Orleans Health Department
- Melanie Richardson, Training Grounds
- Frankie Robertson, Amandla Group
- Meshawn Siddiq, New Orleans Health Department
- Victoria Williams, Birthmark Doulas
- Portia Williams, NOLA Baby Café
- Rodney Wise, Amerihealth Caritas

III. Registry Overview and Selection of Indicators

Inclusion/Exclusion Criteria

Patients were included in the Louisiana Pregnancy Registry if they had a pregnancy outcome indicating live birth, stillbirth, spontaneous abortion, or ectopic pregnancy at Tulane or Ochsner after January 1, 2016. Inclusion criteria were defined by International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) code libraries and grouped accordingly. See **Appendix A** for a description of the inclusion criteria. Patients were excluded if their calculated age at the time of pregnancy outcome was under 10 and over 54.

All available clinical and zip code data were extracted for all 71,181 pregnant people. However, many pregnancy indicators we analyzed only required a short period of look-forward or look-back time, e.g., 42 days post-delivery for diagnosis of a severe maternal morbidity and 84 days post-delivery for presence of a postpartum visit.

Assignment of Pregnancy Characteristics

All pregnancies were assigned an index date that corresponded with the date of the pregnancy outcome. For live births and stillbirths, this was the date recorded in the medical record associated with the delivery of the live or stillborn neonate. For spontaneous abortion and ectopic pregnancy, the index date was the date associated with the clinical diagnoses for such events. Index date was essential for calculating new variables such as maternal age and weeks of gestation, along with anchoring look-back and look-forward time periods. A detailed description of how pregnancy start date and gestational age were estimated is provided in **Appendix B.** All pregnancies were attributed with maternal age, race/ethnicity, and payer type. More details can be found in **Appendix C**.

Calculation of Initial Set of Pregnancy-Related Indicators

The Louisiana Pregnancy Registry Steering Committee and Advisory Panel informed which maternal health predictors and outcomes were of most interest and importance. First, these stakeholders were asked to comment on what they hoped the pregnancy registry could accomplish, free of resource and data-related limitations. Then, we helped narrow this down by providing assessments on four domains: feasibility, complexity, usefulness, and relevance. These domains are described briefly below.

- **Feasibility**: Do we have the data needed for this indicator?
- **Complexity**: How easy or difficult will this be to program?
- **Usefulness**: How much will results inform practice, programs, or policy?
- **Relevance**: Does it matter to pregnant people?

From a technical perspective, we wanted to calculate indicators that were highly feasible, not complex, highly useful, and highly relevant. This meant that we mostly aimed to evaluate clinical predictors and outcomes, or items that could be found in the patient's record. Thus, we chose

indicators that could be programmed using clinical encounter data such as that found in diagnosis, procedures, prescribing, immunization, and vitals tables of the CDM.

The Centers for Disease Control and Prevention (CDC) defines severe maternal morbidities (SMM) as “unexpected outcomes of labor and delivery that result in short- or long-term consequences to a [pregnant person]’s health” (Center for Disease Control and Prevention, n.d.). The CDC provides guidance on how to identify 21 severe maternal morbidities using ICD-9-CM/ICD-10-CM and ICD-9-PCS/ICD-10-PCS diagnosis and procedure codes, respectively (see full code list in **Appendix D**). SMM event code lists were developed and used to query the pregnancy registry. An SMM event was flagged as being associated with a delivery if it occurred between twenty weeks of gestation and within six weeks, or 42 days, after delivery.

Similarly, we chose seven pre-pregnancy health conditions that are frequently associated with complications during and after pregnancy. These were asthma, cancer, overweight/obesity, diabetes, hypertension, thyroid disorder, and a group of mental health conditions. We also looked at alcohol, drug, and tobacco use during pregnancy. These ICD-10 codes are associated with a clinician-diagnosed complication of pregnancy, not patient self-report, and thus may be artificially low. We also looked at diagnosis of a mental health condition during pregnancy or in the year after pregnancy. **Appendix D** contains a full list of clinical codes for these conditions.

We also examined concepts related to healthcare utilization, specifically timeliness of prenatal and postpartum care. Per the National Committee for Quality Assurance (NCQA), prenatal care should take place in the first trimester of pregnancy (NCQA, 2020), which roughly translates to the first fourteen weeks of gestation, to be considered timely. This may include a diagnosis of pregnancy either by urinalysis or blood sample or the presence of a clinical encounter indicating supervision of pregnancy or antepartum care. We required that these encounters take place between the imputed pregnancy start date and 98 days, or 14 weeks, after the pregnancy start date to be classified as timely prenatal care. According to the Centers for Medicare & Medicaid Services (CMS), postpartum care should take place between seven and 84 days after delivery to be considered timely (CMS, 2020). This can include an outpatient postpartum visit, a cervical cytology procedure, or indication of postpartum bundled services (CMS, 2020). There are additional ways to determine whether postpartum care took place, such as a notation that the patient is breastfeeding, but these concepts are not available in the PCORnet CDM and are thus not present in the registry. Finally, we examined postpartum readmission specifically associated with a severe maternal morbidity, which is defined as any emergency encounter within the thirty days immediately following the discharge date associated with the index delivery.

We also looked at certain complications of labor and delivery that were not included as severe maternal morbidity diagnoses such as preterm birth and elective delivery. Preterm birth is defined as childbirth that occurs before 37 weeks of pregnancy have been completed (Center for Disease Control and Prevention, 2021). Pregnancies in the registry were flagged as having a preterm birth if they either had a diagnosis code for preterm birth associated with the delivery or if the weeks of gestation derived variable had a value less than 37 where the pregnancy outcome was not miscarriage or ectopic pregnancy. Elective delivery is defined as an induction of labor or planned

cesarean section procedure taking place where 37 or 38 weeks of pregnancy have been completed (Joint Commission, 2021). An elective delivery is different from an emergency cesarean section performed for medical reasons. Deliveries were flagged as elective if ICD-10-PCS procedure codes indicating medical induction of labor or planned cesarean section in labor were present within seven days of delivery; where gestational age was 37 or 38 weeks; and in patients with no history of prior stillbirth or other conditions justifying elective delivery.

We also analyzed a set of interpregnancy measures such as adequate birth spacing and postpartum contraceptive care. Many experts recommend waiting at least one year, ideally up to 18 months, after a delivery to become pregnant again (Center for Disease Control and Prevention, 2016; Louis et al., 2019). According to a paper published by the American College of Obstetricians and Gynecologists and the Society for Maternal-Fetal Medicine in 2019, the interpregnancy period is a critical opportunity to identify and address mental and physical health issues that appear or resurface during pregnancy, such as diabetes, hypertension, and depression (Louis et al., 2019). In our registry, we defined adequate birth spacing as greater than or equal to 548 days, or about 18 months, between delivery date and subsequent pregnancy start date. We looked at this at the patient level and only looked at patients with at least two pregnancies. Another interpregnancy care-related indicator we programmed and examined was postpartum contraceptive care. The U.S. Office of Population Affairs defines this measure as the percentage of women aged 15 to 44 years who had a live birth who were prescribed a most or moderately effective method of contraception within three and 60 days of delivery (U.S. Office of Population Affairs, 2017). This includes provision of sterilization (e.g., occlusion or destruction of fallopian tubes; hysterectomy), contraceptive implants, intrauterine devices or systems, injectables, oral pills, patch, ring, or diaphragm. The Office of Population Affairs provides technical guidance on how to identify these clinical concepts in the medical chart. For this metric, we only looked at deliveries, in accordance with the numerator and denominator definitions.

Finally, we looked at the proportions of pregnancies during which there was a diagnosis of COVID-19 or a vaccination against COVID-19. Pregnant and postpartum people are more likely to experience obstetric complications (Metz et al., 2022), have a more serious case of COVID-19 (Twanow et al., 2022), and require intensive medical intervention such as admission to intensive care or requiring mechanical ventilation (Walter, 2022) compared to their non-pregnant counterparts of similar demographic profile. We flagged pregnancies as having a COVID-19 diagnosis based on presence of an ICD-10 code indicating COVID-19 or a polymerase-chain reaction (PCR) test resulted as “positive” or “identified” during the pregnancy episode or within 42 days of the end of pregnancy. Similarly, we flagged pregnancies as having received a COVID-19 vaccination based on presence of a valid vaccine in the immunization, procedures, or medication tables during the pregnancy episode. See **Appendix D** for a list of COVID-19 PCR and vaccination codes.

Indicator List

The table below contains a list of the indicators generated from Louisiana Pregnancy Registry data during the pilot phase of its development. Also included are the corresponding tables and figures in this report where the indicator results can be found.

