Objective: The COVID-19 pandemic prompted labor and delivery units to establish ways to decrease viral exposure to healthcare workers while continuing to deliver optimal patient care. A laborist model was implemented to improve safety at our tertiary care hospital in Long Island. The aim of the study is to determine whether implementation of a laborist model during the COVID-19 pandemic is associated with a change in the frequency of cesarean birth.

Methods: The retrospective cohort study included patients who delivered at a single tertiary center during March 2019 to May 2019 and March 2020 to May 2020 when our laborist model was initiated. The primary outcome compared the frequency of a cesarean delivery between both models. Secondary outcomes were the frequency of adverse obstetrical complications, which included intensive care unit admission, shoulder dystocia, intra-amniotic infection, hemorrhage, and need for blood transfusion. Statistical analysis included multivariable regression to adjust for potential confounders.

Results: A total of 1506 patients were included. Baseline characteristics were similar between the 2 groups. After adjusting for potential confounders, there was no significant difference in the frequency of cesarean births between both models (37% versus 35%; adjusted odds ratio, 1.003; 95% confidence interval, 0.46–2.89). Similarly, there were no significant differences in adverse outcomes between the study populations (adjusted odds ratio, 1.064; 95% confidence interval, 0.68–1.59).

Conclusions: A change in practice behavior during a pandemic was not associated with an increase in frequency of cesarean births or adverse obstetrical outcomes.

Key Words: SARS-CoV-2, obstetrics, laborist, cesarean birth

Since its detection in March of 2020, severe acute respiratory syndrome coronavirus (SARS-CoV-2) has made a significant impact on hospital policy and procedures in New York. As the positivity rate increased, measures to curtail the spread of the outbreak were stressed.1 To limit the spread of disease, patients with suspected or confirmed infection were isolated; visitation policies were limited, and healthcare personnel were retrained on infection control practices and use of personal protective equipment.1–3

While maximizing the best interest of individual patients, consideration must also be paid to the health and well-being of healthcare professionals. In an effort to reduce infectious exposure between the individual patient and the healthcare team, alternative models of care have come to the forefront. One such option was the laborist model of care, which refers to the presence of a provider on labor and delivery for a designated period who does not have any additional competing clinical duties.4 In a private practice model, clinicians often must balance the needs and outcomes of patients in both an outpatient and inpatient setting simultaneously. Alternatively, a laborist is solely responsible for the labor and delivery unit without any conflicting duties. Proponents of this model of care have suggested improved patient outcomes with timely recognition and management of adverse events.5 Iriye et al6 noted the potential of physician efficiency, decreased workload, and improved patient safety. Similar studies have found a reduction in cesarean birth rates when compared with traditional models of obstetrical care without an increase in adverse maternal or neonatal outcome.1–6

At our tertiary care hospital, the obstetrical coverage was temporarily changed to the laborist model in an effort to decrease healthcare provider exposure to SARS-CoV-2. Before the pandemic, there were multiple obstetrical groups and individual obstetricians responsible for the management of their own patients. This led to approximately 7 to 10 providers on the obstetrical unit at any given time, increasing the potential risk of SARS-CoV-2 spread. With the laborist model, 3 obstetricians managed all patients admitted to labor and delivery. In this study, we evaluated whether the changes in obstetric practice on labor and delivery during the COVID-19 pandemic would affect the frequency of cesarean births and obstetrical outcomes.

MATERIALS AND METHODS

This retrospective cohort study included all obstetrical patients who delivered at North Shore University Hospital in Manhasset, New York, during the periods of March 21, 2019, to May 25, 2019, and March 21, 2020, to May 25, 2020, when our laborist model was initiated in direct response to minimizing provider exposure to SARS-CoV-2. The laborist model was defined by the presence of 3 obstetrical providers who would manage all patients admitted to labor and delivery for a 12-hour shift. Obstetrical providers were given the option of joining the temporary laborist group model of care or to continue to manage the labor and delivery of their own patients. Patients were excluded from the study if their obstetrician did not join the laborist model of care in 2020, if they were admitted to the antepartum service before their delivery, or if there were no delivery data available for analysis. The Northwell Health Human Research Protection Program and Institutional Review Board approved the study protocol.

