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Investigating Racial and Ethnic Disparities in Maternal Care at the System Level Using Patient Safety Incident Reports

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Background: Maternal mortality in the United States is high, and women and birthing people of color experience higher rates of mortality and severe maternal morbidity (SMM). More than half of maternal deaths and cases of SMM are considered preventable. The research presented here investigated systems issues contributing to adverse outcomes and racial/ethnic disparities in maternal care using patient safety incident reports.

Methods: The authors reviewed incidents reported in the labor and delivery unit (L&D) and the antepartum and postpartum unit (A&P) of a large academic hospital in 2019 and 2020. Deliveries associated with a reported incident were described by race/ethnicity, age group, method of delivery, and several other process variables. Differences across racial/ethnic group were statistically evaluated.

Results: Almost two thirds (64.8%) of the 528 reports analyzed were reported in L&D, and 35.2% were reported in A&P. Non-Hispanic white (NHW) patients accounted for 43.9% of reported incidents, non-Hispanic Black (NHB) patients accounted for 43.2%, Hispanic patients accounted for 8.9%, and patients categorized as "other" accounted for 4.0%. NHB patients were disproportionally represented in the incident reports, as they accounted for only 36.5% of the underlying birthing population. The odds ratio (OR) demonstrated a higher risk of a reported adverse incident for NHB patients; however, adjustment for cesarean section attenuated the association (OR 1.25, 95% confidence interval 1.01–1.54).

Conclusion: Greater integration of patient safety and health equity efforts in hospitals are needed to promptly identify and alleviate racial and ethnic disparities in maternal health outcomes. Although additional systems analysis is necessary, the authors offer recommendations to support safer, more equitable maternal care.

Decades of research have illustrated the presence of pervasive racial and ethnic disparities in maternal mortality in the United States.[1] Maternal mortality increased during the COVID-19 pandemic from 17.4 deaths per 100,000 live births in 2018 to 32.9 deaths in 2020,[2,3] the highest rate of all high-income countries in the world.[4] Racial and ethnic disparities in these outcomes also worsened.[2,3] Black, American Indian, and Alaska Native women and birthing people experienced much higher rates of mortality and were two to three times more likely to die from pregnancy-related causes than white women.[5] Prior research has also found that Black women and birthing people experience higher rates of severe maternal morbidity (SMM), which comprises life-threatening health conditions caused by or exacerbated by pregnancy.[6,7] Maternal mortality and SMM are associated with $350 million in excess health care expenditures,[8,9] and a recently published report from 36 maternal mortality review committees concluded that more than 80% of maternal deaths from 2017 to 2019 were preventable.[10] Extant literature also suggests SMM is largely preventable.[11–13] The presence of substantial and persistent disparities after controlling for patient factors across and within sites of care suggest significant additional contributory factors, including systemic racism,[14] and highlights the need to improve the quality of maternal care.[14,15]

Health system–level investigation is critical for reducing racial/ethnic disparities in maternal care.[13,16–19] Unfortunately, patient safety and quality improvement (QI) initiatives rarely examine the interaction of race and ethnicity and other demographic factors on quality of care and adverse outcomes.[20–22] As aggregated data can mask trends among smaller subpopulations in the dataset,[23] an important step of any maternal health equity initiative at the hospital level is disaggregating data by race/ethnicity and analyzing the distribution of adverse outcomes among women and birthing people of color (American Indian/Alaskan Native, Asian, Black, or Hispanic) to facilitate the identification of disparities.[16,24,25] However, current measures of obstetric quality lack sensitivity, and outcome measures alone, such as mortality and morbidity, are insufficient in supporting targeted areas for improvement in maternal care.[19,24,26] Therefore, examining patient experience, including experiences of racism and discrimination,[24,26]

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Table 1. Racial/Ethnic Distribution of Obstetric Gynecologists

		White	Black	Hispanic	Asian	Total
Faculty	2019	35	0	2	2	39
	2020	34	1	1	2	38
Residents	2019	18	2	2	1	23
	2020	17	5	2	0	24

and process-oriented measures are critical for determining which specific systems factors contribute to poor outcomes and disparities.

