Perinatal Outcomes Associated With Institutional Changes Early in the COVID-19 Pandemic

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ABSTRACT

Objective: Many institutions implemented policy changes to protect patients and clinicians during the COVID-19 pandemic. This study examines how institutional policy changes and patient behaviors affected perinatal outcomes. We hypothesized that obstetric practice changes occurred and that these changes affected perinatal outcomes.

Methods: We conducted a retrospective cohort study of singleton pregnancies delivered at a single institution with low incidence of COVID-19. Deliveries occurring from December 15, 2019 through March 14, 2020 were designated as the pre-COVID-19 group. Those occurring from March 15, 2020, through June 15, 2020, were designated the COVID-19 group. The primary outcome is a perinatal composite defined as delivery ≥ 41 weeks, hypertensive disorder of pregnancy at term, unplanned Cesarean delivery, term neonatal intensive care unit admission, 42-day maternal readmission, and 7-day neonatal readmission. Additional maternal, neonatal, and delivery composites also were analyzed, and we evaluated all individual outcomes secondarily.

Results: Of 2,268 deliveries, 1,210 occurred during the COVID-19 period. Four of the 1,210 (0.3%) were diagnosed with COVID-19. Women during the COVID-19 period were more likely to present in spontaneous labor and less likely to undergo induction. Maternal and neonatal length of stay was also shorter. There was no difference in the perinatal composite between the 2 groups (36.3% vs 36.7% [OR 1.05; 95% CI, 0.86-1.21]). There was a significant increase in deliveries occurring at or after 41 weeks (4.7% vs 6.9% [OR 1.83; 95% CI, 1.00-3.34]). There was no difference in maternal, neonatal, and delivery composites or the outcomes assessed individually.

Conclusions: We demonstrated significant changes in clinical practice secondary to policy changes and patient behaviors during the COVID-19 pandemic. As an institution that globally adopted ARRIVE (A Randomized Trial of Induction Versus Expectant Management) practices, we noted fewer inductions, more women presenting in labor and more women delivering at or after 41 weeks. We also noted a shorter length of hospital stay for the mother-baby dyad. Overall, these changes in clinical practice did not affect perinatal outcomes.

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INTRODUCTION

In December 2019, the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was identified and a novel illness named coronavirus disease 2019 (COVID-19) was described.[1] In March 2020, the United States government declared COVID-19 a national emergency.[2] Health care institutions worked to establish protocols within the health care system to ensure the safety of patients and staff and prevent transmission of COVID-19. The care of pregnant patients posed its own set of challenges in regard to in-person visits, the need for antenatal testing, and visitors within the hospital.

In mid-March 2020, our institution assembled a multidisciplinary team of maternal-fetal medicine specialists, obstetricians, neonatologists, infectious disease specialists, and nursing staff to implement a series of protocols and guidelines due to the COVID-19 pandemic. These policy changes included personal protective equipment for all staff, restricting visitors within the hospital, nasopharyngeal COVID-19 testing for all pregnancy-related admissions, moving prenatal care to a telemedicine platform where appropriate, and encouraging earlier postpartum discharge.

The objective of this study was to examine how institutional policy changes implemented due to COVID-19 and associated patient behaviors affected perinatal outcomes. We hypothesized that obstetric practice changes had occurred, specifically fewer inductions of labor and delivery occurring at later gestational ages, and that these changes worsened perinatal outcomes.

Box. Institutional Changes Implemented on March 15, 2020

1. Staff were provided a mask and face shield to wear while providing patient care. Masks were required on all staff throughout the hospital at all times.
2. Social distancing restrictions were encouraged in all patient care areas, and multidisciplinary meetings were held over the phone or video to minimize gatherings.
3. Routine outpatient prenatal care (except required ultrasounds and antenatal fetal surveillance) was moved to a telemedicine format.
4. Maternal-fetal medicine consultations were performed via telemedicine.
5. Fetal echocardiograms for lower risk indications (ie, in vitro fertilization) were cancelled and the detailed cardiac screening images were reviewed by a pediatric cardiologist.
6. Antenatal testing was modified to weekly biophysical profile rather than twice weekly nonstress tests, where appropriate.
7. Patients who required in-person outpatient visits and those admitted to the antepartum unit were not allowed visitors.
8. Patients admitted for delivery were allowed 1 support person, and babies admitted to the NICU were allowed 2 visitors.
9. Universal nasopharyngeal COVID testing of all pregnant women admitted.
10. Discharge for uncomplicated postpartum patients was strongly encouraged on postpartum day 1 for vaginal deliveries and postpartum day 2 for Cesarean deliveries.
11. Resident coverage was limited to cycle residents in a 2 weeks on, 2 weeks off rotation.

