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Impact of labor and delivery unit policy modifications on maternal and neonatal outcomes during the coronavirus disease 2019 pandemic



Naomi H. Greene, PhD; Sarah J. Kilpatrick, MD, PhD; Melissa S. Wong, MD, MHDS; John A. Ozimek, DO; Mariam Naqvi, MD

BACKGROUND: In response to the coronavirus disease 2019 pandemic, hospitals nationwide have implemented modifications to labor and delivery unit practices designed to protect delivering patients and healthcare providers from infection with severe acute respiratory syndrome coronavirus 2. Beginning in March 2020, our hospital instituted labor, and delivery unit modifications targeting visitor policy, use of personal protective equipment, designation of rooms for triage and delivery of persons suspected or infected with coronavirus disease 2019, delivery management, and newborn care. Little is known about the ramifications of these modifications in terms of maternal and neonatal outcomes.

OBJECTIVE: The objective of this study was to determine whether labor and delivery unit policy modifications we made during the coronavirus disease 2019 pandemic were associated with differences in outcomes for mothers and newborns.

STUDY DESIGN: We conducted a retrospective cohort study of all deliveries occurring in our hospital between January 1, 2020, and April 30, 2020. Patients who delivered in January and February 2020 before labor and delivery unit modifications were instituted were designated as the preimplementation group, and those who delivered in March and April 2020 were designated as the postimplementation group. Maternal and neonatal outcomes between the pre- and postimplementation groups were compared. Differences between the 2 groups were then compared with the same time period in 2019 and 2018 to assess whether any apparent differences were unique to the pandemic year. We hypothesized that maternal and newborn lengths of stay would be shorter in the postimplementation group. Statistical analysis methods included Student's *t*-tests and Wilcoxon tests for continuous variables and chi-square or Fisher exact tests for categorical variables.

RESULTS: Postpartum length of stay was significantly shorter after implementation of labor unit changes related to coronavirus disease 2019. A postpartum stay of 1 night after vaginal delivery occurred in 48.5% of patients in the postimplementation group compared with 24.9% of the preimplementation group ($P < .0001$). Postoperative length of stay after cesarean delivery of ≤ 2 nights occurred in 40.9% of patients in the postimplementation group compared with 11.8% in the preimplementation group ($P < .0001$). Similarly, after vaginal delivery, 49.0% of newborns were discharged home after 1 night in the postimplementation group compared with 24.9% in the preimplementation group ($P < .0001$). After cesarean delivery, 42.5% of newborns were discharged after ≤ 2 nights in the postimplementation group compared with 12.5% in the preimplementation group ($P < .0001$). Slight differences in the proportions of earlier discharge between mothers and newborns were due to multiple gestations. There were no differences in cesarean delivery rate, induction of labor, or adverse maternal or neonatal outcomes between the 2 groups.

CONCLUSION: Labor and delivery unit policy modifications to protect pregnant patients and healthcare providers from coronavirus disease 2019 indicate that maternal and newborn length of stay in the hospital were significantly shorter after delivery without increases in the rate of adverse maternal or neonatal outcomes. In the absence of long-term adverse outcomes occurring after discharge that are tied to earlier release, our study results may support a review of our discharge protocols once the pandemic subsides to move toward safely shortening maternal and newborn lengths of stay.

Key words: coronavirus disease 2019, labor management, severe acute respiratory syndrome coronavirus 2

Introduction

By March 2020, coronavirus disease 2019 (COVID-19), the illness caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was spreading widely in many regions in the United States. Against the backdrop of rapidly changing recommendations

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EDITORS' CHOICE

from the Centers for Disease Control and Prevention (CDC), hospital leadership in regions expecting a surge of COVID-19 cases implemented changes to accomplish the following 2 major goals: to ensure adequate capacity to safely care for infected patients and to prevent unaffected patients, families, and hospital staff from contracting the virus.^{1–5}

California issued a statewide stay-at-home order on March 19, 2020, and shortly after, the Society for Maternal-Fetal Medicine and Society for Obstetric Anesthesiology and Perinatology

issued guidelines on safe delivery of obstetrical care during the COVID-19 pandemic.⁶ In light of these recommendations, a multidisciplinary team of obstetricians, maternal-fetal medicine specialists, pediatricians, anesthesiologists, infectious disease specialists, and nursing leadership was assembled at our institution to create guidelines for maternal and neonatal care during this time period. These guidelines addressed the use of personal protective equipment, designation of rooms for triage and delivery of persons suspected or infected with COVID-19, delivery management, and newborn care. Patients without COVID-19 were

AJOG MFM at a Glance

Why was this study conducted?