Although few studies have specifically investigated root causes in clinical systems contributing to disparities in maternal health outcomes, prior research has found that Black women and birthing people are offered fewer treatment options, frequently experience delays in care, and are subjected to biased decision-making, negatively affecting their care.[15,27,28] In the present study, we sought to build on these findings by identifying factors contributing to disparate outcomes for women and birthing people of color using voluntarily reported patient safety incident reports (IRs). IRs drive QI and patient safety initiatives in hospitals and are used to investigate a broad range of safety issues in clinical systems. Prior research has found these reports to be effective in reducing patient harm and determining opportunities for intervention.[29,30] Initial research using IRs to examine racial and ethnic disparities in adverse events suggested that near-miss events may be underreported for Black patients, while adverse events resulting in harm may occur more frequently for Black patients.[7,20,31,32] To our knowledge, this is the first study to use IRs specifically to examine factors contributing to adverse events and racial/ethnic disparities in maternal care.

METHODS

The dataset used for the study was collected at a large academic hospital in the southeastern United States. The hospital maintains a comprehensive women's health center composed of a 50-bed labor and delivery unit (L&D) and antepartum and postpartum care unit (A&P). The annual birthing volume exceeds 2,500 deliveries annually. The care team includes attending and resident obstetric gynecologists (OB/GYNs), maternal-fetal medicine specialists (MFMs), attending and resident anesthesiologists, nurses, nurse midwives, and nursing assistants. The racial/ethnic composition of the OB/GYN physicians and residents in 2019 and 2020 is shown in Table 1.

We were unable to obtain the racial/ethnic composition of the nursing staff at the institution in 2019 and 2020; however, data from the state of South Carolina found that 79.9% of registered nurses identified as white, 11.2% identified as African American, and 1% identified as Hispanic in 2018.[33]

The hospital follows Association of Women's Health, Obstetric and Neonatal Nurses (AWHONN) standards on nursing ratios on perinatal units.[34] In L&D, the nurse-to-patient ratio typically ranged from 1:1 to 1:2. For antepartum care, the nurse-to-patient ratio ranged from 1:3 to 1:4, depending on patients' acuity. Except in the event that the infant is admitted to the neonatal ICU, postpartum care involved couplet care (nurse caring for both the mother and baby) with standard nurse-to-patient ratios of 1:3 (6 patients). Interpreter services are available for non-English-speaking patients and can be obtained in person (during standard working hours) and via telephone or videoconference using a tablet. The study was approved by the hospital's Institutional Review Board (Pro00105892).

Data Collection

We retrospectively collected two years of IR data, January 1, 2019, to December 31, 2020, from L&D and A&P documented in the hospital's voluntary event reporting system.[30] The reporting system requires reporters to include the patient's medical record number (MRN) (except for unsafe conditions) and answer a series of questions about the incident, including the individual(s) affected (patient, staff, visitor), the type of event, date and time of the event, the floor or unit where the event occurred, and a harm level. The patient's date of birth can also be added. There were 25 categories of event type options available in the event reporting system, including complications of surgery, falls, medication-related, environmental issues, and supplies (Appendix 1, available in online article). Harm score ranged from 1–"Unsafe condition" to 9–"Death." As more than one IR may have been filed, duplicate IRs were excluded, as were IRs with missing MRNs and those involving the infant.

As the event reporting system does not collect demographic data, the hospital's clinical data warehouse (Figure 1) linked the IR to demographic data (race/ethnicity, age) using the patient's MRN. Demographic characteristics included maternal race/ethnicity (non-Hispanic white [NHW], non-Hispanic Black [NHB], Hispanic, and other). The "other" group includes American Indian or Alaska native, Asian, Native Hawaiian or other Pacific Islander, other, patient refused, and unknown without Hispanic ethnicity. Visits with an IR were also described by maternal age group (> 18, 18 to 34, and ≥ 35) as well as by length of stay (LOS) for that visit,