METHODS

We conducted a retrospective cohort study of singleton pregnancies delivered at a single academic institution with a low incidence of COVID-19 from December 15, 2019, through June 15, 2020. Institution-wide policy changes were implemented at UnityPoint Health-Meriter, the academic home of the University of Wisconsin School of Medicine and Public Health's Department of Obstetrics and Gynecology, on March 15, 2020. Deliveries occurring from December 15, 2019 through March 14, 2020, were designated as the pre-COVID-19 group. Those occurring from March 15, 2020 through June 15, 2020, were designated as the during COVID-19 group. Exclusion criteria were multifetal gestations and those women who did not deliver at our institution. These policies included mask mandates for patients and staff, visitor restrictions, transition to telemedicine where appropriate, weekly antenatal testing with biophysical profile, mandatory nasopharyngeal COVID-19 testing for all obstetrical patients on admission, and discharge encouraged on postpartum day 1 for vaginal deliveries and postpartum day 2 for Cesarean deliveries (Box).

Maternal demographic, delivery, postpartum, and neonatal data were obtained from our institution's perinatal database, which is maintained by trained nursing staff. The database contained our specified maternal and neonatal clinical outcomes. This study was deemed exempt by the Institutional Review Board.

The primary outcome was a perinatal composite defined as delivery ≥41 weeks, hypertensive disorder of pregnancy at term, unplanned Cesarean delivery, term neonatal intensive care unit (NICU) admission, 42-day maternal readmission, and 7-day neonatal readmission. Secondary outcomes included maternal, neonatal, and delivery composite outcomes. The maternal composite comprised maternal intensive care unit admission, blood transfusion, postpartum hemorrhage, unplanned postpartum procedure, unplanned hysterectomy, 3rd or 4th degree laceration, and 42-day readmission. The neonatal composite comprised 5-minute Apgar <7, term NICU admission, 7-day neonatal readmission, meconium, and fetal or infant death. Lastly, the delivery composite comprised unplanned Cesarean delivery, delivery at or after 41 weeks, clinical intraamniotic infection, placental abruption, unsuccessful trial of labor after Cesarean, and failed vacuum or forceps delivery.

A power calculation was performed based upon our institution's baseline data. The power of this study is based on the percentage of subjects who have the primary composite event between the 2 groups. Our institution has 400 deliveries per month; therefore, we anticipated 1200 deliveries in each group. Baseline data from our institution suggest the pre-COVID

Table 1. Baseline Maternal and Pregnancy Characteristics

	Pre-COVID-19 12/15/19 – 3/14/20 (n = 1058)	During COVID-19 3/15/20 – 6/15/20 (n = 1210)	*P* value
Race			0.884
White	844 (79.8%)	961 (79.4%)	
Black	87 (8.2%)	105 (8.7%)	
Asian	82 (7.8%)	85 (7.0%)	
Native American	3 (0.3%)	3 (0.2%)	
Multiracial	42 (4.0%)	56 (4.6%)	
Hispanic ethnicity	106 (10.0%)	115 (9.5%)	0.733
Prepregnancy BMI	26.5 (6.6)	26.7 (6.8)	0.577
Previous Cesarean delivery	174 (16.4%)	188 (15.5%)	0.595
Received prenatal care	1051 (99.3%)	1208 (99.8%)	0.092
Number of prenatal visits	12.1 (3.0)	12.0 (2.3)	0.620
Gestational age at delivery (weeks)	38.8 (1.9)	38.8 (2.0)	0.574
<34 weeks	18 (1.7%)	29 (2.4%)	
34 – 36.9 weeks	67 (6.3%)	90 (7.4%)	
37 – 40.9 weeks	923 (87.2%)	1008 (83.3%)	
≥41 weeks	50 (4.7%)	83 (6.9%)	
Birth weight (g)	3321.2 (553.3)	3304 (571.7)	0.488
Labor admission	411 (39.1%)	561 (46.4%)	<0.001
Induction of labor	467 (44.2%)	477 (39.4%)	0.024
Spontaneous delivery >9 weeks	235 (22.3%)	304 (25.1%)	0.127
Maternal length of stay			<0.001
0 – 1 day	169 (16.0%)	416 (34.4%)	
>1 – 2 days	577 (54.6%)	575 (47.5%)	
>2 – 3 days	195 (18.4%)	152 (12.6%)	
>3 days	116 (11.0%)	65 (5.4%)	
Infant length of stay			<0.001
0 – 1 day	163 (15.5%)	346 (28.8%)	
>1 – 2 days	555 (52.9%)	581 (48.3%)	
>2 – 3 days	177 (16.9%)	134 (11.1%)	
>3 days	154 (14.7%)	142 (11.8%)	

Abbreviations: BMI, body mass index.
Reported as N (%), mean (SD).

group would have a 39% rate of the primary composite event. With 1200 patients in each group, we will have 99% power in a test of 2 independent proportions if the primary composite rate is 48% during COVID-19, 95% power if the rate is 46%, and 85% power if the rate is 45%.

