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OBJECTIVE: To describe racial and ethnic disparities in the incidence of severe maternal morbidity during delivery hospitalizations in the United States.

METHODS: We conducted a pooled, cross-sectional analysis of 2012–2015 data from the National Inpatient Sample to define the prevalence of chronic conditions and incidence of severe maternal morbidity among deliveries to non-Hispanic white, non-Hispanic black, Hispanic, Asian or Pacific Islander, and Native American or Alaska Native women. We used weighted multivariable logistic regression and predictive margins to generate prevalence and incidence estimates. Adjusted rate ratios and differences were calculated to quantify disparities across racial and ethnic categories. Subgroup analyses were performed to examine the incidence of severe maternal morbidity among deliveries to women with co-morbid physical health conditions, behavioral health conditions, and multiple chronic conditions within each racial and ethnic category.

RESULTS: The incidence of severe maternal morbidity was significantly higher among deliveries to women in every racial and ethnic minority category compared with deliveries among non-Hispanic white women. Severe maternal morbidity occurred in 231.1 (95% CI 223.6–238.5) and 139.2 (95% CI 136.4–142.0) per 10,000 delivery hospitalizations among non-Hispanic black and non-Hispanic white women, respectively (P<.001). When excluding cases in which blood transfusion was the only indicator of severe maternal morbidity, only deliveries to non-Hispanic black women had a higher incidence of severe maternal morbidity compared with deliveries among non-Hispanic white women: 50.2 (95% CI 47.6–52.9) and 40.9 (95% CI 39.6–42.3) per 10,000 delivery hospitalizations, respectively (risk ratio 1.2 [95% CI 1.2–1.3], risk difference 9.3 [95% CI 6.5–12.2] per 10,000 delivery hospitalizations; P<.001 for each comparison). Among deliveries to women with co-morbid physical and behavioral health conditions, significant differences in severe maternal morbidity were identified among racial and ethnic minority compared with non-Hispanic white women and the largest disparities were identified among women with multiple chronic conditions.

CONCLUSION: Programs for reducing racial and ethnic disparities in severe maternal morbidity may have the greatest effect focusing on women at highest risk for blood transfusion and maternity care management for women with co-morbid chronic conditions, particularly multiple chronic conditions.
The increasing contribution of preexisting, chronic conditions to cases of maternal death has been recently highlighted as an important mechanism through which racial and ethnic disparities in maternal mortality may persist in the United States. \(^1\)–\(^3\) There are three means through which this could be the case: higher prevalence of high-risk conditions among racial and ethnic minority women, higher case-fatality from high-risk conditions among racial and ethnic minority women, or a combination of the two. Higher case-fatality rates among non-Hispanic black compared with non-Hispanic white women with select obstetric conditions (preeclampsia, eclampsia, postpartum hemorrhage, placenta previa, placental abruption) have been described,\(^4\) but variation in the prevalence and risk associated with chronic conditions, including multimorbidity, by race and ethnicity has not been comprehensively examined in a national sample of delivering women.

Moreover, although catastrophic, the absolute number of cases of maternal deaths, approximately 1,200 women per year in the United States, makes maternal death a difficult outcome to study.\(^5\) Severe maternal morbidity, however, affects more than 60,000 women per year in the United States and is associated with significant disability and cost.\(^6\)–\(^8\) Severe maternal morbidity is defined as a life-threatening diagnosis or the need to undergo a life-saving procedure during a delivery hospitalization.\(^9\) Severe maternal morbidity encompasses a broad range of serious health complications that, without prevention and treatment, could lead to maternal death.

We designed this analysis to test the primary hypothesis that differences in severe maternal morbidity in non-Hispanic black women reflect increased case morbidity rates in addition to increased prevalence of comorbid chronic conditions when compared with non-Hispanic white women.

**MATERIALS AND METHODS**

We conducted a pooled, cross-sectional analysis of 2012–2015 data from the National Inpatient Sample, a nationally representative sample of hospital discharges.\(^10\) The National Inpatient Sample is a 20% stratified sample of all hospital discharges in the United States that is compiled by the Healthcare Cost and Utilization Project at the Agency for Healthcare Research and Quality. The sample includes weights to account for the complex sampling and allow for national estimates. The National Inpatient Sample is the largest administrative data source with race and ethnicity data for delivering women.