This study aimed to examine downstream effects of labor and delivery unit policy modifications implemented to reduce the risk of infection of patients and staff with severe acute respiratory syndrome coronavirus 2.

Key findings

Postpartum lengths of stay for mother and newborn were markedly shorter without differences in rates of cesarean delivery and adverse obstetrical outcomes.

What does this add to what is known?

Because rapid implementation in labor and delivery unit policy modifications is a recent concept in response to the coronavirus disease 2019 pandemic, little is known about associated short- and long-term effects of these practice changes and of the pandemic overall.

permitted 1 support person during delivery and no visitors postpartum. This policy was modified on April 20, 2020, to allow a single support person during the postpartum stay.

The objective of this study was to compare maternal and neonatal outcomes before and after the implementation of stay-at-home orders and our institutional COVID-19 obstetrical and neonatal policy changes in the labor and delivery unit. Given that efforts to protect staff and patients from infection with SARS-CoV-2 would aim to reduce face-to-face exposure time, we hypothesized that the COVID-19 labor and

delivery modifications directed at reducing the in-hospital transmission rate would be associated with shorter lengths of stay for mothers and newborns compared with mothers and newborns delivered before the modifications were made.

Materials and Methods

This study was performed at a tertiary care, academic hospital with approximately 6200 deliveries a year staffed by 130 academic and community physicians. Certified nurse midwives, residents, and fellows are involved with intrapartum care, and all deliveries are

performed under the supervision of an attending physician. The labor and delivery unit policy modifications made in response to COVID-19 at Cedars-Sinai Medical Center were implemented beginning March 2020 (Box).

To assess the impact of these changes on delivery outcomes, we conducted a retrospective cohort study of all deliveries occurring in our hospital between January 1, 2020 and April 30, 2020. We divided the cohort into the following 2 groups: patients who delivered before implementation of these guidelines in January and February 2020 (preimplementation) and patients who delivered during or after their implantation in March and April 2020 (postimplementation).

Maternal demographic information, delivery information, and maternal and neonatal outcome data were extracted from the medical record and compared between the preimplementation and the postimplementation groups. Obstetrical outcomes included time to delivery, delivery analgesia, mode of delivery, indications for cesarean delivery, and compliance with the American College of Obstetricians and Gynecologists/Society for Maternal-Fetal Medicine (ACOG/SMFM) Guidelines for when cesarean delivery was performed for arrest of labor.⁷ The ACOG/SMFM

BOX**Labor and delivery unit modifications made in response to COVID-19**

Measures were instituted beginning March 2020 and included:

1. All hospital staff underwent a health screening and temperature check on arrival to the hospital and were provided a mask, which they were required to wear at all times.
2. A COVID-19 treatment team was designated at the start of each shift, and included a group of nurses, physicians, and operating room staff.
3. Patients admitted with or suspected to have COVID-19—designated persons under investigation—were not permitted visitors during the hospital stay.
4. Patients without COVID-19 were permitted 1 support person during delivery and no visitors postpartum. This policy was modified on April 20, 2020, to allow a single support person during the postpartum stay.
5. Patients with COVID-19 or persons under investigation were admitted to designated COVID-19 rooms on the labor unit, and their treatment team was to remain unchanged during a hospital shift to minimize exposure to hospital staff.
6. Patients with COVID-19 and persons under investigation were advised to undergo a temporary separation from the newborn after delivery. If they declined, protective measures were recommended including isolette care in the room and wearing gloves and mask during any handling of the newborn.
7. Labor and delivery workroom COVID policy: every other workstation was shut down to reduce the amount of people in the workroom. There was a strict limit of no more than 10 people in the workroom at any given time.
8. Breastmilk handling and breast pump and kit cleaning or sanitation: identified a new workflow to address how to handle breastmilk and the cleaning of breast pumps/breast pump kits safely.