Demographic data were compared between the 2 groups with *t* tests and chi-square tests based on the statistical distribution of the specific variable. Similarly, perinatal characteristics were compared between groups with *t* tests and chi-square tests. Composite and individual outcomes were compared between groups and summarized by logistic regression and odds ratio (OR) with a 95% confidence interval (CI). Significance level of 5% was used to determine statistical significance. The statistical software R (version 3.5) was used for all statistical analyses.

RESULTS

During the study period from December 15, 2019, through June 15, 2020, 2,366 deliveries occurred at our institution, with 2,268 deliveries (95.9%) included in the analysis. During the pre-COVID time period, 1,058 deliveries (46.6%) occurred, and 1,210 deliveries (53.4%) occurred during the COVID time period. Baseline maternal and pregnancy characteristics did not differ between groups, indicating both groups were comparable (Table 1). Our practice changes showed decreased incidence of labor induction (44.2% vs 39.4%, $P = 0.024$) and an increase in hospital admissions for labor (39.1% vs 46.4%, $P < 0.001$) during the COVID time period. Maternal and infant length of stay also were significantly lower during the COVID time period (Table 1).

The incidence of the perinatal composite did not differ between groups (36.3% vs 36.7%, OR 1.02; 95% CI, 0.86-1.21; $P = 0.844$). During COVID, deliveries were more likely to occur at or after 41 weeks (4.7% vs 6.9%, OR 1.83; 95% CI, 1.00-3.34; $P = 0.032$). There were no differences in the other individual outcomes within the primary composite (Table 2). There was no difference in the maternal composite (8.7% vs 8.8%; OR 1.02; 95% CI, 0.76-1.36; $P = 0.902$), neonatal composite (11.5% vs 13.4%; OR 1.19; 95% CI, 0.92-1.52, $P = 0.183$), or delivery composite (26.1% vs 25.4%; OR 0.96; 95% CI, 0.80-1.16, $P = 0.697$). All secondary outcomes evaluated separately were also not statistically significant (Table 2).

Table 2. Perinatal Outcomes Before and During the COVID-19 Pandemic

	Pre-COVID-19 12/15/19—3/14/20 (n = 1058)	During COVID-19 3/15/20–6/15/20 (n = 1210)	OR (95% CI)	*P* value
Perinatal composite	384 (36.3%)	444 (36.7%)	1.02 (0.86-1.21)	0.844
Hypertensive disorder of pregnancy >37 weeks	128 (12.1%)	123 (10.2%)	0.82 (0.63-1.07)	0.144
Delivery ≥41 weeks	50 (4.7%)	83 (6.9%)	1.83 (1.00-3.34)	0.032
Unplanned Cesarean delivery	214 (20.2%)	217 (17.9%)	0.86 (0.70-1.06)	0.165
Term NICU admission	57 (5.4%)	88 (7.3%)	1.38 (0.98-1.94)	0.068
42-day maternal readmission	17 (1.6%)	16 (1.3%)	0.82 (0.41-1.63)	0.573
7-day neonatal readmission	19 (1.8%)	24 (2.0%)	1.11 (0.60-2.03)	0.744
Maternal composite	92 (8.7%)	107 (8.8%)	1.02 (0.76-1.36)	0.902
Maternal ICU admission	2 (0.2%)	3 (0.2%)	1.31 (0.22-7.87)	0.766
Transfusion	8 (0.8%)	7 (0.6%)	0.76 (0.28-2.11)	0.604
Hemorrhage	32 (3.0%)	23 (1.9%)	0.62 (0.36-1.07)	0.085
Unplanned procedure	15 (1.4%)	21 (1.7%)	1.23 (0.63-2.39)	0.546
Unplanned hysterectomy	3 (0.3%)	2 (0.2%)	0.58 (0.10-3.49)	0.554
3rd or 4th degree laceration	33 (3.1%)	51 (4.2%)	1.37 (0.88-2.13)	0.17
42-day maternal readmission	17 (1.6%)	16 (1.3%)	0.82 (0.41-1.63)	0.573
Neonatal composite	122 (11.5%)	162 (13.4%)	1.19 (0.92-1.52)	0.183
5-minute Apgar <7	33 (3.1%)	27 (2.2%)	0.71 (0.42-1.19)	0.191
Term NICU admission	57 (5.4%)	88 (7.3%)	1.38 (0.98-1.94)	0.068
7-day neonatal readmission	19 (1.8%)	24 (2.0%)	1.11 (0.60-2.03)	0.744
Fetal death	7 (0.7%)	6 (0.5%)	0.75 (0.25-2.23)	0.603
Infant death	3 (0.3%)	2 (0.2%)	0.58 (0.10-3.49)	0.554
Meconium	20 (1.9%)	37 (3.1%)	1.64 (0.94-2.84)	0.079
Delivery composite	276 (26.1%)	307 (25.4%)	0.96 (0.80-1.16)	0.697
Unplanned Cesarean delivery	214 (20.2%)	217 (17.9%)	0.86 (0.70-1.06)	0.165
Delivery ≥41 weeks	50 (4.7%)	83 (6.9%)	1.83 (1.00-3.34)	0.032
Clinical intraamniotic infection	23 (2.2%)	22 (1.8%)	0.83 (0.46-1.50)	0.545
Placental abruption	14 (1.3%)	7 (0.6%)	0.43 (0.17-1.08)	0.072
Unsuccessful TOLAC	16 (1.5%)	14 (1.2%)	0.76 (0.37-1.57)	0.461
Failed vacuum delivery	6 (0.6%)	3 (0.2%)	0.44 (0.11-1.75)	0.241
Failed forceps delivery	3 (0.3%)	0 (0.0%)	NA	NA