Indicator name	Location
HIV screening	Table 2a
Syphilis screening	Table 2a
Hepatitis B screening	Table 2a
Chlamydia screening	Table 2a
Gonorrhea screening	Table 2a
Severe maternal morbidity	Table 2b, Figure 1
Pre-pregnancy conditions	Table 2c
Tobacco, drug, or alcohol use	Table 2d
Timeliness of prenatal care	Table 2e
Timeliness of postpartum care	Table 2e
Mental health conditions	Table 2f
Gestational diabetes	Table 2f
Pre-eclampsia	Table 2f
Chorioamnionitis	Table 2f
Postpartum readmission	Table 2f
Elective delivery	Table 2g
Preterm birth	Table 2g
Complications of labor and delivery	Table 2g
Cesarean birth	Table 2g
COVID-19 diagnosis	Table 2h
COVID-19 vaccination	Table 2h
Prescription of contraception	Table 2i
Birth spacing	Table 2j
Early pregnancy loss	Table 2k

IV. Results and Interpretation

Registry characteristics

Table 1a. Patient-level demographic and gravidity information for the Louisiana Pregnancy Registry

Characteristic	n (%)
N (patients)	**71,181**
Age, years	
Mean (SD)	29.1
Median (IQR) [range]	29 (25-33) [11-54]
Race/ethnicity	
American Indian or Alaska Native	242 (<1)
Asian American or Pacific Islander	1,720 (2)
Hispanic	8,112 (11)
Non-Hispanic Black	27,030 (38)
Non-Hispanic White	31,177 (44)
Unknown	2,900 (4)
Number of pregnancies per patient*	
1	55,215 (78)
2	12,508 (18)
3	2,761 (4)
4	697 (<1)

*During 2016-2023 timeframe

Table 1b. Pregnancy episode information for the Louisiana Pregnancy Registry

Characteristic	n (%)
N (pregnancies)	**91,457**
Year	
2016	11,720 (13)
2017	11,914 (13)
2018	11,815 (13)
2019	12,435 (14)
2020	12,696 (14)
2021	14,121 (15)
2022	16,747 (18)
2023	<11 (<1)
Pregnancy outcome	
Live birth	73,990 (81)
Spontaneous abortion	15,371 (17)
Stillbirth	726 (<1)
Ectopic	1,370 (2)
Insurance type	
Medicaid	49,065 (54)
Commercial	31,632 (35)
Unknown	10,760 (12)

Table 1c. Comparison of demographic characteristics for all patients with live births in the state of Louisiana and patients with live births in the Louisiana Pregnancy Registry
Data for Louisiana from the March of Dimes Perinatal Data Center (2023)

	% of live births in Louisiana, 2018-2020 (N=57,328)	% of live births in the Louisiana Pregnancy Registry, 2018-2020 (N=29,917)
Age category		
<20	6.7	2.6
20-29	55.8	49.7
30-39	35.3	42.1
≥40	2.1	2.8
Race/ethnicity*		
American Indian or Alaska Native	0.5	0.4
Asian American or Pacific Islander	2.0	2.6
Hispanic	8.4	11.5
Non-Hispanic Black	37.8	37.7
Non-Hispanic White	50.8	44.0

*Percentages do not total 100 percent due to missing ethnicity data not being shown

Table 1a and **Table 1b** respectively provide patient- and pregnancy episode-level information on the Louisiana Pregnancy Registry. The racial makeup of the registry is 44% non-Hispanic white, 38% non-Hispanic Black, 11% Hispanic, 2% Asian American or Pacific Islander patients, and <1% American Indian. The median age of patients at first recorded pregnancy between January 2016 and January 2023 was 29 (25-33) [11-54]. More than half of pregnancies in the registry (54%) were covered by Medicaid. 81% of pregnancies resulted in a live birth, 17% resulted in miscarriage, 2% resulted in ectopic pregnancy, and <1% resulted in stillbirth. The majority of patients in the registry (78%) had only one pregnancy on record during the timeframe.

We attempted to determine whether our pregnancy registry constitutes a demographically representative sample of pregnancies in the whole state. EHR data obtained from Tulane and Ochsner systems are for pregnancies mostly in the Greater New Orleans area and southeast Louisiana. **Table 1c** shows a comparison of age and race breakdown for live births in the state of Louisiana from 2018 to 2020 (March of Dimes, 2023). Overall, the registry skews slightly older, with 44.9% of live births being associated with birthing persons aged 30 or older, compared to 37.4% in the state. Our registry also contains a lower proportion of live births associated with white birthing persons (44.0%) compared to that of the state (50.8%). This is likely attributable to our data being pulled from health systems in metropolitan areas of the state, e.g., New Orleans. The racial breakdown of patients in the registry, shown in **Table 1a**, falls between Louisiana as a whole (Census, 2020) and New Orleans (Census, 2020).

Registry Indicators

Table 2a. Pregnancies resulting in birth receiving the recommended number of screenings (LDH, 2018)

STD screening	n	% of pregnancies with birth outcome (N=74,716)
Received 2 HIV screenings	34,406	46.0
Received 2 syphilis screenings	39,610	53.0
Received 1 hepatitis B screening	43,723	58.5
Received 1 chlamydia screening	43,327	58.0
Received 1 gonorrhea screening	43,345	58.0

Table 2a outlines the number of pregnancies resulting in delivery that were characterized by having received the recommended number of sexually transmitted disease (STD) screenings, according to guidelines from the Louisiana Department of Health (2018). Proper screening for human immunodeficiency virus (HIV), which entails having two prenatal screenings, was only seen in 46.0% of pregnancies resulting in delivery. Proper screening was highest for hepatitis B, which was seen in 58.5% of pregnancies.

Table 2b. Indicators of severe maternal morbidity per 10,000 deliveries, 2016-2022 (N=73,335)

	n	Prevalence
Any severe maternal morbidity	1,569	213.9
Any severe maternal morbidity (excluding blood products transfusion)	1,533	209.0

Table 2b (above) and **Figure 1** (next page) demonstrate that the prevalence of deliveries with a severe maternal morbidity indicator was 213.9 per 10,000 deliveries between 2016 and 2022. When adjusted for blood products transfusion (i.e., removing it as an indicator), that prevalence rate was 209.0 per 10,000 pregnancies.

Figure 1. Indicators of severe maternal morbidity, per 10,000 deliveries, 2016-2022 (N=73,335)

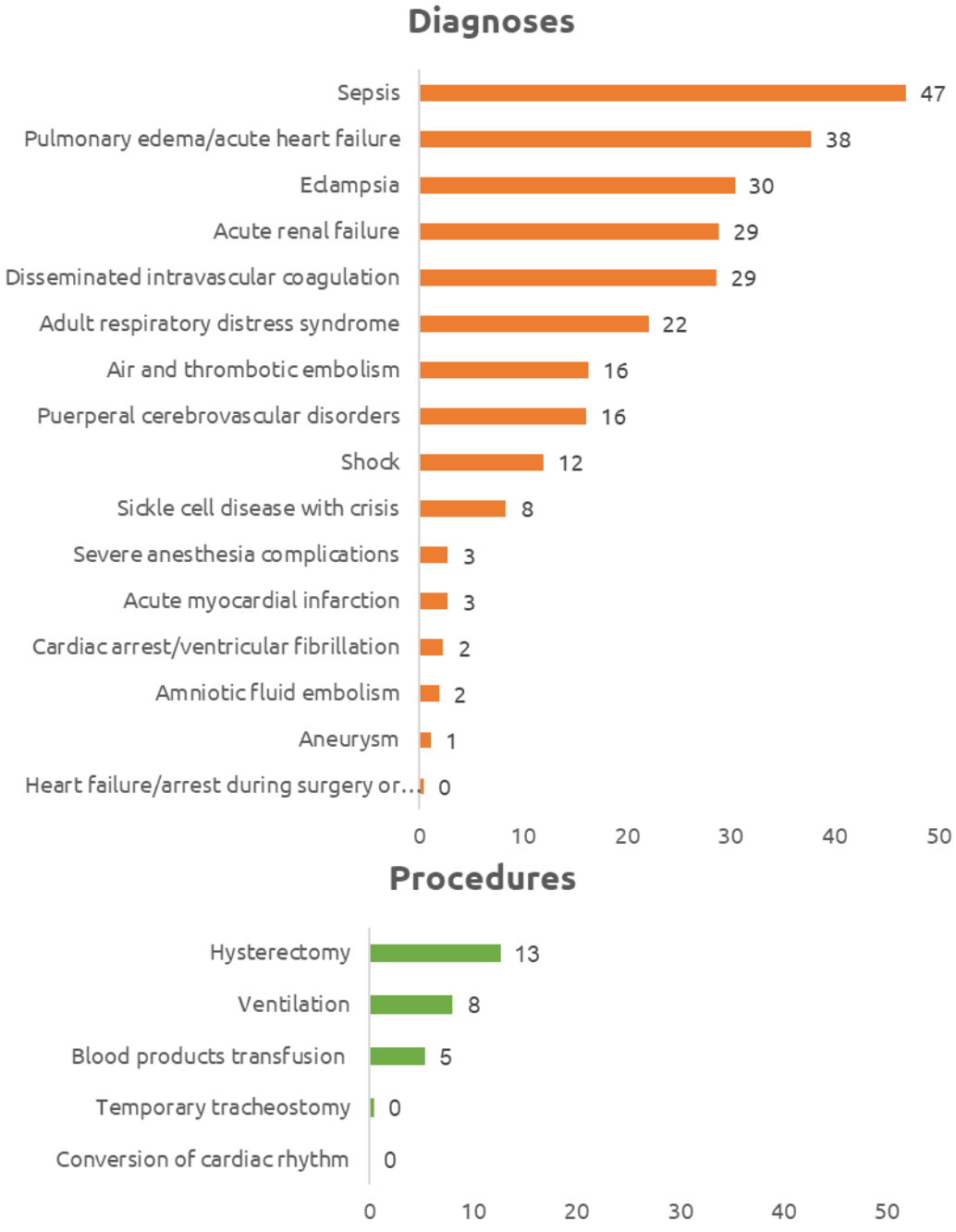


Table 2c. Patients with select conditions prior to pregnancy

Pre-pregnancy condition	n	% of all patients (N=71,181)
Asthma	3,384	4.8
Cancer	3,727	5.2
Type 2 diabetes mellitus	1,152	1.6
Hypertension	2,739	3.8
Mental health conditions	12,499	17.6
Thyroid disorder	2,069	2.9
	n	**% of all patients age 25+ at earliest pregnancy (N=51,712)**
Overweight/obesity (25.0 or greater)	28,216	54.6

Table 2d. Patients with tobacco, drug, or alcohol use during pregnancy

Substance	n	% of all pregnancies (N=91,457)
Tobacco	6,647	7.3
Drug	3,051	3.3
Alcohol	150	0.2

Table 2c shows the proportion of birthing persons who had select conditions prior to their first recorded pregnancy between 2016 and 2022. Pre-existing mental health conditions and overweight/obesity were common, with 17.6% of pregnant people having at least one mental health diagnosis prior to first pregnancy and just over half (54.6%) of pregnant people having a BMI greater than or equal to 25 prior to first pregnancy. **Table 2d** shows that 7.3% of all pregnancies having a diagnosis code indicating tobacco use during pregnancy.