COVID-19, coronavirus disease 2019.

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TABLE 1

Demographic and clinical characteristics in patients delivering before and after implementation of the COVID-19 guidelines

Characteristic	Preimplementation (Jan.–Feb., 2020) n=1016	Postimplementation (March–April, 2020) n=920	Pvalue
Maternal age, mean (SD)	34.2 (4.7)	33.8 (4.8)	.09
Age ≥35 y	493 (48.5)	420 (45.7)	.21
Age ≥40 y	128 (12.6)	95 (10.3)	.12
Race or ethnicity			
White	591 (58.2)	560 (60.9)	.43
Black	72 (7.1)	69 (7.5)	
Asian	136 (13.4)	121 (13.2)	
LatinX	154 (15.2)	112 (12.2)	
Other	63 (6.2)	58 (6.3)	
BMI, mean (SD)	29.4 (5.0)	29.3 (5.2)	.59
BMI >30 kg/m ²	374 (37.1)	341 (37.5)	.85
Gestational age, mean (SD)	38.6 (1.9)	38.6 (1.8)	.59
Gestational age <37 wk	91 (9.0)	66(7.2)	.15
Labor type			
Spontaneous labor	430 (42.3)	372 (40.4)	.40
Induction of labor	409 (40.3)	376 (40.9)	.78
Prior cesarean delivery	135 (13.3)	128 (13.9)	.69

Data are presented as number (percentage) unless indicated otherwise.

BMI, body mass index; COVID-19, coronavirus disease 2019; SD, standard deviation.

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Guidelines provide definitions for arrest of labor in the first and second stages of labor, and compliance with these guidelines was determined by independent review of each nulliparous term singleton vertex (NTSV) cesarean delivery record by a trained departmental quality assessor. These data are routinely gathered as part of our institutional quality improvement program aimed at safely lowering the NTSV cesarean rate. Postpartum outcomes included length of stay, opioid use, and exclusive breastfeeding on discharge. Adverse outcomes included markers of severe maternal morbidity (defined as transfer to an intensive care unit or transfusion of 4 or more units of packed red cells), rate of transfusion of any number of units of packed red cells, and readmission within 30 days. Neonatal outcomes included neonatal intensive care unit (NICU) admissions, Apgar scores, neonatal

hypoglycemia, abnormal cord blood gas (pH <7 or base excess <−13), unexpected term newborn complications (The Joint Commission Perinatal Core Measure 06),⁸ neonatal length of stay, and readmission within 28 days.

To account for yearly variation in our outcomes, we compared the identified differences between pre- and postimplementation outcomes during the pandemic year to the same time period (January–April) in 2018 and 2019. To identify potential differences in postpartum or postoperative lengths of stay owing to changes to our hospital visitation policy on April 20, 2020, we compared the lengths of stay for deliveries in the postimplementation period between March 1, 2020, and April 19, 2020, to the same from April 20, 2020, through April 30, 2020, the end of our study period.

Statistical methods included the use of Student's *t*-test or Wilcoxon tests for

continuous variables and chi-square or Fisher's exact tests for categorical variables, as appropriate. To correct for multiple comparisons, a Bonferroni correction was applied (corrected significance probability value of <0.0016). Statistical analysis was performed using SAS (version 9.4, Cary, NC). This study was approved by the Cedars-Sinai Institutional Review Board (Study 00000768, approved June 15, 2020).

We included all patients in the 2020 study period, regardless of laboratory-confirmed SARS-CoV-2 status. We accounted for potential differences in outcomes attributable to infection status rather than labor and delivery unit practice modifications by rerunning analyses without laboratory test-positive cases.