We identified all hospital deliveries that occurred between 2012 and 2015 using standard methods.\(^11\) Our analyses included deliveries occurring among non-Hispanic white, non-Hispanic black, Hispanic, Asian or Pacific Islander, and Native American or Alaska Native women, because these are the racial and ethnic categories available in the National Inpatient Sample. For each year in the study period, approximately 6% of observations had missing data for race and ethnicity and 4% of observations were categorized as other race and ethnicity. These observations were not included in our analytic sample. The Healthcare Cost and Utilization Project reports that race and ethnicity in the National Inpatient Sample is not missing at random.\(^10,12\) We kept with other recent investigators and chose not to impute missing data for race and ethnicity.\(^13\) Instead, we used complete case-based analysis. Demographic descriptive data for observations with missing data for race and ethnicity and for observations with race and ethnicity designated as other are provided in Appendix 1, available online at http://links.lww.com/AOG/B169.

Severe maternal morbidity was the primary outcome of this study, identified using diagnosis and procedure codes compiled by Centers for Disease Control and Prevention (CDC).\(^6\) The algorithm includes 25 indicators of end-organ dysfunction such as renal failure, shock, embolism, eclampsia, and mechanical ventilation. As specified by the CDC, delivery hospitalizations with a diagnosis code indicating severe maternal morbidity and a short length of stay (less than the 90th percentile as calculated separately for vaginal, primary, and repeat cesarean deliveries) were not classified as severe maternal morbidity. The algorithm does not apply length of stay restrictions to delivery hospitalizations in which hospital transfer or in-hospital death occurred or among those that were identified by procedure codes (blood transfusion, hysterectomy, mechanical ventilation, temporary tracheostomy, and cardiac conversion).

We included maternal sociodemographic characteristics based on known or plausible association with the primary outcome, severe maternal morbidity. These included age, median income in ZIP code of residence, payer, rural compared with urban residence, and hospital census region. We grouped payment sources into public insurance (Medicaid and Medicare), commercial insurance, and uninsured or self-pay. Given that Medicare funded fewer than 0.6% of the delivery hospitalizations, we refer to public sources as Medicaid throughout the study. We defined location of residence as rural or urban using the National Center for Health Statistics Classification and Urban Influence Codes.\(^14\) The number...
of observations with missing values for these covariates was less than 2\% of all delivery hospitalizations.

We examined chronic conditions associated with severe maternal morbidity. These included chronic respiratory disease, chronic hypertension, preexisting diabetes mellitus, chronic heart disease, chronic kidney disease, systemic lupus erythematosus (SLE), pulmonary hypertension, human immunodeficiency virus (HIV) or acquired immunodeficiency syndrome (AIDS), depression, and identification of at least one substance use disorder.\textsuperscript{15,16} We generated indicators for chronic respiratory disease, chronic hypertension, preexisting diabetes, chronic heart disease, chronic kidney disease and HIV or AIDS using International Classification of Diseases 9th Revision, Clinical Modification (ICD-9-CM) codes defined in prior work.\textsuperscript{17} We identified substance use disorders using published Healthcare Cost and Utilization Project algorithms.\textsuperscript{18} Pulmonary hypertension was defined using ICD-9-CM codes 416.0x, 416.8x, 416.9x; SLE was defined with ICD-9-CM code 710.0; and depression was defined with ICD-9-CM codes 296.2x 296.3x, 300.4x, and 311.

We first used weighted frequencies to describe sociodemographic characteristics across each racial and ethnic category. Differences were compared statistically using Pearson χ² tests.

We then estimated the prevalence of each category of chronic conditions per 10,000 delivery hospitalizations across each racial and ethnic category using adjusted logistic regression models and predictive margins. Adjusted rate ratios and rate differences were calculated using the \textit{adjrr} command in Stata.\textsuperscript{19} Rate ratios are a measure of relative disparity that can be easily transformed into a percentage difference by multiplying the ratio by 100. In the context of health disparities, rate differences, the absolute disparity between two rates, are also often used to compare the health of a less advantaged social group to more advantaged.\textsuperscript{20} The same methods were used to calculate incidence rates and adjusted rate ratios and rate differences for severe maternal morbidity across each racial and ethnic category.