Table 2e. Pregnancies with timely care visits (NCQA)

Timeliness of prenatal care	
Pregnancies with a prenatal care visit before end of first trimester	62,074
Pregnancies with an outcome after 10/1/16	82,689
%	**75.1**
Timeliness of postpartum visit	
Deliveries with a postpartum visit between seven and 84 days after birth	52,847
Live births before 9/1/22	71,035
%	**74.4**

Table 2e displays the rates of timely prenatal and postpartum care. 75.1% of pregnancies were characterized by a timely prenatal visit, while 74.4% of deliveries were characterized by a timely postpartum visit.

Table 2f. Pregnancies with health conditions during or after pregnancy

Mental health conditions diagnosed during or after pregnancy	
Pregnancies where patient was diagnosed with anxiety, PTSD, OCD, or depression during pregnancy or within one year of pregnancy outcome	20,175
All pregnancies prior to 1/1/22	74,701
%	**27.7**
Gestational diabetes mellitus	
Pregnancies resulting in delivery where patient was diagnosed with diabetes mellitus between 20 weeks gestation and 6 weeks postpartum	6,504
All deliveries between 1/1/16 and 11/24/22	73,335
%	**8.9**
Pre-eclampsia (including HELLP syndrome)	
Pregnancies resulting in delivery where patient was diagnosed with pre-eclampsia between 20 weeks gestation and 6 weeks postpartum	6,992
All deliveries between 1/1/16 and 11/24/22	73,335
%	**9.5**

Chorioamnionitis during pregnancy	
Pregnancies resulting in delivery where patient was diagnosed with chorioamnionitis between 20 weeks gestation and 6 weeks postpartum	2,328
All deliveries between 1/1/16 and 11/24/22	73,335
%	**3.2**
Postpartum readmission	
Pregnancies where birthing person aged 15-44 between 11/1/21 and 10/31/22 readmitted within 30 days of discharge with a severe maternal morbidity-related diagnosis	112
Pregnancies where birthing person aged 15-44 between 11/1/21 and 10/31/22	10,873
%	**1.0**

Table 2f shows rates for select mental health conditions during pregnancy, gestational diabetes, pre-eclampsia, chorioamnionitis, and postpartum readmission.

Table 2g. Pregnancy labor and delivery

Elective delivery	
Early term pregnancies with elective delivery	878
All pregnancies with gestational age between 37 and 38.6 weeks	21,550
%	**4.1**
Preterm birth	
Pregnancies with live birth <37 weeks gestational age	9,180
All pregnancies resulting in live birth	74,032
%	**12.4**
Complications of labor and delivery	
Deliveries associated with a complication of delivery or labor within six weeks of delivery date	59,337
All deliveries	74,716
%	**79.4**
Cesarean birth	
Deliveries associated with cesarean section procedure	20,994
Deliveries resulting in live birth or stillbirth that can be classified as vaginal or cesarean	61,000
%	**34.4**

Table 2g shows the rates of early term pregnancies with elective delivery, preterm birth, and complications of labor and delivery. “Complications of labor and delivery” constitutes a suite of diagnostic codes (O60-O77) and is likely overinclusive for purposes of making sense of the results presented. The most commonly occurring complications of labor and delivery diagnosis codes in our registry were cord around neck; abnormality in fetal heart rate and rhythm; perineal laceration; and fetal stress.

Table 2h. Indicators related to the COVID-19 pandemic

COVID-19 diagnosis during pregnancy	
Pregnancies between 3/1/20 and 9/30/22 with a positive COVID-19 diagnosis or PCR test during pregnancy or within 6 weeks of pregnancy end	1,940
All pregnancies between 3/1/20 and 9/30/22	31,334
%	**6.2**
COVID-19 vaccination during pregnancy	
Pregnancies where birthing person aged 16+ and had a pregnancy that began after 1/1/21 with at least one COVID-19 vaccination	1,390
All pregnancies where birthing person aged 16+ and had a pregnancy that began after 1/1/21	22,117
%	**6.3**

Table 2h shows our attempts to quantify the rates of COVID-19 diagnosis and vaccination among pregnant people in our registry, though we are aware that these are almost certainly undercounts given the scope of COVID-19 testing and vaccination that took place and continues to take place outside of health systems. 6.2% of pregnancies during the COVID-19 pandemic were characterized by a COVID-19 diagnosis or a positive COVID-19 PCR test. 6.3% of pregnancies during the time that COVID-19 vaccinations have been widely available were characterized by administration of a COVID-19 vaccine.

Table 2i. Prescription of contraception after delivery

Birthing persons aged 15-44 with a live birth between 1/1/16 and 10/30/22 who were provided a most or moderately effective method of contraception within three and 60 days of delivery	26,551
Birthing persons aged 15-44 with a live birth between 1/1/16 and 10/30/22	71,450
%	**37.2**

Table 2j. Inadequate birth spacing after a live birth

Birthing persons aged 15-44 whose most recent pregnancy was conceived within 18 months of a previous live birth	6,096
Birthing persons aged 15-44 with at least two pregnancies	15,923
%	**38.3**

Table 2i and **Table 2j** show rates of postpartum contraceptive care and inadequate birth spacing, measures critical to understanding and improving interpregnancy care.

Table 2k. Early pregnancy loss

Pregnancies ending ≤13 weeks	15,846
All pregnancies	91,457
%	**17.3**

Finally, **Table 2k** shows the percentage of pregnancies that result in early pregnancy loss, which is defined as pregnancy loss at or before 13 weeks of gestation regardless of pregnancy outcome. 17.6% of pregnancies in our registry resulted in early pregnancy loss.

Analyses

Table 3a. Rates of severe maternal morbidity by race/ethnicity (2016-2022)

Race/ethnicity	Number of deliveries* by race/ethnicity	% of deliveries with an indication for any severe maternal morbidity
American Indian or Alaska Native	253	2.4
Asian American or Pacific Islander	1,806	2.0
Hispanic	8,220	1.4
Non-Hispanic Black	27,059	3.0
Non-Hispanic White	33,232	1.6
Total ±	**70,570**	**2.1**

*Between 1/1/16 and 11/24/22
± Deliveries with missing race data are not shown

Figure 2. Rates of severe maternal morbidity by race/ethnicity (2016-2022)

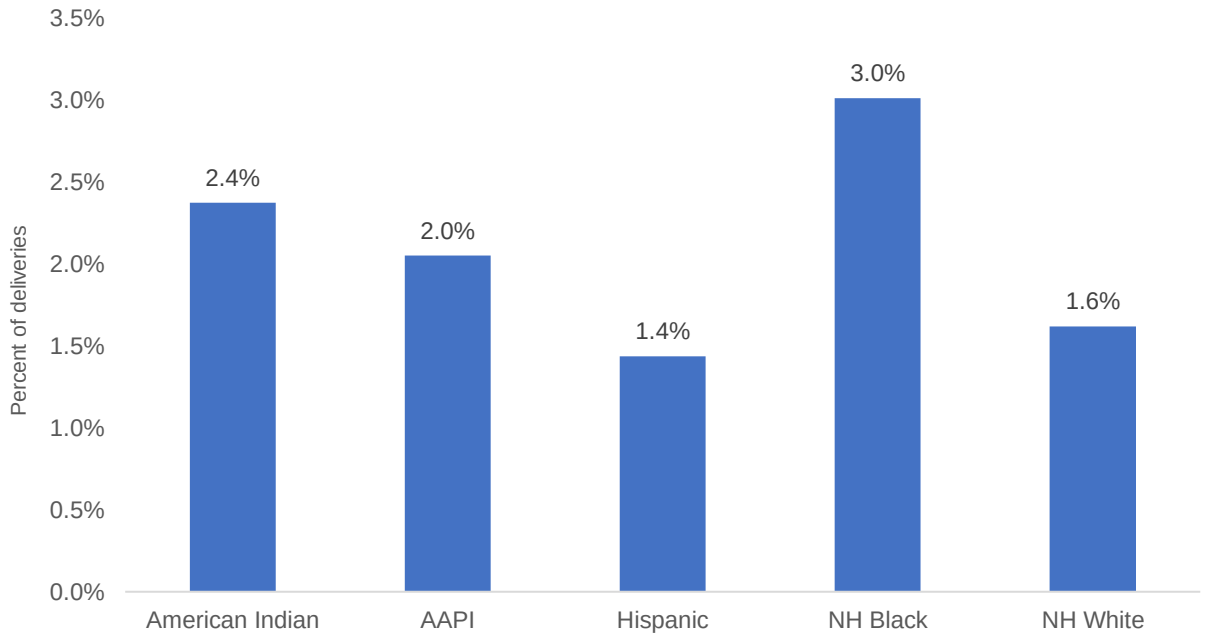
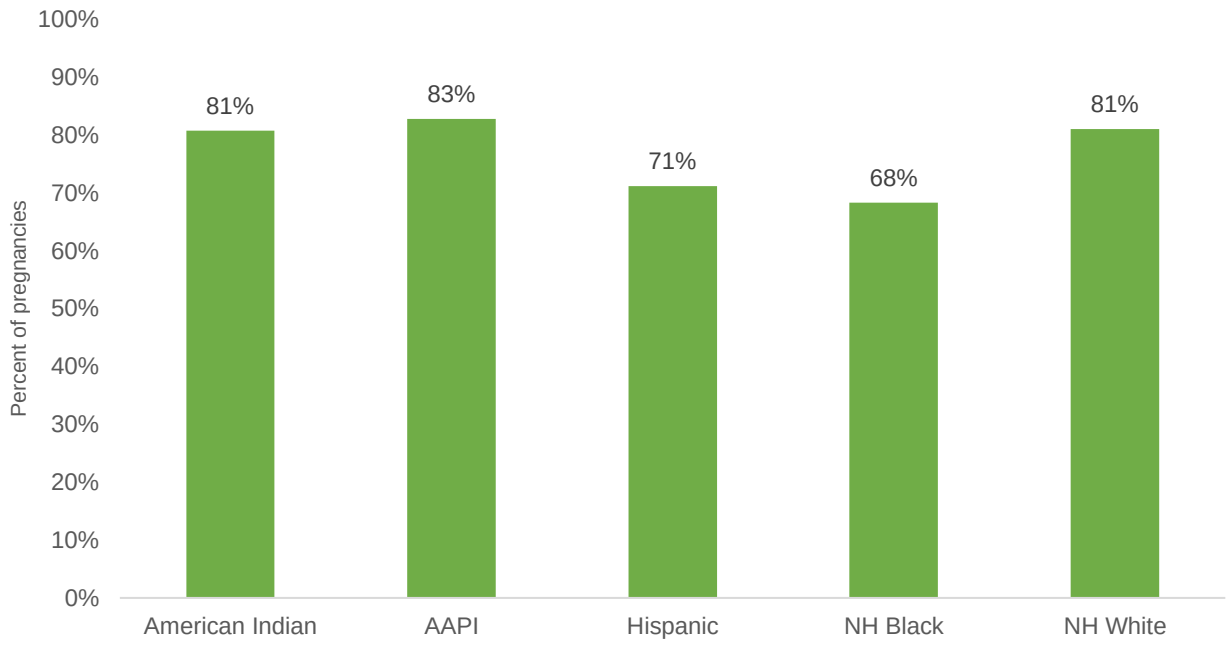