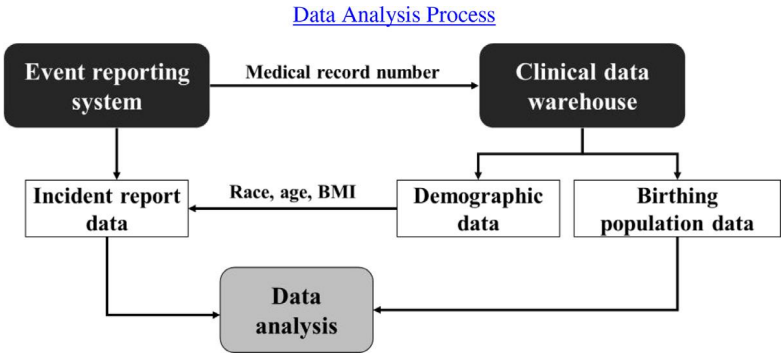


Figure 1: Illustrated here is the process used in the study for data analysis. BMI, body mass index.

year reported, location of incident (L&D, A&P), event type, harm level, number of incidents, having more than one incident noted, method of delivery, anesthesia type, and estimated blood loss. The IR cohort does not include data on terminated pregnancies. In addition, we requested demographic data on all deliveries at the hospital within the same time frame (2019–2020) to provide estimates of the population at risk of an incident.

Analysis

Visits with an IR were described by demographic and incident characteristics. Differences in demographic and incident characteristics in the IR cohort were evaluated across racial/ethnic group variables with chi-square tests of homogeneity or analysis of variance as appropriate. A p value of < 0.05 was considered statistically significant for global tests; Tukey methods were used to adjust the significance level for multiple comparisons.

Deliveries with an IR (cases) were further linked to all deliveries via MRN. Deliveries that did not correspond to an incident were classified as controls. Logistic regression methods were used to generate unadjusted and adjusted odds ratios (ORs) of an incident in these data. Variables significantly associated with an IR were evaluated for inclusion in an adjusted model using likelihood ratio tests for goodness of fit. Analyses were conducted with SAS 9.4 (SAS Institute Inc., Cary, North Carolina) and STATA 16 (StataCorp LLC, College Station, Texas), and all tests were evaluated with significance at $\alpha = 0.05$ level.

RESULTS

IR Cohort

The data included 952 IRs, of which 117 were classified as "unsafe condition" not associated with an individual patient, and 307 did not map to a delivery during our time frame. The analytic cohort was thus limited to 528 IR–documented maternal incidents that could be matched to a delivery: 300 incidents reported in 2019, and 228 reported in 2020 (Figure 2). Of the 528 IRs, NHW and NHB patients accounted for 43.9% and 43.2% of the reported incidents, respectively. Hispanic patients accounted for 8.9% of reported incidents, and patients categorized as "other" accounted for 4.0% of the reported incidents. Almost two thirds (342; 64.8%) of incidents were reported in L&D, and the remaining 186 (35.2%) incidents were reported in A&P. The 528 incidents reported occurred in 476 deliveries. Multiple incidents were noted in 9.9% (47) of deliveries—42 deliveries were associated with 2 incidents, and 5 deliveries had 3 incidents noted. We did not see any association of race/ethnicity with having multiple IRs at delivery ($p = 0.49$).

Event Type

The most commonly reported event types were coordination/communication ($n = 149$), laboratory tests ($n = 85$), maternal ($n = 65$), medication-related ($n = 62$), and omission/errors in assessment, diagnosis, or monitoring ($n = 50$). These 5 event types accounted for 77.8% of the reported events (Table 2). Of the top 5 event categories, only omission/errors events were statistically different by race/ethnicity ($p = 0.02$). NHB patients accounted for 54.0% of omission incidents. Sample IRs for these event types are provided in Table 2.

In addition, there were several event types—infrastructure failures ($n = 16$), falls ($n = 15$), complications of care ($n = 10$), medical records/patient identification ($n = 8$), transfusions ($n = 8$), and anesthesia events ($n = 5$)—in which NHB patients accounted for more than 50% of the reported incidents.