The initial period in 2019 was designated as the “traditional model of care” at our institution, defined as individual obstetrical groups responsible for the management of their own patients. The implementation of the “laborist model” in 2020 was defined as the period when all labor and delivery care was provided by a 24-hour, in-hospital team of 3 obstetricians per 12-hour shift.
management of patients was according to the provider’s interpretation of the clinical case presentation, clinical judgment, and hospital policies.

The enterprise electronic health record system (Sunrise Clinical Manager, Allscripts Corp, Chicago, Ill) was used to obtain baseline maternal characteristics of the study population, including demographics, medical comorbidities, and obstetrical outcome. Results of SARS-CoV-2 testing, if available, were obtained from patients who delivered from March 2020 to May 2020. Universal polymerase chain reaction testing for the virus began in April 2020. Data were reviewed by coinvestigators to ensure appropriate transfer of data, which were in a secure REDCap (Vanderbilt University, Nashville, TN) database. Obstetric outcomes reviewed included mode of delivery, indication for induction, indication for cesarean delivery, and gestational age at delivery. Adverse obstetrical outcomes were reviewed and obtained. This included the need for blood transfusion (the transfusion of 1 or more packed red blood cells), intensive care unit (ICU) admission, shoulder dystocia, hemorrhage (an estimated blood loss >500 mL for vaginal delivery and >1000 mL for cesarean birth determined by the obstetric provider), and clinically diagnosed intra-amniotic infection. The decision to transfuse was left to the discretion of the physician caring for the patient and the clinical scenario. However, our hospital uses an obstetrical hemorrhage algorithm upon which transfusion is based to decrease unnecessary transfusions. Each adverse outcome was a binary (yes/no) outcome and the presence of any one of the individual components was considered to meet criteria. Neonatal outcome was evaluated by obtaining the Apgar score (1 and 5 minutes) at delivery. The Apgar scores were assigned by the labor and delivery nurse or the pediatrician if they were present at delivery.

The primary variable of interest was the frequency of cesarean births during the study period. A secondary outcome evaluated was a composite adverse obstetrical events, including ICU admission, shoulder dystocia, hemorrhage, intra-amniotic infection, and need for blood transfusion. These variables are quantified as per hospital policies in assessing maternal and neonatal morbidity and mortality. Cesarean births were chosen as a performance indicator because of its significant effect upon maternal morbidity and mortality. Cesarean births were chosen as a performance indicator because of its significant effect upon maternal morbidity and mortality. It is associated with increased risks of obstetric hemorrhage, thromboembolism, puerperal infection, and longer hospital stays with increased hospital costs.6

Descriptive statistics were used to characterize the data. Comparisons between groups for continuous variables were performed using either the Mann-Whitney test or $t$ test. Results are presented as means and standard deviations for normally distributed continuous variables and as median and interquartile range for nonnormally distributed continuous variables. Either the Fisher exact test or $\chi^2$ test was used, as appropriate, to examine associations between categorical variables. Categorical variables were expressed as frequency and percentage. Multivariable logistic regression was performed to examine the association between the likelihood of having a cesarean delivery and the likelihood of developing composite adverse obstetrical outcome, separately, with the following potential confounders: maternal age, parity, race, ethnicity, hypertension, pregestational diabetes, asthma, obesity, health insurance, SARS-CoV-2 test positivity, and gestational age at delivery. Results were reported as adjusted odds ratios (aORs) with their corresponding 95% confidence intervals (CIs). Statistical significance was defined as a $P$ value less than 0.05. The Northwell Health Institutional Review Board approved this study as minimal-risk research using data collected for routine clinical practice and waived the requirement for informed consent.