Table 3b. Rates of timely postpartum care by race/ethnicity (2016-2022)

Race/ethnicity	Number of deliveries* by race/ethnicity	% of deliveries with a timely postpartum visit
American Indian or Alaska Native	249	80.7
Asian American or Pacific Islander	1,762	82.7
Hispanic	7,946	71.1
Non-Hispanic Black	26,291	68.3
Non-Hispanic White	32,115	81.0
Total ±	**68,363**	**75.0**

*Between 1/1/2016 and 9/30/2022
± Deliveries with missing race data are not shown

Figure 3. Rates of timely postpartum care by race/ethnicity (2016-2022)



Results described in **Table 3a** and **Table 3b** (and visualized in **Figure 2** and **Figure 3**, respectively) show that racial disparities exist for the health indicators we analyzed: indication of any severe maternal morbidity and indication of postpartum care in the fourth trimester. **Table 3a/Figure 2** show that 3.0% of deliveries among Black people were characterized by at least one severe maternal morbidity compared to only 1.6% of deliveries among white people. In other words, Black people experienced severe maternal morbidity at almost twice the rate of white people. This racial disparity was also seen in healthcare utilization indicators. As outlined in **Table 3b/Figure 3**, only 68.3% of pregnancies among Black people were characterized by a timely postpartum care visit compared to their white (81.0%) and AAPI (82.7%) counterparts.

Table 3c. Ambulatory encounters during pregnancy, prior to and during the COVID-19 pandemic

Description	N	Mean	SD	Pr>|t|
Pregnancies* prior to COVID-19 pandemic[α]	12,045	16.5	8.4	<.001
Pregnancies* during COVID-19 pandemic[β]	14,087	15.5	7.7	<.001

* only pregnancies resulting in live birth
[α] 10/1/17 – 9/30/19
[β] 1/1/20 – 12/31/21

Finally, results described in **Table 3c** suggest that healthcare utilization during pregnancy may have decreased during the COVID-19 pandemic. In a two-year period before the COVID-19 pandemic, pregnant people who gave birth averaged 16.5 outpatient encounters during pregnancy (p<.001). In a two-year period after the COVID-19 pandemic began, pregnant people who gave birth averaged 15.5 outpatient encounters during pregnancy (p<.001). Some of these encounters may be virtual visits, phone calls, patient portal communications, or medication refills. For this reason and others, more sophisticated analytic methods are required to determine causation.

V. Discussion

Comparison to Published Rates

Results from most indicators were compared with published national trends to both validate our programming and provide context for the current state of maternal health risk factors and outcomes in Louisiana. Some of these comparisons are described below.

Results in **Table 2b** show that the prevalence of SMM events in the Pregnancy Registry was 213.9. per 10,000 deliveries. National figures on SMM prevalence vary, depending on measurement period and source data (Hirai et al., 2022; Admon et al., 2023; Center for Disease Control and Prevention, 2014; Brown et al., 2020), but generally fall in the range of 80 to 150 per 10,000 deliveries. In other words, even compared to the high end of that range, our registry still has about 1.5 times as many SMM events per 10,000 deliveries compared to the country overall. It is worth noting that we used the CDC-validated code list (Center for Disease Control and Prevention, 2019), which only contains ICD-10-CM and ICD-10-PCS codes. We determined with further investigation that some of the procedures could be alternatively captured with CPT codes. However, to promote comparability with published rates, we did not make modifications to the CDC code list in our analysis.

Table 2e shows that 75.1% of pregnancies were characterized by timely prenatal care and 74.4% of live births were characterized by timely postpartum care. The prenatal care rate in the Louisiana Pregnancy Registry is about the same as the national rate of 75.6% of pregnant women who receive early and adequate prenatal care (Healthy People 2030, n.d.). There is no national benchmark for postpartum care, though ACOG estimates that as many as 40% of women do not receive a proper postpartum care visit (ACOG, 2018).

Table 2f shows pregnancies affected by certain conditions. In our registry, the rate of gestational diabetes was 8.9%. The CDC estimates that between two and 10 percent of pregnancies are affected by gestational diabetes at the national level (CDC, 2022), which means that our population is on the higher end of that spectrum. Similarly, the rate of pre-eclampsia in our registry is 9.5%, which is higher than the national range of between five and eight percent (March of Dimes, 2023). Finally, the rate of chorioamnionitis in our registry is at the high end of a range provided by one study (Tita and Andrews, 2010), which estimated that between one and four percent of births are affected by this condition. Our registry showed that 3.2% of births were affected by chorioamnionitis.

Table 2g shows rates for labor and delivery. The elective delivery rate in our registry was 4.1%, which is similar to rates published in literature ranging from 4% to 9% (Teitler et al, 2019). The preterm birth rate was 12.4% in our registry, compared to a national rate of 10.5%, as of 2022 (March of Dimes, 2022). The cesarean birth rate in our registry was 34.4%, slightly higher than the national rate of 32.1% as of 2021 (March of Dimes, 2021).

Table 2j shows the birth spacing rate in our registry, i.e. that 38.3% of birthing persons with at least two pregnancies had their most recent pregnancy conceived within 18 months of a previous live birth. The national rate for this indicator is 26.6% as of 2019 (U.S. Department of Health and Human Services, 2019).

Table 2k shows that 17.3% of all pregnancies in the registry ended at or before 13 weeks of gestation. Nationally, between 10 and 20 percent of pregnancies end in loss (March of Dimes, 2023), which puts our overall registry on the higher end of that range.

Importance

There are many exposure-specific pregnancy registries, but few that look at pregnancies as comprehensively as the Louisiana Pregnancy Registry. Louisiana has a distinct need for timely, comprehensive data as our pregnancy-associated deaths are more than three times the nationwide maternal mortality rate. Louisiana's rate of pregnancy-related deaths was 101.5 per 100,000 births in 2017-2019 (PAMR, 2022) versus the national rate of 20.1 per 100,000 live births in 2019 (Center for Disease Control and Prevention, 2021). Louisiana's Pregnancy-Associated Mortality Review (PAMR) identified eight overarching needs after reviewing the 2017-2019 maternal deaths:

1. Improve care coordination before, during and after pregnancy, including support for the 4th trimester.
2. Ensure women receive the appropriate level of care based on their medical issues and risk factors.
3. Expand the obstetric healthcare workforce through telehealth and inclusion of specialists.
4. Address racial and cultural bias.
5. Improve and expand identification of and treatment for substance use and mental health during pregnancy.
6. Address social determinants of health to improve maternal mortality and decrease disparities.
7. Increase awareness of Louisiana's Maternal Mortality Review Committee to support the need for data sharing and access to medical records.
8. Contribute to the public health evidence base to increase capacity to understand and address root causes of pregnancy-associated mortality.

The Louisiana Pregnancy Registry can support these goals by enabling timely measurement of progress towards desired outcomes and contributing to the public health evidence base. The pregnancy registry is an asset in the state's efforts to improve maternal health outcomes because it allows for up-to-date indicators to be used for monitoring and surveillance of health outcomes in pregnant people. It is also Louisiana-specific, allowing researchers to focus on what the state's unique issues are.