Harm Level

Of the 528 IRs, the highest proportion of harm level was "Level 3: No harm evident" in 135 (25.6%) reports, followed by "Level 1: Unsafe condition" in 126 (23.9%), "Level 4: Emotional distress or inconvenience" in 115 (21.8%), "Level 2: Near miss" in 86 (16.3%), and "Level 5: Additional treatment" in 59 (11.2%) reports. Only 7 of the IRs were classified as harm, with 6 (1.1%) listed as "Level 6: Temporary harm" and 1 (0.2%) listed as "Level 8: Severe permanent harm"; no maternal deaths were reported (Table 3). Overall, we did not see a significant difference in mean harm score by race/ethnicity.

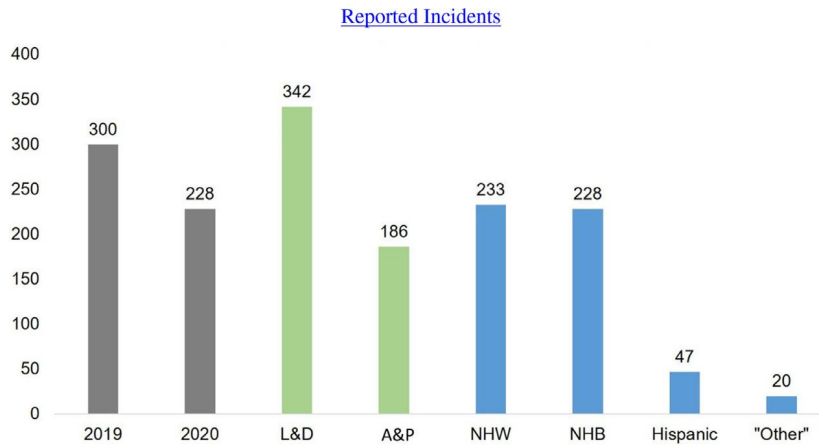


Figure 2: This graph shows reported incidents by year, unit, and race/ethnicity. L&D, labor and delivery; A&P, antepartum and postpartum; NHW, non-Hispanic white; NHB, non-Hispanic Black.

Table 2. Top Five Event Categories by Race/Ethnicity*

Event Type	Total	NHW n (%)	NHB n (%)	Hispanic n (%)	Other n (%)	Example of Incident
Care coordination / communication	149	75 (50.3)	58 (38.9)	14 (9.4)	2 (1.3)	Nursing shortage on the unit prevented patient from getting admitted to a room and delayed her receiving an epidural. Patient had to wait almost two hours while in severe pain due to no nurse being available to offer her safe care. Every other nurse had multiple patients. [L&D]
Laboratory test	85	33 (38.8)	44 (51.8)	4 (4.7)	4 (3.5)	Nurse called to request cancellation on a CBC [complete blood count] on a lavender tube and blood bank tests on a pink tube. She informed me that another patient's blood was mistakenly sent with these labels. . . . I canceled the CBC and transferred her to blood bank so they could cancel their tests as well. [L&D]
Medication-related	62	30 (48.4)	28 (45.2)	2 (3.2)	2 (3.2)	RN questioned charge RN and another RN on 5W if it was normal to give Motrin and Toradol at the same time. Response was no. RN called pharmacy which also said not to start the Motrin. Pharmacist changed date and time for Motrin to be initiated. There were multiple doses of Motrin & Toradol scheduled simultaneously until pharmacy adjusted time. [A&P]
Maternal	65	31 (47.7)	21 (32.3)	9 (13.8)	4 (6.2)	No OB hemorrhage called. Pt was on mother baby. [Nurse] called me for a heads up. When I arrived, pt was actively hemorrhaging. She was 6 hours pp and had lost 700+ in the recent time period. OB was at bedside but anesthesia was unaware until I called them. [L&D]
Omission/ errors	50	12 (24.0)	27 (54.0)	8 (16.0)	3 (6.0)	Mother was not set up to pump within 6 hours of delivery. No feeding plan documented in mother or infant chart. Mom was set up to pump at 13 hours pp. [A&P]
Total	411	181 (44.0)	178 (43.3)	37 (9.0)	14 (3.4)	

* Percentage based on event type (row) totals.
NHW, non-Hispanic white; NHB, non-Hispanic Black; L&D, labor and delivery; A&P, antepartum and postpartum; OB, obstetrician; Pt, patient; pp, postpartum.