Results

During the study period of January 1, 2020, to April 30, 2020, 1936 deliveries

TABLE 2

Delivery outcomes in patients delivering before and after implementation of the COVID-19 guidelines

Outcome	Preimplementation (Jan.–Feb., 2020), n=1016	Postimplementation (March–April, 2020), n=920	P value ^a
Obstetrical outcomes			
Admission to delivery time (h), median (IQR)	11 (16)	10 (14)	.14
Delivery analgesia			
Epidural	771 (75.9)	710 (77.2)	.79
Spinal	173 (17.0)	154 (16.7)	
General	5 (0.5)	5 (0.5)	
None or missing	67 (6.6)	51 (5.5)	
Mode of delivery, all deliveries			
Spontaneous vaginal delivery	635 (62.5)	574 (62.4)	.96
Cesarean delivery	321 (31.6)	276 (30.0)	.45
Operative vaginal delivery	60 (5.9)	70 (7.6)	.14
Vaginal birth after cesarean	31 (3.1)	26 (2.8)	.77
Trial of labor after cesarean rate	42/135 (31.1)	37/128 (28.9)	.70
VBAC rate ^b	31/135 (23.0)	26/128 (20.3)	.60
VBAC success rate ^b	31/42 (73.8)	26/37 (70.3)	.73
NTSV cesarean rate	127/457 (28.2)	110/444 (24.8)	.24
Compliance with ACOG/SMFM Dystocia Guidelines ^c (NTSV)	19/24 (79.2)	20/26 (76.9)	.84
Cesarean indication in NTSV deliveries			
Nonreassuring fetal status	57/121 (47.1)	36 (36.7)	.39
Protracted or arrested labor	49/121 (40.5)	44 (44.9)	
Elective	15/121 (12.4)	15 (15.3)	
Other	1 (0.8)	3 (3.1)	
Postpartum outcomes			
Postpartum length of stay (nights)			
Vaginal deliveries			
1	173 (24.9)	312 (48.5)	<.0001
2	503 (72.4)	321 (49.8)	
≥3	19 (2.7)	11 (1.7)	
Cesarean deliveries			
≤2	38 (11.8)	113 (40.9)	<.0001
3	176 (54.8)	109 (39.5)	
4	98 (30.5)	46 (16.7)	
≥5	9 (2.8)	8 (2.9)	

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(continued)

occurred at our institution, with 1016 deliveries during the preimplementation period and 920 deliveries during the postimplementation period. Baseline demographic characteristics of the study population in the preimplementation and

postimplementation time periods are described in Table 1. There were no demographic differences between the 2 groups.

Postpartum length of stay was significantly shorter in the postimplementation

group. A postpartum stay of 1 night after vaginal delivery occurred in 48.5% of patients in the postimplementation group compared with 24.9% of the preimplementation group ($P<.0001$). Postoperative length of stay after cesarean

TABLE 2
Delivery outcomes in patients delivering before and after implementation of the COVID-19 guidelines (continued)

Outcome	Preimplementation (Jan.—Feb., 2020), n=1016	Postimplementation (March—April, 2020), n=920	P value ^a
Postpartum urinary catheter removal (h), mean (SD)	19.5 (12.2)	19.5 (12.5)	.97
Postpartum opioid use per day, ^d median (IQR)			
Cesarean delivery	10 (23)	10 (22)	.94
Vaginal delivery	0 (6)	0 (6)	.30
Exclusive breastfeeding at discharge	521 (51.3)	504 (55.8)	.12
Adverse outcomes			
Severe maternal morbidity ^a	5 (0.5)	6 (0.7)	.64
ICU admission	3 (0.3)	3 (0.3)	1.00
Blood transfusion			
Received any number of units of pRBCs units	16 (1.6)	30 (3.3)	.02
Received ≥4 units pRBCs	3 (0.3)	4 (0.4)	.72
Readmission within 30 days	30 (3.0)	18 (2.0)	.16

Data are presented as number (percentage) unless indicated otherwise.

ACOG/SMFM, American College of Obstetricians and Gynecologists/Society for Maternal-Fetal Medicine; COVID-19, coronavirus disease 2019; ICU, intensive care unit; IQR, interquartile range; NTSV, nulliparous term singleton vertex; pRBC, packed red blood cells; SD, standard deviation; TOLAC, trial of labor after cesarean; VBAC, vaginal birth after cesarean.

^a Corrected significant P value < .0016 after Bonferroni adjustment; ^b The VBAC rate is number of VBAC divided by the number of patients with prior cesarean deliveries eligible for TOLAC. The VBAC success rate is the number of VBAC divided by number of patients who underwent TOLAC; ^c Denominator is NTSV patients with cesarean deliveries for which the sole indication was arrest of labor; ^d Units: morphine equivalents per postpartum day; ^e Severe maternal morbidity defined as ICU admission and/or receiving ≥4 units packed red blood cells.