Current and Potential Use Cases

At the time of writing, the Louisiana Pregnancy Registry data infrastructure has been leveraged for one funded project. We have partnered with the National Healthy Start Association on their Alliance for Innovation on Maternal Health Community Care Initiative (AIM CCI) project. A federally funded project, AIM CCI aims to reduce maternal mortality and morbidity through the creation of maternal safety bundles on evidence-based practices and the development of a national database to house community-based reports on maternal health outcomes. The AIM CCI project is focused on uncovering and addressing racial disparities and systemic inequities in maternal health outcomes and prioritizes community-based approaches to these challenges. (AIM CCI, n.d.). Our team has repurposed key indicators on prenatal care, severe maternal morbidity, and postpartum care into reports for the AIM CCI project. We stratified results by race and ethnicity to highlight differences in outcomes.

Our intention is for the Louisiana Pregnancy Registry to serve as a data resource for researchers and practitioners in the maternal health space to conduct retrospective research and monitor trends in health outcomes. It is our hope that the outputs from said work can affect meaningful change to policy and legislation, support services both in and out of healthcare settings, and the general discourse around pregnancy and childbirth. This is especially true for pregnant and birthing people of color, who experience pregnancy complications at disproportionate rates. Further, we aim to use the existing infrastructure as a foundation on which to incorporate data from additional sources, such as Vital Records, patient-reported outcomes, and insurance claims.

VI. Limitations

The Louisiana Pregnancy Registry was designed in part to demonstrate the usability of clinical data for maternal health outcomes research and pregnancy-related morbidity and mortality surveillance, and to inform the development of policies and programs geared towards reducing health disparities and improving the overall health of pregnant people. Medical chart data are useful for identifying and flagging billable clinical events that happen in formal care settings, such as encounters denoting prenatal and postpartum care and diagnoses rendered before, during, and after pregnancy. Chart data are also particularly helpful for tying these clinical data points to demographic ones, such as race, ethnicity, age, and insurance status. However, exclusive reliance on population-level clinical data to answer research questions about and make policy recommendations regarding pregnant people is not necessarily precise and has many limitations.

First, this registry is not inclusive of all healthcare centers that provide pregnancy care to those in Louisiana, or specifically in the New Orleans area. While LCMC Health is a partner in REACHnet, it currently only contributes data from one hospital (University Medical Center) with tentative plans to bring on birthing hospitals like Touro, East Jefferson, and West Jefferson. More generally, patients who receive non-delivery healthcare at non-participating health systems will not have these data points captured in this registry. This particularly pertains to populations who do not receive established, consistent care at Ochsner or Tulane due to fluctuations in insurance status, residential address, or some other reason. Plans to link registry data to Medicaid claims data and expand participation in the registry to community health centers are in development to address this gap.

Second, while the algorithms used to develop gestational age and pregnancy start dates are based on peer-reviewed scientific processes, it is still ultimately a machine-based process that is not sensitive to individual nuance or outlying data points. Because the PCORnet CDM does not currently accommodate the abstraction of clinician notes and other non-discrete data points, we did not have access to last menstrual period, ultrasound results, or other non-algorithmic ways to estimate pregnancy start date.

Third, the registry does not currently contain data on infants. This means that important neonatal health indicators like low birthweight are not currently being captured in our registry. The registry also does not contain death data, restricting us from looking at maternal mortality. We are currently exploring the feasibility of linkage to Louisiana Vital Records data, which may support maternal-infant linkage and mortality analyses.

Finally, the registry does not contain certain sociodemographic data. For example, we do not have information on marital status, employment status, income level, educational attainment, or housing situation. Although some of this may eventually be integrated into the PCORnet CDM as a new table, it is not clear what that timeline would be or how feasible it would be for health systems to populate these fields based on electronic health record data alone. Linkages to other data sources may be the best approach in the interim period, although these projects would require additional resources.

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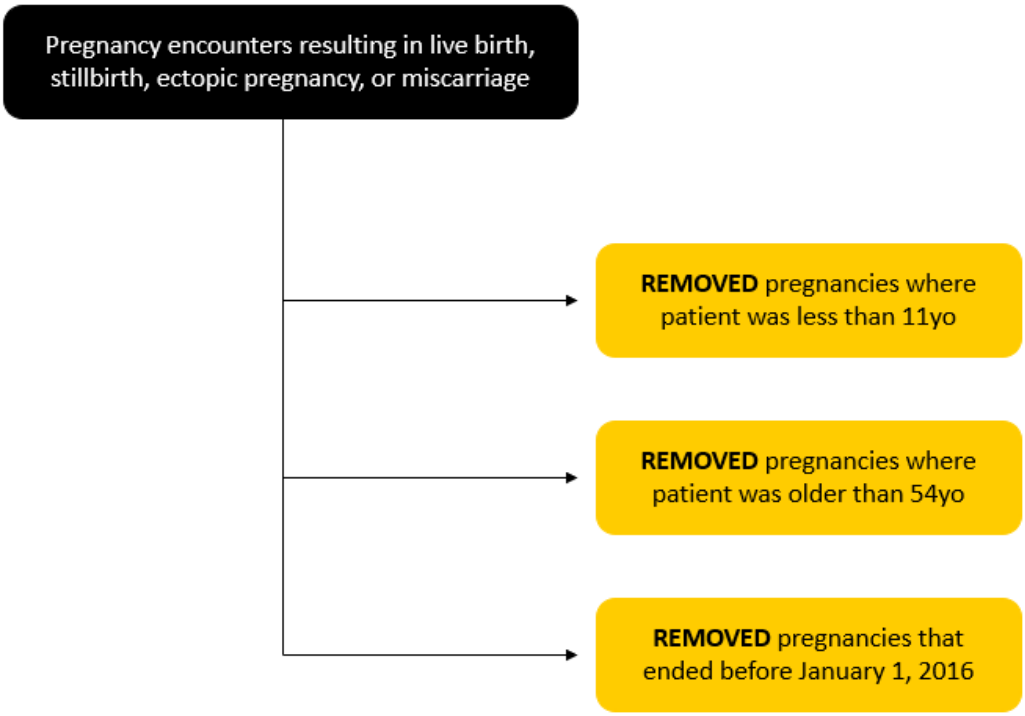
Appendix A. Description of inclusion criteria for the Louisiana Pregnancy Registry



Appendix B. Technical description of algorithm used to estimate gestational age and pregnancy start date

Gestational age, defined as the period in weeks between conception and birth, is not readily available as a discrete data element in the PCORnet CDM. Thus, this data element had to be derived, with some imputation for missing or nonspecific values. A series of ICD-10 codes, under the umbrella prefix Z3A, are used on the maternal record throughout the pregnancy to indicate the weeks of gestation when known. The ICD-10 code's numerical suffix corresponds to the number of weeks, e.g. code Z3A.21 indicates 21 weeks of gestation of pregnancy. These codes may be applied at routine prenatal care visits as a secondary diagnosis, but they are not required to be applied and thus are not present for every encounter related to supervision of the pregnancy (American Academy of Professional Coders, n.d.; Jitendra, 2019). This is especially true for spontaneous abortions and ectopic pregnancies, which result in termination of pregnancy and often occur in the first trimester (March of Dimes, 2023; Cleveland Clinic, 2023; Dugas and Slane, 2022).

Z3A diagnosis codes were available for 82,290 (89.8%) of pregnancies in our registry. The final recorded Z3A code for each pregnancy was selected, which often corresponded to the outcome of the pregnancy. For example, a Z3A code was usually present for the encounter for delivery. In cases where more than one Z3A code was erroneously coded on the same encounter date, the Z3A code with the higher value (i.e. number of weeks) was selected. For each record, the numerical suffix on the Z3A code was extracted from the code, converted to an integer corresponding to weeks, and then multiplied by seven to result in an integer corresponding to days. Finally, the number of days was subtracted from the index date (or pregnancy outcome date) to estimate a pregnancy start date. The pregnancy period for each record in the registry is defined as the period between the derived pregnancy start date and the established index date.

Imputation was performed on pregnancy records where Z3A data were not available (n=9,167). Ectopic pregnancies and spontaneous abortions comprised 95.0% of the 9,167 pregnancies where Z3A codes were missing. In these cases, weeks of gestation was imputed as median gestational age by pregnancy category, either calculated from the pregnancy registry where Z3A data were not missing (in the case of live births, spontaneous abortions, and stillbirths) or determined by a peer-reviewed, published median gestational age (in the case of ectopic pregnancy) [Phiri et al., 2018; Chomistek et al., 2021; Hornbrook et al., 2007; Naleway et al., 2013]. For live births, the imputed gestational age was 39 weeks; for spontaneous abortions, 8 weeks; for stillbirths, 25 weeks; and ectopic pregnancies, 8 weeks. The same calculation was then performed on these records with imputed gestational age to derive pregnancy start date.