Table 3. Harm Type by Race/Ethnicity (Percentage Based on the Group [Column] Total)

Harm Type (least to most severe)	Total	NHW *n* (%)	NHB *n* (%)	Hispanic *n* (%)	Other *n* (%)
1 – Unsafe condition	126 (23.9)	55 (23.7)	54 (23.7)	10 (21.3)	7 (33.3)
2 – Near miss	86 (16.3)	41 (17.7)	39 (17.1)	3 (6.4)	3 (14.3)
3 – No harm evident	135 (25.6)	54 (23.2)	59 (25.9)	18 (38.3)	4 (20.0)
4 – Emotional distress or inconvenience	115 (21.8)	52 (22.4)	47 (20.6)	13 (27.7)	3 (14.3)
5 – Additional treatment	59 (11.2)	29 (12.5)	24 (10.5)	3 (6.4)	3 (14.3)
6 – Temporary harm	6 (1.1)	2 (0.9)	4 (1.8)	0	0
8 – Severe permanent harm	1 (0.2)	0	1 (0.4)	0	0
Total	528	233	228	47	20
Mean (SD)	2.84 (1.38)	2.8 (1.37)	2.84 (1.41)	2.91 (1.21)	2.6 (1.5)

No reported events for categories 7 – Permanent Harm and 9 – Death

NHW, non-Hispanic white; NHB, non-Hispanic Black; SD, standard deviation.

Table 4. Length of Stay (LOS), Age and BMI of Population with a Reported Incident

Race/Ethnicity	Total	NHW	NHB	Hispanic	Other
Age (years)					
Mean (SD)	29.3 (6.0)	30.5 (5.5)	28.1 (5.9)*	29.3 (7.1)	30.5 (7.1)
BMI					
Mean (SD)	33.5 (17.8)	32.4 (23.9)	35.6 (11.0)	29.7 (12.5)	28.5 (4.8)
LOS† (days)					
Mean (SD)	3.2 (4.9)	2.6 (2.9)	3.9 (6.4)*	3.5 (4.5)	2.0 (2.7)
Median (IQR)	1 (1–4)	1 (1–4)	1 (1–5)	1 (1–4)	1 (1–1)

* Statistically different.

† LOS was available for only 407 patients. As LOS could be zero, we inflated the value by 1.

BMI, body mass index; NHW, non-Hispanic white; NHB, non-Hispanic Black; SD, standard deviation; IQR, interquartile range.

The highest mean harm score was reported for adverse reactions (2 events, each with a harm score of 5), complications of surgery (3 events, mean harm score 4.3 ± 2.9), complications of care (7 events, mean 4.3 ± 1.0), food/nutrition (1 event with a harm score of 4), and equipment safety (1 event with a harm score of 4). The remaining event types had means ranging from 1.0 to 3.8.

Delivery Characteristics

The mean maternal age for deliveries with a reported incident was 29.3 (standard deviation [SD] 6.0) (Table 4). The vast majority of incidents were reported for patients in the 18–34 age range (79.6%), with patients of 35+ accounting for 18.3% of reported incidents and those under 18 years of age accounting for 2.1%. The age group of patients with a reported incident differed by race/ethnicity ($p = 0.02$). The mean body mass index (BMI) for women with an IR was 33.5 (SD 17.8) and mean LOS was 3.2 days (SD 4.9). NHB women were significantly slightly younger and had a significantly longer LOS compared with NHW women; however, no differences were seen when comparing other race/ethnic groups. Although mean BMI differed significantly across the four race/ethnicity categories, pairwise comparisons showed no differences.