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delivery of ≤2 nights occurred in 40.9% of patients in the postimplementation group compared with 11.8% in the preimplementation group ($P<.0001$) (Table 2). The proportion of patients transfused ≥1 unit of packed red blood cells was higher in the postimplementation group than in the preimplementation group (3.3% vs 1.6%), but this was no longer statistically different after correction for multiple comparisons. There were no other differences in obstetrical, maternal, or adverse outcomes between the preimplementation and postimplementation groups (Table 2).

Newborn length of stay was also significantly shorter after implementation of practice modifications compared with the preimplementation group. After vaginal delivery, 49.0% of newborns were discharged home after 1 night in the postimplementation group compared with 24.9% in the preimplementation group ($P<.0001$, Table 3). After cesarean delivery, 42.5% of newborns were discharged after ≤2 nights in the postimplementation group compared with 12.5% in the preimplementation group

($P<.0001$). There were no differences in NICU admissions, abnormal cord blood gas, neonatal hypoglycemia, unexpected newborn complications, and newborn readmission within 28 days between the 2 time periods.

When comparing postpartum length of stay after easing of visitor restrictions on April 20, 2020, there were no differences in maternal postpartum length of stay after vaginal delivery (1.6 vs 1.5 nights; $P=.25$) or after cesarean delivery (2.8 vs 2.7 nights; $P=.6$). Newborn length of stay after cesarean delivery was shorter after easing the visitor policy (4.4 vs 3.2 nights; $P=.02$), and there was no difference after vaginal delivery (1.9 vs 2.8 nights; $P=.48$).

To adjust for month-to-month variation in length of postpartum hospitalization for the mother and the newborn, we compared the proportion of patients who were discharged home after 1 night following vaginal delivery and after ≤2 nights following cesarean delivery in the pandemic year to the patients who delivered during the same time period in 2018 and 2019 (Figure). There were no

significant differences in neonatal or maternal lengths of stay between January–February and March–April in 2018 and 2019, regardless of the mode of delivery.

The first SARS-CoV-2 tests in our hospital were reported on March 21, 2020. There were 2 laboratory test-positive cases during the study period. When excluding these 2 cases from the length of stay analyses, the reduction in postpartum and postoperative maternal stays and newborn lengths of stay after vaginal and cesarean deliveries remained significant ($P<.0001$ for all comparisons).

Structured Discussion or Comment

Principal findings

Similar to many hospitals nationwide, our labor unit instituted internal practice modifications intended to protect patients and healthcare providers from COVID-19 in March 2020. In this study, we found that maternal and newborn lengths of stay were significantly shorter after implementation of these changes to

TABLE 3

Outcomes in newborns delivered before and after implementation of COVID-19 guidelines

Outcome	Preimplementation (Jan.–Feb., 2020, n=1033)	Postimplementation (March–April, 2020, n=941)	P value ^a
NICU admissions	131 (13.7)	121 (12.9)	.61
5-minute Apgar <7	19 (1.8)	13 (1.4)	.42
Cord blood gas testing performed	131 (12.7)	139 (14.8)	.18
Abnormal cord blood gas ^b	5 (0.5)	7 (0.7)	.46
Neonatal hypoglycemia	49 (4.8)	44 (4.9)	.87
Unexpected severe term newborn complications per 1000 births ^c	10 (1.0)	10 (1.1)	.83
Unexpected moderate term newborn complications per 1000 births ^c	19 (1.8)	12 (1.3)	.31
Newborn length of stay after vaginal delivery (nights)			
1	170 (24.9)	309 (49.0)	<.0001
2	464 (67.9)	285 (45.2)	
≥3	49 (7.2)	37 (5.9)	
Newborn length of stay after cesarean delivery (nights)			
≤2	37 (12.5)	111 (42.5)	<.0001
3	171 (57.8)	104 (39.9)	
4	75 (25.3)	34 (13.0)	
≥5	13 (4.4)	12 (4.6)	
Newborn readmission within 28 days	22 (2.1)	12 (1.3)	.15

Data are presented as number (percentage) unless indicated otherwise.