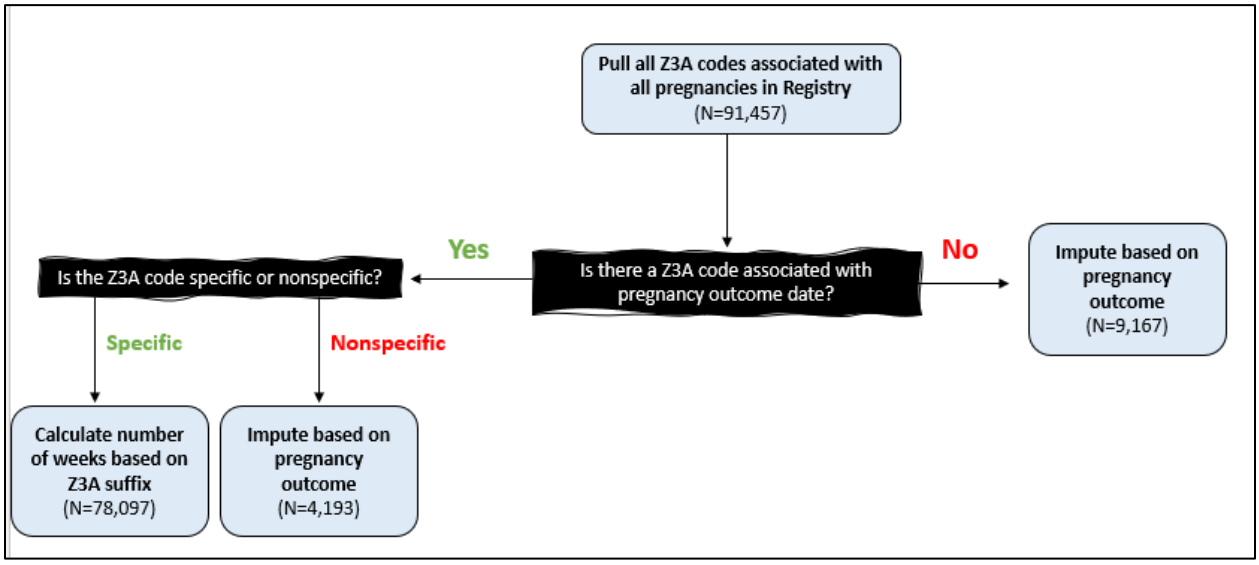
Imputation was also performed on pregnancy records where the Z3A code present was nonspecific (n=4,193), thus rendering an imprecise gestational age. Pregnancies where diagnosis code equaled Z3A.00 [weeks of gestation of pregnancy not specified, (n=1,879)] or Z3A.01 [less than 8 weeks gestation of pregnancy, (n=2,247)] were stratified by pregnancy category and imputed according to the same median-based methodology described in the above paragraph.

Finally, pregnancies where diagnosis code equaled Z3A.49 [greater than 42 weeks gestation of pregnancy, (n=67)] were imputed to gestational age of 42 weeks.

Overall, gestational age was imputed for 13,360 (14.6%) pregnancies in the registry, 9,167 of which did not have any gestational age data available and 4,193 of which had imprecise gestational age data. Imputation was deemed necessary to estimate a pregnancy start date, as many pregnancy-related metrics are contingent upon having pregnancy start and end dates clearly defined for lookback and look-forward purposes. The pregnancy interval was defined as the period between the estimated pregnancy start date and pregnancy outcome date.

The literature does describe more sophisticated – and potentially more accurate – algorithms to determine gestational age. Such processes involve more advanced chart searches such as trying to identify pregnancy-specific procedures like nuchal translucency scans and chorionic villus sampling that are usually performed at a certain week of pregnancy to estimate gestational age (Moll et al., 2021). Other researchers have developed model-based methods like multiple imputation and expectation maximization algorithms to handle missingness (Lupattelli et al., 2019). Ultimately, this team decided on a median-based imputation approach that was low in complexity and replicated in much of the literature.

A flow diagram depicting this process is shown below.



Appendix C. Description of assignment of demographic covariates

Assignment of Race and Age Category

The PCORnet CDM's specifications for the demographic table provide guidance for the population of patient race and ethnicity. These value sets are based on the Office of Management and Budget standard and are compatible with the United States Census. They are described below.

Race	
American Indian or Alaska Native	A person having origins in any of the original peoples of North and South America (including Central America), and who maintains tribal affiliation or community attachment.
Asian	A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam
Black or African American	A person having origins in any of the black racial groups of Africa
Native Hawaiian or Other Pacific Islander	A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands
White	A person having origins in any of the original peoples of Europe, the Middle East, or North Africa

Ethnicity	
Hispanic	A person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin, regardless of race.

We coded such that if a person was Hispanic, that race category superseded others. For example, if a person's race was recorded white but their ethnicity was recorded as Hispanic, we coded them as Hispanic in our registry. Although the PCORnet CDM allows for the population of "Multiple Races" as a race value, there were no records in the source data with this value populated.

Maternal age was calculated at the date of pregnancy outcome. Although not presented in this report, we also assigned age categories to patients: 10-17; 18-34; and 35-54.

Insurance Coverage during Pregnancy

The PCORnet CDM's specifications for the encounter table provide guidance for population of primary payer type associated with an individual clinical encounter. Although imperfect, this is a more precise approach to proxying for socioeconomic status than a zip code-level approach as it points directly to the financial status of an individual in the registry, whereas median zip code-level attributes may obscure variability within a single, broad geographic area.

In our registry, we chose the payer type that was associated with the clinical encounter at the date of the pregnancy outcome. Payer category was grouped into three categories: Medicaid, commercial insurance, or other/unknown. Commercial insurance includes employer-based health insurance and federal or state marketplace plans. The category "other/unknown" included scenarios where the pregnancy care was covered by TRICARE, the uniformed services health care program for active-duty service members, or Veterans Affairs. It also included patients who paid for the encounter out of pocket. Finally, the other/unknown category included records where the wording was too vague to indicate whether it was a privately or publicly insured plan, (e.g., "HMO"). In some cases, more than one payer type was erroneously assigned to the same encounter as "primary payer." These were likely cases where one payer was meant to be assigned to secondary payer. For these cases, we selected the non-missing payer type over missing payer type. When both commercial insurance and Medicaid were indicated as primary payer, we selected to categorize the pregnancy as being covered by Medicaid primarily.

Appendix D. Description of computable phenotypes for pregnancy-related indicators

Table(s)	Concept	Group	Ontology	Codes
1a, 1b	Pregnancy episode inclusion	Ectopic	ICD-10	O00.0, O00.01, O00.1, O00.10, O00.2, O00.8, O00.80, O00.81, O00.9, O00.90, O08.0, O08.1, O08.2, O08.3, O08.4, O08.5, O08.6, O08.7, O08.81, O08.82, O08.83, O08.89, O08.9
		Spontaneous Abortion	ICD-10	O02.1, O02.81, O03.0, O03.1, O03.2, O03.30, O03.31, O03.32, O03.33, O03.34, O03.35, O03.36, O03.37, O03.38, O03.39, O03.4, O03.5, O03.6, O03.7, O03.80, O03.81, O03.82, O03.83, O03.84, O03.85, O03.86, O03.87, O03.88, O03.89, O03.9
		Live birth	ICD-10	O80, O82, Z37.0, Z37.2, Z37.50, Z37.51, Z37.52, Z37.53, Z37.54, Z37.59, Z37.9
		Stillbirth	ICD-10	Z37.1, Z37.4, Z37.7
		Live birth and stillbirth		Z37.3, Z37.60, Z37.61, Z37.62, Z37.63, Z37.64, Z37.69
2a	STD screening	Chlamydia	CPT	86631, 86632, 87110, 87270, 87320, 87490, 87491, 87492, 87810, 87800
		Gonorrhea	CPT	87590, 87591, 87592, 87850, 87800
		Syphilis	CPT	0064U, 0065U, 0210U, 80081, 86592, 86593, 87285, 86780
		HIV	CPT	87536, 87539, 87389, 87390,87534, 87535, 87536, 87537, 87538, 87539, 87806, 87391, 87901, 87906 ,87903, 87904, 86689, 86701, 86702, 86703, 80081
2b	Severe maternal morbidities	Hepatitis B	CPT	86704, 86705, 86706, 87340, 87341, 80081, 87516, 87517, 87912
		Acute Myocardial Infarction	ICD-10	I21.01, I21.02, I21.09, I21.11, I21.19, I21.21, I21.29, I21.3, I21.4, I21.9, I21.A1 and I21.A9 I22.0, I22.1, I22.2, I22.8, I22.9
		Aneurysm	ICD-10	I71.00 – I71.03, I71.1, I71.2, I71.3, I71.4, I71.5, I71.6, I71.8, I71.9, I79.0
		Acute Renal Failure	ICD-10	N17.0, N17.1, N17.2, N17.8, N17.9, O90.4
		Adult Respiratory Distress Syndrome (ARDS)	ICD-10	J80, J95.1, J95.2, J95.3, J95.821, J95.822, J96.00, J96.01, J96.02, J96.20, J96.21, J96.22, R09.2
		Amniotic Fluid Embolism	ICD-10	O88.111, O88.112, O88.112, O88.123, O88.119, O88.12, O88.13
		Cardiac Arrest/Ventricular Fibrillation	ICD-10	I46.2, I46.8, I46.9, I49.01, I49.02
		Conversion of Cardiac Rhythm	ICD-10-PCS	5A2204Z, 5A12012
		Disseminated Intravascular Coagulation (DIC)	ICD-10	D65, D68.8, D68.9, O72.3