Deliveries at Risk of Incident Report

From 2019 to 2020, there were 5,915 deliveries recorded. Of these, 476 (8.0%) had an IR recorded. A total of 2,839 (48.0%) deliveries were to NHW women, 2,188 (37.0%) were to NHB women, 610 (10.3%) were to Hispanic women, and 126 (2.1%) were to women of other race. Table 5 describes differences between deliveries with and without an IR. The unadjusted odds of an IR were significantly higher in NHB women compared with NHW women (OR 1.32, 95% confidence interval [CI] 1.07–1.61), women with LOS (OR 1.04, 95% CI 1.02–1.06), deliveries via cesarean section (OR 1.90, 95% CI 1.58–2.30), combined anesthesia (OR 1.51, 95% CI 1.10–2.06), general anesthesia (OR 2.48, 95% CI 1.76–3.51), and in women with higher estimated blood loss (OR 1.05, 95% CI 1.04–1.06). The unadjusted odds of an IR were significantly lower in 2020 (OR 0.745, 95% CI 0.62–0.91) and in women with epidural anesthetic (OR 0.79, 95% CI 0.65–0.95). When evaluating the association of an IR with race/ethnicity in

Table 5. Descriptive Characteristics of Deliveries With and Without a Reported Incident and Odds of an Incident

	With Incident $N = 476$	Without Incident $N = 5{,}439$		Unadjusted	Adjusted
Race/ethnicity	*n* (%)	*n* (%)		OR (95% CI)	OR (95% CI)
Missing	0 (0.0)	11 (0.2)			
1 NHW	206 (43.3)	2,632 (48.4)	0.05	referent	referent
2 NHB	205 (43.1)	1,983 (36.5)		**1.32 (1.07–1.61)**	**1.25 (1.01–1.54)**
3 Hispanic	45 (9.5)	565 (10.4)		1.01 (0.72–1.42)	1.01 (0.71–1.43)
4 Other	20 (4.2)	248 (4.6)		0.97 (0.60–1.59)	1.02 (0.62–1.66)
Reported year					
2019	272 (57.1)	2,723 (50.1)	0.003	referent	
2020	204 (42.9)	2,716 (49.9)		**0.75 (0.62–0.91)**	
LOS mean ± SD	3.2 ± 4.9	2.5 ± 3.4	< 0.001	**1.04 (1.02–1.06)**	
Method of delivery					
Vaginal	218 (45.8)	3,354 (61.7)		referent	referent
Cesarean section	258 (54.2)	2,085 (38.3)	< 0.001	**1.90 (1.58–2.30)**	**1.84 (1.52–2.23)**
Anesthesia type					
Combined	49 (10.3)	385 (7.1)	0.01	**1.51 (1.10–2.06)**	
General	42 (8.8)	204 (3.8)	< 0.001	**2.48 (1.76–3.51)**	
Epidural	255 (53.6)	3,233 (59.4)	0.01	**0.79 (0.65–0.95)**	
Local	0 (0.0)	43 (0.8)	0.05		
Pudendal	0 (0.0)	1 (0.0)	0.68		
Other	4 (0.8)	36 (0.7)	0.5	1.43 (0.51–4.07)	
None	35 (7.4)	568 (10.4)	0.03		
EBL (100 ccs)	897.5 ± 803.9	642.8 ± 554.1	< 0.001	**1.05 (1.04–1.06)**	

OR, odds ratio; CI, confidence interval; NHW, non-Hispanic white; NHB, non-Hispanic Black; LOS, length of stay; SD, standard deviation; EBL, estimated blood loss.

the logistic model, only cesarean section was retained in the model.

After controlling for cesarean delivery, the association of an IR and race/ethnicity was attenuated but still significant for NHB patients compared to NHW patients (OR 1.25, 95% CI 1.01–1.54). When controlling for race/ethnicity, the odds of an IR were significantly increased for deliveries via cesarean section (OR 1.84, 95% CI 1.52–2.23). As race/ethnicity and delivery via cesarean section were both significantly associated with the odds of an IR, we evaluated the association of the two variables (data not shown). Compared with NHW women, NHB women were more likely (OR 1.28, 95% CI 1.14–1.44) and Hispanic patients were less likely (OR 0.78, 95% CI 0.64–0.94) to have delivered via cesarean section. In addition, in comparison to NHW patients, NHB patients were more likely to have general anesthesia (OR 1.56, 95% CI 1.18–2.06). Both NHB and Hispanic patients were less likely to have procedures undertaken with an epidural (OR 0.75, 95% CI 0.67–0.84 and OR 0.78, 95% CI 0.65–0.93, respectively).