Abbreviations: NICU, neonatal intensive care unit, TOLAC, trial of labor after Cesarean.

DISCUSSION

Our data demonstrate significant changes in clinical practice secondary to policy changes and patient behaviors early in the COVID-19 pandemic. Patients who delivered during the COVID-19 period were less likely to undergo induction of labor and were more likely to present in labor. While the overall perinatal composite did not differ between groups, we did see an increase in deliveries occurring at or after 41 weeks. We also noted a shorter length of hospital stay for the mother-baby dyad but no difference in maternal or neonatal readmission rates. Overall, these changes in clinical practice did not affect perinatal outcomes.

The primary strength of this study was our institution's high volume of deliveries and low incidence of COVID-19 during this time period. Of the 1,210 deliveries that occurred in the COVID-19 period, only 4 patients tested positive for COVID-19 (0.03%). This allows us to adequately study the institutional changes and perinatal outcomes without the bias of COVID-related adverse outcomes.

This study is limited by its single site patient population with a majority of patients of White race, thereby limiting our generalizability to other institutions with different patient populations. We are also underpowered to show a difference in more rare adverse obstetric outcomes as they relate to maternal and neonatal morbidity and mortality. It also should be noted our a priori estimate of the rate of the composite outcome in the pre-COVID-19 group was higher than our results show. However, this difference is small. Therefore, we believe the estimate of our power analysis is still accurate.

A similar study published in September 2020 showed shorter maternal and infant length of stay without an increase in adverse obstetric outcomes. This study did not show a difference in induction of labor or admission for spontaneous labor in the study population.[3] Other literature has shown a significant increase in stillbirth during the COVID-19 pandemic.[4] Our data did not show an increase in fetal or neonatal death, but we were underpowered to show this association.

Following publication of the ARRIVE trial (A Randomized Trial of Induction Versus Expectant Management), our institution globally adopted offering patients the option of an elective induction of labor at 39 weeks.[5] In this study, we saw a decrease in induction of labor and an increase in those deliveries occurring at or after 41 weeks during the COVID-19 period. While not statistically significant, there were trends toward increased term NICU admission and meconium, which would be consistent with pregnancies continuing to gestational ages in the late term period. It is possible these trends were an effect of risk perceptions and changes in patient behaviors and were not directly linked to the changes in institutional policies, which may further support our data that our institutional changes did not affect perinatal outcomes.

In mid-May 2020, there was concern for an increase in neonatal readmissions due to prompt discharge of moms and babies. Therefore, our care teams were less likely to encourage early discharge in the latter portion of our study period. Ultimately, we did not see an increase in maternal or neonatal readmissions at our institution. As the pandemic has continued, our policies have become more lenient, and more patients have returned to staying in the hospital for longer time periods. These data are reassuring it is safe to return to encouraging shorter postpartum stay, should this be necessary in the future.

In comparison to other global outbreaks, the policy changes implemented due to the COVID-19 pandemic are unprecedented. The 2009 H1N1 outbreak in the United States could be considered a comparable global health crisis witnessed in the 21st century. The Centers for Disease Control and Prevention (CDC) released a guideline during the H1N1 outbreak to specifically give guidance to clinicians in the intrapartum setting.[6] The CDC promptly recognized the needs of the pregnant population and assembled a maternal health team to help triage public health inquiries and disseminate information. This collaborative effort has served as a model for future responses, such as the response to the COVID-19 pandemic.[7]

CONCLUSIONS

The policy changes implemented at our institution during the COVID-19 pandemic and the subsequent clinical practice modifications did not affect our perinatal outcomes. Our institution's set of policy changes can be considered a model for emergency preparedness and resource allocation during the COVID-19 pandemic and possible future local or global emergencies.

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