		Eclampsia/Pre-Eclampsia	ICD-10	O15.00, O15.02, O15.03, O15.1, O15.2, O15.9
		Heart Failure/Arrest During Surgery or Procedure	ICD-10	I97.120, I97.121, I97.130, I97.131, I97.710, I97.711
		Puerperal Cerebrovascular Disorders	ICD-10	I60.xx- I68.xx, O22.51, O22.52, O22.53, I97.81x, I97.82x, O87.3
		Pulmonary Edema/Acute Heart Failure	ICD-10	J81.0, I50.1, I50.20, I50.21, I50.23, I50.30, I50.31, I50.33, I50.40, I50.41, I50.43, I50.9
		Severe Anesthesia Complications	ICD-10	O74.0 , O74.1, O74.2, O74.3,O89.01, O89.09, O89.1, O89.2
		Sepsis	ICD-10	O85, O86.04, T80.211A, T81.4XXA, T81.44xx, or R65.20, or A40.x, A41.x, A32.7
		Shock	ICD-10	O75.1, R57.x, R65.21, T78.2XXA, T88.2 XXA, T88.6 XXA, T81.10XA, T81.11XA, T81.19XA
		Sickle Cell Disease with Crisis	ICD-10	D57.0x, D57.21x, D57.41x, D57.81x
		Air and Thrombotic Embolism	ICD-10	I26.x, O88.0x, O88.2x, O88.3x, O88.8x
		Blood Products Transfusion	ICD-10-PCS	30233H1, 30233L1, 30233K1, 30233M1, 30233N1, 30233P1, 30233R1, 30233T1, 30233H0, 30233L0, 30233K0, 30233M0, 30233N0, 30233P0, 30233R0, 30233T0, 30230H1, 30230L1, 30230K1, 30230M1, 30230N1, 30230P1, 30230R1, 30230T1, 30230H0, 30230L0, 30230K0, 30230M0, 30230N0, 30230P0, 30230R0, 30230T0, 30240H1, 30240L1, 30240K1, 30240M1, 30240N1, 30240P1, 30240R1, 30240T1, 30240H0, 30240L0, 30240K0, 30240M0, 30240N0, 30240P0, 30240R0, 30240T0, 30243H1, 30243L1, 30243K1, 30243M1, 30243N1, 30243P1, 30243R1, 30243T1, 30243H0, 30243L0, 30243K0, 30243M0, 30243N0, 30243P0, 30243R0, 30243T0, 30250H1, 30250L1, 30250K1, 30250M1, 30250N1, 30250P1, 30250R1, 30250T1, 30250H0, 30250L0, 30250K0, 30250M0, 30250N0, 30250P0, 30250R0, 30250T0, 30253H1, 30253L1, 30253K1, 30253M1, 30253N1, 30253P1, 30253R1, 30253T1, 30253H0, 30253L0, 30253K0, 30253M0, 30253N0, 30253P0, 30253R0, 30253T0, 30260H1, 30260L1, 30260K1, 30260M1, 30260N1, 30260P1, 30260R1, 30260T1, 30260H0, 30260L0, 30260K0, 30260M0, 30260N0, 30260P0, 30260R0, 30260T0, 30263H1, 30263L1, 30263K1, 30263M1, 30263N1, 30263P1, 30263R1, 30263T1,

				30263H0, 30263L0, 30263K0, 30263M0, 30263N0, 30263P0, 30263R0, 30263T0
		Hysterectomy	ICD-10-PCS	0UT90ZZ, 0UT94ZZ, 0UT97ZZ, 0UT98ZZ, 0UT9FZZ
		Temporary Tracheostomy	ICD-10-PCS	0B110F4, 0B113F4, 0B114F4
		Ventilation	ICD-10-PCS	5A1935Z, 5A1945Z, 5A1955Z
2c	Pre-pregnancy conditions	Asthma	ICD-10	J45.2, J45.20, J45.21, J45.22, J45.3, J45.30, J45.31, J45.32, J45.4, J45.40, J45.41, J45.42, J45.5, J45.50, J45.51, J45.52, J45.9, J45.90, J45.901, J45.902, J45.909, J45.99, J45.990, J45.991, J45.998
			ICD-9	493.00, 493.01, 493.02, 493.10, 493.11, 493.12, 493.20, 493.21, 493.22, 493.81, 493.82, 493.90, 493.91, 493.92
		Cancer	ICD-10	Codes available upon request
			ICD-9	Codes available upon request
		Type 2 diabetes mellitus	ICD-10	E11, E11.0, E11.00, E11.01, E11.1, E11.10, E1.11, E11.2, E11.21, E11.22, E11.29, E11.3, E11.31, E11.311, E11.319, E11.32, E11.321, E11.3211, E11.3212, E11.3213, E11.3219, E11.329, E11.3291, E11.3292, E11.3293, E11.3299, E11.33, E11.331, E11.3311, E11.3312, E11.3313, E11.3319, E11.339, E11.3391, E11.3392, E11.3393, E11.3399, E11.34, E11.3411, E11.3412, E11.3413, E11.3419, E11.349, E11.3491, E11.3492, E11.3493, E11.3499, E11.35, E11.351, E11.3511, E11.3512, E11.3513, E11.3519, E11.352, E11.3521, E11.3522, E11.3523, E11.3529, E11.353, E11.3531, E11.3532, E11.3533, E11.3539, E11.354, E11.3541, E11.3542, E11.3543, E11.3549, E11.355, E11.3551, E11.3552, E11.3553, E11.3559, E11.359, E11.3591, E11.3592, E11.3593, E11.3599, E11.36, E11.3, E11.37X1, E11.37X2, E11.37X3, E11.37X9, E11.39, E11.4, E11.40, E11.41, E11.42, E11.43, E11.44, E11.49, E11.5, E11.51, E11.52, E11.59, E11.6, E11.61, E11.610, E11.618, E11.62, E11.620, E11.621, E11.622, E11.628, E11.63, E11.630, E11.638, E11.64, E11.641, E11.649, E11.65, E11.69, E11.8, E11.9
			ICD-9	250.00, 250.02, 250.10, 250.12, 250.20, 250.22, 250.30, 250.32, 250.40, 250.42, 250.50, 250.52, 250.60, 250.62, 250.70, 250.72, 250.80, 250.82, 250.90, 250.92
		Hypertension	ICD-10	I10, I11, I11.0, I11.9, I12, I12.0, I12.9, I13, I13.0, I13.1, I13.10, I13.11, I13.2, I15, I15.0, I15.1, I15.2, I15.8, I15.9, I16, I16.0, I16.1, I16.9

			ICD-9	401.0, 401.1, 401.9
		Mental health conditions	ICD-10	Codes available upon request
			ICD-9	Codes available upon request
		Thyroid disorder	ICD-10	E00, E00.0, E00.1, E00.2, E00.9, E01, E01.0, E01.1, E01.2, E01.8, E02, E03, E03.0, E03.1, E03.2, E03.3, E03.4, E03.5, E03.8, E03.9, E04, E04.0, E04.1, E04.2, E04.8, E04.9, E05, E05.0, E05.00, E05.01, E05.1, E05.10, E05.11, E05.2, E05.20, E05.21, E05.3, E05.30, E05.31, E05.4, E05.40, E05.41, E05.8, E05.80, E05.81, E05.9, E05.90, E05.91, E06, E06.0, E06.1, E06.2, E06.3, E06.4, E06.5, E06.9, E07, E07.0, E07.1, E07.8, E07.81, E07.89, E07.9
			ICD-9	240.0, 240.9, 241.0, 241.1, 241.9, 242.00, 242.01, 242.10, 242.11, 242.20, 242.21, 242.30, 242.31, 242.40, 242.41, 242.80, 242.81, 242.90, 242.91, 243, 244.0, 244.1, 244.2, 244.3, 244.8, 244.9, 245.0, 245.1, 245.2, 245.3, 245.4, 245.8, 245.9, 246.0, 246.1, 246.2, 246.3, 246.8, 246.9
2d	Substance use	Tobacco/drug/alcohol	ICD-10	O99.31x, O99.32x, O99.33x
2e	Timely prenatal and postpartum care	Prenatal care	ICD-10	O09.00, O09.01, O09.10, O09.11, O09.A0, O09.A1, O09.211, O09.219, O09.291, O09.299, O09.30, O09.31, O09.40, O09.41, O09.511, O09.519, O09.521, O09.529, O09.611, O09.619, O09.621, O09.629, O09.70, O09.71, O09.811, O09.819, O09.821, O09.829, O09.891, O09.899, O09.90, O09.91, Z33, Z33.1, Z33.2, Z33.3, Z34.00, Z34.01, Z34.80, Z34.81, Z34.90, Z34.91, Z36.0, Z36.1, Z36.2, Z36.3, Z36.4, Z36.5, Z36.8, Z36.81, Z36.82, Z36.83, Z36.84, Z36.85, Z36.86, Z36.87, Z36.88, Z36.89, Z36.8A, Z36.9, Z3A.0, Z3A.00, Z3A.01, Z3A.08, Z3A.09, Z3A.1, Z3A.10, Z3A.11, Z3A.12, Z3A.13, Z3A.14, Z32.01, Z32.2, Z32.2
			CPT	99500, 0500F, 0501F, 0502F, H1000, H1001, H1002, H1003, H1004, 59025, 59425, 76801, 76802, 76803, 76804, 76805, 76806, 76807, 76808, 76809, 76810, 76811, 76812, 76813, 76814, 76815, 76816, 76817, 76818, 82105, 82106, 88271, 88272, 88273, 88274, 88275, 88291
		Postpartum Care	ICD-10	Z01.411, Z01.4119, Z01.42, Z30.430, Z39.1, Z39.2
			CPT	57170, 58300, 59430, 99501, 0503F, G0101, 59400, 59410, 59510, 59515, 59610, 59614, 59618, 59622, 88141, 88142, 88143, 88147, 88148, 88150, 88152, 88153,