COVID-19, coronavirus disease 2019; NICU, neonatal intensive care unit.

^a Corrected significant P value of <.0016 after Bonferroni adjustment; ^b Cord blood gas with pH <7 or base excess <−12; ^c Unexpected term newborn complications defined by The Joint Commission on the Accreditation of Hospitals as Perinatal Core Measure 06 (PC-06).

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the labor unit, and that shorter lengths of stay in March and April were not seen in previous years when compared with January and February in the same year. We did not find an increase in adverse maternal or neonatal outcomes despite the shorter postpartum lengths of stay for mother and newborn.

Clinical and research implications

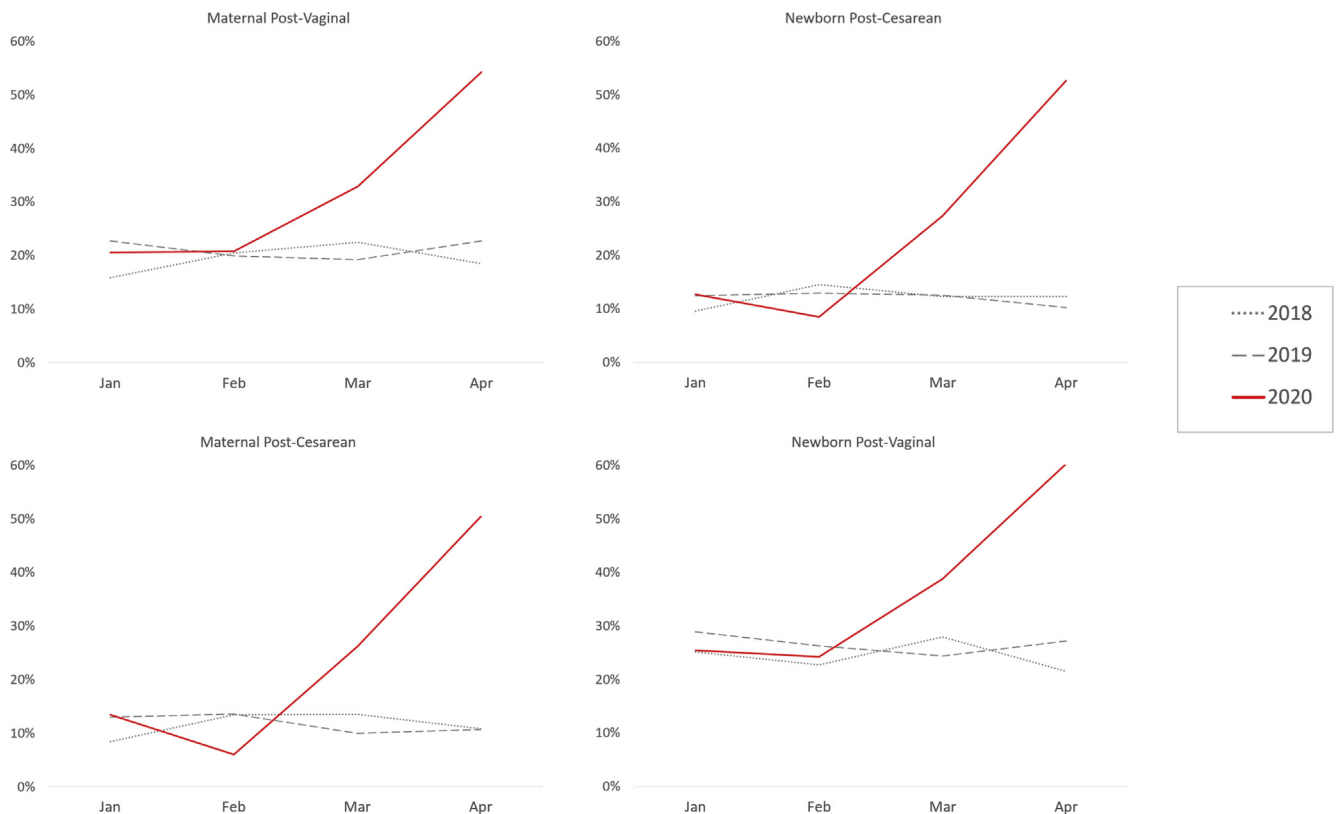
As hospitals nationwide work to effectively protect patients and healthcare providers from COVID-19, it remains important to determine whether labor and delivery practice modifications designed to reduce transmission of SARS-CoV-2 are associated with adverse maternal and neonatal outcomes. A recent comprehensive summary of international obstetrical practice modifications