**RESULTS**

A total of 1506 patients were included in the study. Among this group, 49.7% of patients ($n = 748$) were in the traditional model of care, and 50.3% of patients ($n = 758$) were in the laborist model of care (Fig. 1). A total of 61 obstetricians were asked to join the laborist model, and 89% of obstetric providers participated ($n = 54/61$). There were no delivering maternal fetal medicine specialists in either model. Because of 7 obstetricians not joining the laborist model, 659 patients were excluded from the analysis. This made up 341 and 318 patients between 2019 and 2020, respectively. There was no significant difference in the rate of cesarean sections between the excluded subjects (data not shown). Patient demographics and clinical characteristics are summarized in Table 1. The study population had a mean maternal age of 32.8 ± 4.7 years and a mean pregnancy body mass index (BMI) of 30.9 ± 5.8 kg/m². There were no significant differences in parity, BMI, health insurance, medical comorbidities, race and ethnicity, or gestational age at delivery between the 2 study groups (Table 1). There was a significant increase in multiple gestation in 2020, which was made up of only twin gestations. When evaluating the mode of delivery, 60% of multiple gestations were delivered by primary cesarean section in 2019 while 30.2% were delivered by primary cesarean section in 2020. This was not statistically significant. There was no significant difference when evaluating the indication for induction between the study groups. In addition, there was no significant difference in the indication for primary cesarean birth when comparing the traditional model to the laborist model (Table 1).

The percentage of primary cesarean births was 18.2% ($n = 136/748$) and 18.3% ($n = 136/758$) between the traditional model and the laborist model, respectively. For nulliparous, singleton, term,
TABLE 1. Clinical Characteristics of the Women Managed With Traditional and Laborist Model of Care

| Characteristic                          | Obstetrical Model of Care |   | P  |
|----------------------------------------|---------------------------|---|---|
|                                       | Traditional (n = 748)    | Laborist (n = 758) |   |
| Demographics                           |                           |   |   |
| Maternal age, y                        | 32.7 ± 4.7                | 32.9 ± 4.7          | 0.29 |
| ≥35                                    | 240 (32)                  | 278 (36)            | 0.06 |
| Race and ethnicity*                    |                           |   |   |
| Non-Hispanic White                     | 401 (57)                  | 411 (58)            | 0.87 |
| Non-Hispanic Black                     | 62 (9)                    | 63 (9)              |   |
| Hispanic/Latino                        | 5 (0.7)                   | 5 (0.7)             |   |
| Asian                                  | 126 (18)                  | 132 (19)            |   |
| Multiracial/other                      | 109 (16)                  | 95 (14)             |   |
| Insurance                              |                           |   |   |
| Private                                | 588 (79)                  | 609 (80)            |   |
| Public                                 | 159 (21)                  | 149 (20)            |   |
| Self-pay                               | 1 (0.1)                   | 0 (0)               |   |
| Parity                                 |                           |   | 0.37 |
| 0                                      | 319 (43)                  | 336 (44)            |   |
| 1                                      | 294 (39)                  | 284 (37)            |   |
| 2                                      | 92 (12)                   | 106 (14)            |   |
| ≥3                                     | 43 (6)                    | 32 (4)              |   |
| BMI‡, kg/m²                             | 31.1 ± 5.9                | 30.7 ± 5.8          | 0.19 |
| ≥30 group                              | 399 (54)                  | 389 (51)            | 0.35 |
| Comorbidities                          |                           |   |   |
| Chronic hypertension                   | 16 (2)                    | 25 (3)              |   |
| Pregestational diabetes                | 11 (1)                    | 14 (2)              |   |
| Asthma                                 | 19 (4)                    | 0 (0)               |   |
| Multiple gestation                     | 10 (1.3)                  | 53 (7)              | <0.001 |
| COVID positive†§                       | —                         | 43 (7.2)            |   |
| Asymptomatic§                          | —                         | 36 (84)             |   |
| Symptomatic                            | —                         | 7 (16)              |   |
| Indication for induction               |                           |   | 0.40 |
| Maternal indication                    | 183 (24)                  | 203 (27)            |   |
| Fetal indication                       | 66 (9)                    | 59 (8)              |   |
| Elective                               | 37 (5)                    | 45 (6)              |   |
| Indication for primary cesarean        |                           |   | 0.40 |
| Breech or malpresentation              | 17 (13)                   | 24 (17)             |   |
| Dystocia                               | 28 (21)                   | 25 (18)             |   |
| Elective                               | 32 (24)                   | 21 (15)             |   |
| Non reassuring fetal heart rate       | 47 (35)                   | 59 (43)             |   |
| Placenta previa                        | 1 (0.7)                   | 1 (0.7)             |   |
| Other                                  | 11 (8)                    | 9 (6)               |   |
| Gestational age at delivery, wk        | 39.2 (38.3–40)            | 39.1 (38.3–39.6)    | 0.855 |