Discussion

Maternal mortality and SMM are largely preventable with timely and risk-appropriate care.[7,10,16] Hospital-level factors contribute to adverse maternal health outcomes as well as racial and ethnic disparities in these outcomes.[13,16–18,35] Our study investigated factors in systems and clinical environments contributing to adverse outcomes and racial and ethnic disparities by examining two years of IRs extracted from the hospital's event reporting system. We also examined the association of adverse incidents with LOS, delivery type, and anesthesia method. We found disparities in the proportion of incidents reported for NHB patients and identified variations in care that were associated with adverse outcomes and increased LOS. The findings from this analysis can be used to directly inform safety and equity efforts in intrapartum care.

NHB patients accounted for 43.2% of the reported incidents despite representing only 36.5% of the hospital's birthing population. Hispanic patients were slightly underrepresented in reported incidents and the reported incidents for "other" patients were comparable with the overall patient distribution. However, the odds of having a reported incident for NHB patients were attenuated when controlling for cesarean section, indicating that cesarean delivery is a confounder for the association between race and reported incident. NHB patients have higher rates of cesarean delivery, with some research suggesting physician bias in choosing the mode of delivery for women of color.[36–38] Our study did not compare parity; however, prior research has documented decreasing rates of vaginal birth after cesarean (VBAC)[24,37] as well as increasing rates of cesarean deliveries

among both NHW and NHB patients. Cesarean deliveries and multiple cesareans are associated with increased likelihood of morbidity.[24,39] Black women and birthing people are less likely to be provided an opportunity to attempt a vaginal delivery after a prior cesarean delivery.[40] This may be attributable to a race correction in the VBAC algorithm that predicted lower rates of success for Black patients.[41] Reducing cesarean deliveries for NHB patients is a critical component in reducing disparities in outcomes.[37] The World Health Organization,[42] American College of Obstetricians and Gynecologists,[43] California Maternal Quality Care Collaborative,[44] and Alliance for Innovation on Maternal Health[45] all provide resources for reducing cesarean deliveries. In addition, the race correction was removed from the VBAC calculator in June 2021 to eliminate that source of bias against Black women and birthing people.

NHB patients were disproportionately represented in omission/error in assessment, diagnosis, and monitoring incidents. Although we cannot draw conclusions due to low sample sizes, we also noted that NHB patients also accounted for the majority of the following event types: falls, complications of care, infrastructure failures, medical records/patient identification, and transfusions. These findings align with prior work that found omissions, diagnosis and treatment events, and falls as the top five most frequently reported events resulting in harm for NHB patients.[32,46] Omissions included missed or delayed lab tests, blood glucose level readings, medication administrations, and initiation of breastfeeding or pumping. The omissions and delays described can have significant short- and long-term health effects on NHB and Hispanic patients who experience higher rates of comorbidities such as diabetes and hypertension.[16] Within the IR data, understaffing, layout of the L&D unit, and poor nurse training were described as contributing to these issues. Although these factors undoubtedly contribute to unsafe care for all maternal patients, these events disproportionately affect higher-acuity patients. Delays in diagnosis and treatment and coordination among care team members are known causes of preventable maternal mortality and SMM.[13,16] Though hospitals typically have fall precautions in place, understanding the cause of falls in the NHB patient population can provide an opportunity to supplement fall bundles with targeted interventions to reduce these disparities.[47] In addition, prior research has identified transfusions as a leading cause of SMM for NHB patients, with the transfusion rate of NHB patients nearly twice that of NHW patients.[48] Thus, maintaining robust massive transfusion protocols is a specific action that can be undertaken by hospitals to reduce the severity of hemorrhages.[18] As of July 2020, The Joint Commission requires birthing hospitals to demonstrate that they have enacted these safety standards for postpartum hemorrhage.[49] The Alliance for Innovation on Maternal Health's hemorrhage bundle[50] and tools such as the Jada System[51] are also reported to reduce the severity of postpartum hemorrhage.[22]