indicates that professional societies in USA, Italy, and Spain are encouraging early postdelivery discharge.⁹ In our hospital, early discharge was not among the practice modifications we made. Nevertheless, our study results revealed discharge after 1 or 2 nights for vaginal and cesarean deliveries, respectively, and this allowed us to study potential short-term adverse outcomes that could be associated with the shorter lengths of stay. Our labor and delivery practice modifications aimed at reducing COVID-19 transmission to patients and staff were not associated with time from admission to delivery, altered rates of induction of labor, delivery analgesia, cesarean delivery, vaginal birth after cesarean, operative delivery, compliance with ACOG/SMFM guidelines for reducing cesarean delivery because of

dystocia, postpartum analgesia, or exclusive breastfeeding at discharge. The policy modifications in the labor and delivery unit in our institution during the COVID-19 epidemic were associated with a significant reduction in postpartum and neonatal length of stay without an increase in the rate of maternal and neonatal complications.

The reasons for this reduction in postpartum length of stay are likely multifactorial but may be attributed partially to changes to our visitor policy enacted in early March, which allowed only a single support person during labor and delivery and prohibited any postpartum visitors. Although this policy was later liberalized on April 20, 2020, to allow for 1 healthy visitor on the postpartum unit, it is likely that the initial restrictions may have motivated

FIGURE
Short length of stay by implementation periods and prior years



Short length of stay was defined as discharge after 1 night after vaginal delivery (postpartum day 1) and discharge after ≤ 2 nights after cesarean delivery (postoperative day 1 or 2). There was a significant increase in short lengths of stay for both mothers and neonates after both types of delivery with implementation of the guidelines in the era of COVID-19 (year 2020, all P values $< .0001$). There were no significant differences in neonatal or maternal lengths of stay between January to February and March to April in 2018 and 2019, regardless of mode of delivery (P values, .35–.93).

COVID-19, coronavirus disease 2019.

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patients and providers toward an earlier discharge. This study suggests that it is reassuring that these early discharges were not associated with an increased rate of readmissions or postpartum medical complications, although future studies are needed to determine what long-term effects the shorter stay might have on other outcomes such as maternal mental health, bonding, and ongoing breastfeeding.

Strengths and limitations

The strength of this study was the timely evaluation of the impact of rapidly implemented labor unit alterations focused on reducing COVID-19 transmission on mothers and their infants at a single institution. As a large-volume

labor and delivery unit, we have the capability to assess outcomes on a scale that would be challenging with fewer numbers of total deliveries.

This study is not without limitation. It is possible that this study was underpowered to assess differences in less common but severe adverse outcomes, including severe maternal morbidity or stillbirth. Our patient population may also not be generalizable to patients admitted to other labor and delivery units.

It is plausible that the reduction in postpartum hospital stay was a random event, owing to normal month-to-month variation. However, the marked reduction in length of stay seen in 2020 compared with no such change in the

same months of 2018 and 2019 lends support for the association between shorter lengths of stay and either COVID-19 practice modifications or unmeasurable factors related to the pandemic as a whole, including the statewide lockdown.

Conclusions

Labor and delivery unit policy modifications implemented to protect pregnant patients and healthcare providers from COVID-19 at Cedars-Sinai Medical Center in Los Angeles indicate that maternal and newborn length of stay in the hospital were significantly shorter after delivery without increases in the rate of adverse maternal or neonatal outcomes. ■

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Author and article information

From the Division of Maternal-Fetal Medicine, Department of Obstetrics & Gynecology, Cedars-Sinai Medical Center, Los Angeles, CA (Drs Greene, Kilpatrick, Wong, Ozimek, and Naqvi).

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Corresponding author: Naomi Greene, PhD. Naomi.Greene@cshs.org