Data are presented as median (interquartile range), n (%), and mean ± SD.

*Race and ethnicity data missing from 52 (7%) laborist and 45 (6%) nonlaborist patients.

†Body mass index data missing for 2 (0.3%) laborist and 7 (0.9%) nonlaborist patients.

‡COVID testing completed on 597 patients.

§Severity evaluated from 43 SARS-CoV-2–positive patients.

and vertex gestations, 30.6% (n = 85/278) and 28.7% (n = 79/275), were delivered by cesarean in 2019 and 2020, respectively (P = 0.63). There was no significant difference in adverse outcome during the labor or delivery process between the study populations. The time from admission to delivery was not statistically different with the change in obstetrical model of care (Table 2).

Multivariable logistic regression analysis did not identify any specific maternal or peripartum factors to predict the likelihood of having a cesarean delivery or the likelihood of developing adverse obstetrical outcome once adjusting for known confounders (Table 3). Of the 78.8% of patients (n = 597/758) who were tested for SARS-CoV-2, 7.2% (n = 43/597) were noted to be positive. There was no significant difference in mode of delivery for symptomatic and asymptomatic patients. The effect of SARS-CoV-2 positivity was included in the logistic regression model and was not statistically significantly associated with the risk of cesarean birth or adverse obstetrical outcome (Table 3).

DISCUSSION

The implementation of a laborist model during the SARS-CoV-2 pandemic was aimed at reducing the number of necessary individuals on the obstetrical unit to decrease viral exposure and spread. Large changes in obstetric care occurred rapidly, and this study evaluated the impact of those changes on several obstetrical outcomes. There was no significant difference in both labor and delivery parameters in our study. There was no difference in the frequency of cesarean births between the 2 different obstetric care models. A change in practice behavior during the time of a pandemic was not associated with an increase in frequency of adverse maternal or neonatal outcomes. We did note a significant increase in multiple gestations in 2020, which may reflect an overall change in birth trends.7

The limitations of our study include the retrospective study design. Analyzed data were limited to what was available in the electronic medical record. Significant changes in maternal and/or neonatal outcome may be noteworthy in a larger sample size. By comparing different models of care within the same hospital system, we were able to account for the effect of hospital specific policies and procedures. This includes the availability of anesthesia, neonatal intensive care unit services, and the resources available to a tertiary care academic institution.8 Our study was limited to one hospital site and therefore may not be generalizable to other patient populations or hospitals. Nonetheless, our hospital provides care to the greater New York City area with approximately 6500 deliveries annually with a large referral base. Deliveries were not excluded by gestational age, maternal comorbidities, or fetal anomalies. Our analysis included both singleton and multiple gestation pregnancies. As the laborist model was implanted for a short period, we chose to compare the laborist model to a similar study epoch in 2019. It was unknown how long the laborist model would be implemented given the continually evolving changes in national and global perspectives about the virus and its long-term impact. It is reassuring that these "temporary" models can be implemented during a public health crisis and have no significant change in adverse outcomes. Furthermore, there may be additional COVID-19–related influences, such as increased physician stress, that we could not account for. Earlier reports noted an increased in cesarean births during the SARS-CoV-2 pandemic, especially among positive patients, and this was not replicated in our study.8,9 We do not know whether this model would produce similar results if implemented before the pandemic.