Anesthesia-related incidents represented another source of disparity in our study. The five anesthesia-related IRs involved NHB patients, including delays, difficult placement, and onset of hypotension. NHB patients were also more likely to have cesarean sections under general anesthesia. The use of general or combined regional and general anesthesia were associated with an adverse event in our data, and prior research suggests general anesthesia is associated with higher rates of mortality and morbidity.[52–54] Recent research has also identified an association between general anesthesia and postpartum depression, though these findings are disputed.[55–57] At the study site, all patients are counseled on their anesthesia options, and neuraxial anesthesia is generally recommended. However, NHB patients are more likely to have urgent cesarean deliveries, and general anesthesia is more commonly used in emergency cesarean deliveries when compared to elective cesarean sections.[53] Given the compounding effect of cesarean delivery, greater investigation of decision-making regarding delivery type and anesthetic method is warranted. Identifying the factors creating deviations from standards of care, including implicit bias in decision-making, and ensuring optimal pain management provide a significant opportunity for hospitals to improve patient experience and equity in maternal care.

Limitations and Future Work

The data obtained from the event reporting system do not provide a comprehensive picture of the system safety issues existing in the clinical system due to reporting bias and underreporting.[11,13,14] Thomas et al. also noted possible differences in reporting bias by race.[46] Despite these limitations, IRs remain a key driver for QI initiatives in hospitals and health systems. Our review of more than 500 IRs offers insight into latent threats in maternal care and highlights specific issues disproportionately affecting NHB patients. This analysis is part of a larger study investigating causes of disparities in maternal health outcomes that also involves direct observations in L&D and A&P, as well as interviews with health care team members working in maternal care. Combining these approaches, as well as completing a qualitative analysis on the IR narratives, should provide us with a more holistic understanding of safety and equity issues in intrapartum maternal care. In examining possible disparities, prior work has also found value in reporting the race/ethnicity of the care team members to assess racial concordance.[58] However, this was not feasible in this analysis, as the majority of the reports were anonymous. Thus, we were unable to assess racial and language concordance among patient and care team members.

There was a notable decrease in the number of incidents reported in 2020. This may be attributable to several issues: a QI initiative to improve reporting among OB/GYN resi-

dents in 2019, nursing staff turnover, and the COVID-19 pandemic. In 2019, residents participated in a QI project associated with incident reporting. Without this QI initiative, reporting potentially decreased in this group and incoming OB/GYN residents in 2020. High nursing staff turnover resulted in additional use of contract nurses, who may not report incidents as often, particularly in A&P, where the decrease in reporting was most significant. In addition, the increasing demands placed on staff during the pandemic potentially reduced reporting opportunities or affected safety attitudes.[22,23] Recoding of event types may be valuable, as our initial review of the IR narratives discovered inconsistencies in coding, particularly among broader, less well-defined categories such as "maternal" and "coordination/communication." Prior research has noted that reporters may not have easy access to the description of event types.[59,60] We are developing a machine learning model to assist with reclassification of event types.

CONCLUSION

Greater integration of patient safety and health equity efforts within hospitals is needed to promptly identify and alleviate racial and ethnic disparities in maternal health outcomes. Many of these challenges identified are recognized at the national or state level, but individual hospitals and health systems may be unaware of racial and ethnic disparities in their maternal care and health outcomes.[19,22,24] Therefore, a critical step in alleviating disparities will include developing an infrastructure to support timely and accurate data collection and analysis, including disaggregating outcome and quality and safety measures by race/ethnicity. These data can then be used to design equity dashboards, develop more precise and targeted intervention to reduce disparities, and establish accountability for health equity goals. Although IRs alone cannot identify all inequities in care, as a primary driver of QI and patient safety in health care organizations, leveraging this data source is valuable in identifying potential variations in care and ensuring that interventions do not exacerbate existing disparities. By continuing to identify the manner in which the clinical system is failing women and birthing people of color, hospitals can be redesigned to support safe, patient-centered, and equitable maternal care.

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SUPPLEMENTARY MATERIALS

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