				88154, 88164, 88165, 88166, 88167, 88174, 88175
			HCPCS	G0123, G0124, G0141, G0143, G0144, G0145, G0147, G0148, P3000, P3001, Q0091
			LAB_LOINC	10524-7, 18500-9, 19762-4, 19764-0, 19765-7, 19766-5, 19774-9, 33717-0, 47527-7, 47528-5
2f	Health conditions during or after pregnancy	Mental health conditions	ICD-10	Codes available upon request
		Gestational diabetes	ICD-10	O24x
		Pre-eclampsia	ICD-10	O14x
		Chorioamnionitis	ICD-10	O41.12x
2g	Labor and delivery	Elective delivery	ICD-10	P95, Z37.1, Z37.3, Z37.60, Z37.61, Z37.62, Z37.63, Z37.64, Z37.69, Z37.7, O75.82
			ICD-9	V27.1, V27.3, V27.4, V27.7
			ICD-10-PCS	0U7C7DZ, 0U7C7ZZ, 10900ZC, 10903ZC, 10904ZC, 10907ZC, 10908ZC,'3E053VJ',
		Preterm birth	ICD-10	O61.1x
		Complications of labor and delivery	ICD-10	O60, O60.0, O60.00, O60.02, O60.03, O60.1, O60.10, O60.10X0, O60.10X1, O60.10X2, O60.10X3, O60.10X4, O60.10X5, O60.10X9, O60.12, O60.12X0, O60.12X1, O60.12X2, O60.12X3, O60.12X4, O60.12X5, O60.12X9, O60.13, O60.13X0, O60.13X1, O60.13X2, O60.13X3, O60.13X4, O60.13X5, O60.13X9, O60.14, O60.14X0, O60.14X1, O60.14X2, O60.1X3, O60.1X4, O60.14X5, O60.14X9, O60.2, O60.20, O60.20X0, O60.20X1, O60.20X2, O60.20X3, O60.20X4, O60.20X5, O60.20X9, O60.22, O60.22X0, O60.22X1, O60.2X2, O60.22X3, O60.22X4, O60.22X5, O60.22X9, O60.23, 060.23X0, 060.23X1, 060.23X2, 060.23X3, 060.23X4, 060.23X5, 060.23X9, O61, O61.0, O61.1, O61.8, O61.9, O62, O62.0, O62.1, O62.2, O62.3, O62.4, O62.8, O62.9, O63.0, O63.0, O63.1, O63.2, O63.9, O64, O64.0, O64.0XX0, O64.0XX1, O64.0XX2, O64.0XX3, O64.0XX4, O64.0XX5, O64.0XX9, O64.1, O64.1XX0, O64.1XX1, O64.1XX2, O64.1XX3, O64.1XX4, O64.1XX5, O64.1XX9, O64.2, O64.2XX0, O64.2XX1, O64.2XX2, O64.2XX3, O64.2XX4, O64.2XX5, O64.2XX9, O64.3, O64.3XX0, O64.3XX1, O64.3XX2, O64.3XX3, O64.3XX4, O64.3XX5, O64.3XX9, O64.4, O64.4XX0, O64.4XX1, O64.4XX2, O64.4XX3, O64.4XX4,

				O64.4XX5, O64.4XX9, O64.5, O64.5XX0, O64.5XX1, O64.5XX2, O64.5XX3, O64.5XX4, O64.5XX5, O64.5XX9, O64.8, O64.8XX0, O64.8XX1, O64.8XX2, O64.8XX3, O64.8XX4, O64.8XX5, O64.8XX9, O64.9, O64.9XX0, O64.9XX1, O64.9XX2, O64.9XX3, O64.9XX4, O64.9XX5, O64.9XX9, O65, O65.0, O65.1, O65.2, O65.3, O65.4, O65.5, O65.8, O65.9, O66, O66.0, O66.1, O66.2, O66.3, O66.4, O66.40, O66.41, O66.5, O66.6, O66.8, O66.9, O67, O67.0, O67.8, O67.9, O68, O69, O69.0, O69.0XX0, O69.0XX1, O69.0XX2, O69.0XX3, O69.0XX4, O69.0XX5, O69.0XX9, O69.1, O69.1XX0, O69.1XX1, O69.1XX2, O69.1XX3, O69.1XX4, O69.1XX5, O69.1XX9, O69.2, O69.2XX0, O69.2XX1, O69.2XX2, O69.2XX3, O69.2XX4, O69.2XX5, O69.2XX9, O69.3, O69.3XX0, O69.3XX1, O69.3XX2, O69.3XX3, O69.3XX4, O69.3XX5, O69.3XX9, O69.4, O69.4XX0, O69.4XX1, O69.4XX2, O69.4XX3, O69.4XX4, O69.4XX5, O69.4XX9, O69.5, O69.5XX0, O69.5XX1, O69.5XX2, O69.5XX3, O69.5XX4, O69.5XX5, O69.5XX9, O69.8, O69.81, O69.81X0, O69.81X1, O69.81X2, O69.81X3, O69.81X4, O69.81X5, O69.81X9, O69.82, O69.82X0, O69.82X1, O69.82X2, O69.82X3, O69.82X4, O69.82X5, O69.82X9, O69.89, O69.89X0, O69.89X1, O69.89X2, O69.89X3, O69.89X4, O69.89X5, O69.89X9, O69.9, O69.9XX0, O69.9XX1, O69.9XX2, O69.9XX3, O69.9XX4, O69.9XX5, O69.9XX9, O70, O70.0, O70.1, O70.2, O70.20, O70.21, O70.22, O70.23, O70.3, O70.4, O70.9, O71, O71.0, O71.00, O71.02, O71.03, O71.1, O71.2, O71.3, O71.4, O71.5, O71.6, O71.7, O71.8, O71.81, O71.82, O71.89, O71.9, O72, O72.0, O72.1, O72.2, O72.3, O73, O73.0, O73.1, O74, O74.0, O74.1, O74.2, O74.3, O74.4, O74.5, O74.6, O74.7, O74.8, O74.9, O75, O75.0, O75.1, O75.2, O75.3, O75.4, O75.5, O75.8, O75.81, O75.82, O75.89, O75.9, O76, O77, O77.0, O77.1, O77.8, O77.9
		Cesarean birth	ICD-10	O75.82, O82
			MS-DRG	765, 766, 783, 784, 785, 786, 787, 788
			CPT	59510, 59514, 59515, 59525, 59618, 59620, 59622
		COVID-19 PCR	ICD-10	U07.1

2h	Covid-19 test and vaccine		LAB_LOINC	94306-8, 94531-1, 95380-2, 95422-2, 95941-1, 95942-9, 96094-8, 96894-1, 97099-6, 94307-6, 94308-4, 94309-2, 94310-0, 94314-2, 94315-9, 94316-7, 94500-6, 94502-2, 94532-9, 94533-7, 94534-5, 94559-2, 94565-9, 94639-2, 94640-0, 94641-8, 94647-5, 94660-8, 94756-4, 94757-2, 94758-0, 94759-8, 94760-6, 94765-5, 94766-3, 94767-1, 94822-4, 94845-5, 95406-5, 95409-9, 95423-0, 95424-8, 95425-5, 95608-6, 95609-4, 95823-1, 95824-9, 96091-4, 96120-1, 96121-9, 96122-7, 96123-5, 96448-6, 96741-4, 96763-8, 96765-3, 96957-6, 96958-4, 96986-5, 97098-8, 94311-8, 94312-6, 94313-4, 94509-7, 94510-5, 94511-3, 94642-6, 94643-4, 94644-2, 94645-9, 94646-7, 94745-7, 94746-5, 94819-0, 95521-1, 95522-9, 96764-6, 97104-4
		COVID-19 Vaccine	HCPCS	D1701, D1702, D1703, D1704, D1707, D1708, D1709, D1710, D1711, D1712, D1713, D1714, M0201
			CPT	91300, 91301, 91302, 91303, 91304, 91305, 91306, 91307, 91308, 91309, 91310, 91311, 91312, 91313, 91314, 91315, 91316, 91317, 0001A, 0002A, 0003A, 0004A, 0011A, 0012A, 0013A, 0021A, 0022A, 0031A, 0034A, 0041A, 0042A, 0044A, 0051A, 0052A, 0053A, 0054A, 0064A, 0071A, 0072A, 0073A, 0074A, 0081A, 0082A, 0083A, 0091A, 0092A, 0093A, 0094A, 0104A, 0111A, 0112A, 0113A, 0124A, 0134A, 0144A, 0154A, 0164A, 0173A, 0174A
2i	Contraceptive care	Most or moderate effective method of contraception	ICD-10	Z30.013, Z30.42, T83.31XA, T83.31XD, T83.31XS, T83.32XA, T83.32XD, T83.32XS, T83.39XA, T83.39XD, T83.39XS, Z30.014, Z30.430, Z30.431, Z30.433, Z30.017, Z30.46, Z30.015, Z30.44, Z30.011, Z30.41, Z30.016, Z30.45, Z30.2
			ICD-10-PCS	0UH90HZ, 0UH97HZ, 0UH98HZ, 0UHC7HZ, 0UHC8HZ, 0JHD0HZ , 0JHD3HZ , 0JHF0HZ , 0JHF3HZ , 0JHG0HZ , 0JHG3HZ , 0JHH0HZ , 0JHH3HZ , 0U570ZZ, 0U573ZZ, 0U574ZZ, 0U577ZZ, 0U578ZZ, 0UL70CZ, 0UL70DZ, 0UL70ZZ, 0UL73CZ, 0UL73DZ, 0UL73ZZ, 0UL74CZ, 0UL74DZ, 0UL74ZZ, 0UL77DZ, 0UL77ZZ, 0UL78DZ, 0UL78ZZ, 0UT70ZZ, 0UT74ZZ, 0UT77ZZ, 0UT78ZZ, 0UT7FZZ
			CPT	58300, 11981, 11983, 58565, 58600, 58605, 58611, 58615, 58670, 58671, 0567T, 57170

			NDC	Codes available upon request
			HCPCS	J1050, J7296, J7297, J7298, J7300, J7301, S4981, S4989, J7306, J7307, J7303, S4993, J7304, A4264, A4261, A4266