Our study did not see a decrease in the frequency of cesarean births, unlike what has been noted in prior studies evaluating a laborist model.5 This lack of change may reflect that this model was temporary in nature. In a true laborist model, obstetricians...
are trained in this role and have no other clinical responsibilities. In our temporary model, obstetricians had additional clinical responsibilities when they were not scheduled to manage labor and delivery. In addition, practice patterns in management of labor and delivery may be unlikely to change based on an unexpected transient readjustment to the scope of responsibility. As the same obstetricians were involved in both periods, we were able to depict that practice patterns did not deviate with a collaborative model.

While additional research is encouraged, this study has shown that a collaborative laborist model of care can be considered during a pandemic without adversely affecting maternal or neonatal outcome. We evaluated time from hospital admission to delivery; we also suggest additional research be conducted to evaluate length of time from triage evaluation to admission. With a laborist model, ancillary staff can immediately speak to an obstetrical provider regarding an admission and active management. Notably, we did not study patient satisfaction and the risk of medical error during patient hand-offs during the laborist period. While sympathetic to the need for social distancing measures, patients may not appreciate a different obstetric provider from the one with whom they have formed a relationship with during their pregnancy.

**CONCLUSIONS**

The COVID-19 pandemic has prompted many hospitals to implement new policies and procedures to protect both patients and healthcare providers. To decrease exposure to healthcare providers, a laborist model of care may be considered without a significant increase in the frequency of cesarean births or adverse obstetrical outcomes.

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TABLE 2. Obstetrical and Neonatal Outcome of the Women Managed With Traditional and Laborist Model of Care

| Characteristic                  | Traditional (n = 748) | Laborist (n = 758) | P     |
|--------------------------------|----------------------|-------------------|-------|
| Mode of delivery               |                      |                   | 0.19  |
| Vaginal                        | 422 (56)             | 455 (60)          |       |
| Operative                      | 49 (7)               | 36 (5)            |       |
| Cesarean                       | 277 (37)             | 267 (35)          |       |
| Adverse obstetrical outcome    |                      |                   |       |
| ICU admission                  | 1 (0.1)              | 0 (0)             |       |
| Shoulder dystocia              | 8 (1)                | 5 (0.7)           |       |
| Intra-amniotic infection       | 0 (0)                | 12 (2)            |       |
| Hemorrhage*                    | 32 (4)               | 34 (4)            |       |
| Blood transfusion†             | 13 (2)               | 12 (2)            |       |
| 5-Min Apgar score <7‡          | 0 (0)                | 7 (0.9)           |       |
| Time to delivery, h            | 9.68 (4.62–17.06)    | 9.75 (5.46–16.13) | 0.763 |

Data are presented as median (interquartile range), n (%), and mean ± standard deviation.

*Requiring 1 or more units of packed red blood cells.

†An estimated blood loss >500 mL for vaginal delivery and >1000 mL for cesarean birth.

‡Known fetal demise, preivable gestation, and missing Apgar score were excluded from analysis from laborist (n = 10, 1.3%) and nonlaborist (n = 6, 0.8%) patients.

TABLE 3. Primary and Secondary Outcomes of the Women Managed With Traditional and Laborist Model of Care

| Characteristic                  | aOR*     | 95% CI    | P     |
|--------------------------------|----------|-----------|-------|
| Cesarean delivery              | 1.003    | 0.46–2.89 | 0.990 |
| Composite adverse obstetrical outcome† | 1.064    | 0.68–1.59 | 0.893 |

*Adjusted for known confounders such as age, BMI, parity, race and ethnicity, and gestational age at delivery. Because of the COVID-19 pandemic, COVID positivity was also included in the models.

†Composite adverse obstetrical outcome includes hemorrhage, blood transfusion, shoulder dystocia, intra-amniotic infection, and ICU admission.

CI, confidence interval; OR, odds ratio.