We estimated the excess incidence of severe maternal morbidity among racial and ethnic minority women compared with non-Hispanic white women by dividing the weighted number of affected observations by the incidence rate ratio (compared with non-Hispanic white women) and then subtracting these estimates from the total number of weighted cases of severe maternal morbidity for each racial and ethnic minority category. This process was repeated to calculate excess cases of blood transfusion, the most frequent indicator of severe maternal morbidity, among delivering mothers annually in the United States.

To test the hypothesis that differences in severe maternal morbidity reflect increased case morbidity rates among racial and ethnic minority women, particularly non-Hispanic black women, in addition to increased prevalence of comorbid chronic conditions when compared with non-Hispanic white women, we estimated the incidence of severe maternal morbidity across deliveries in which no chronic conditions, any (one or greater) physical health condition (of conditions examined: asthma, hypertension, diabetes, heart disease, kidney disease, SLE, HIV or AIDS, pulmonary hypertension), any (one or greater) behavioral health condition (of conditions examined: depression, substance use disorder), and multiple (two or greater) chronic conditions were identified. We present the incidence of severe maternal morbidity among women with any physical or behavioral health condition, as opposed to for each of the individual condition listed, because the unweighted number of cases of severe maternal morbidity was low within each racial and ethnic category for a number of conditions, resulting in unstable estimates. Again, we used the \textit{adjrr} command to calculate rate ratios and rate differences across categories of severe morbidity.

We adjusted all models for age, primary insurance payer, median household income for the patient’s ZIP code, rural compared with urban residence, and hospital census region unless otherwise noted. We weighted all results to allow for nationally representative inferences unless otherwise noted. In 2015, ICD-9-CM diagnoses codes were available only for the first three quarters. We adjusted the survey weights in 2015 to generate annualized estimates from the first three quarters of data. We conducted all analyses using STATA 14.2 with two-sided \textit{p} values < .01 considered statistically significant. The University of Michigan Medical School institutional review board determined that this analysis of deidentified data was exempt from review. All analyses comply with the seven methodologic principles recommended when working with data from the National Inpatient Sample.\textsuperscript{21}

RESULTS
The sample consisted of 2,523,528 unweighted delivery hospitalizations among non-Hispanic white (n = 1,417,559), non-Hispanic black (n = 385,031), Hispanic (n = 550,771), Asian or Pacific Islander (n = 149,720), and Native American or Alaska Native
women, representing an estimated 13,464,214 deliveries occurring nationally between 2012 and 2015. In total, 40,873 unweighted cases of severe maternal morbidity were identified among non-Hispanic white (n = 18,878), non-Hispanic black (n = 9,483), Hispanic (n = 9,687), Asian or Pacific Islander (n = 2,375), and Native American or Alaska Native (n = 450) women, representing 218,248 total cases of severe maternal morbidity.

Medicaid paid for approximately two thirds of all deliveries among non-Hispanic black (65.8%, 95% CI 65.0–66.5), Hispanic (64.3%, 95% CI 63.3–65.3), and Native American or Alaska Native (60.5%, 95% CI 57.8–63.1) women. In comparison, commercial insurance paid for nearly two thirds of all deliveries among non-Hispanic white women (62.1%, 95% CI 61.5–62.6) and Asian or Pacific Islander women (63.2%, 95% CI 61.4–63.0; Table 1). Cesarean deliveries comprised a higher proportion of deliveries among non-Hispanic black women compared with all other racial and ethnic categories (36.0%, 95% CI 35.8–36.3; P <.001 for each comparison).

Compared with deliveries among non-Hispanic white women, deliveries among non-Hispanic black women experienced a significantly higher prevalence of nearly every physical health condition examined: asthma, hypertension, diabetes, kidney disease, SLE, HIV or AIDS, and pulmonary hypertension (Appendix 2, available online at http://links.lww.com/AOG/B169). The largest absolute differences in prevalence rates among deliveries to non-Hispanic black compared with non-Hispanic white women were identified for diagnoses of hypertension, asthma, and diabetes (rate ratio [RR] 2.5 [2.4–2.6], difference 312.5 [95% CI 300.6–324.4]; RR 1.5 [1.4–1.5], rate difference 198.1 [95% CI 181.2–215.0]; and RR 1.6 [1.5–1.7], rate difference 55.9 [95% CI 50.5–61.2] per 10,000 delivery hospitalizations, respectively; P <.001 for each comparison.

Table 1. Sociodemographic Characteristics of Delivering Women by Race and Ethnicity, United States, 2012–2015 (N = 2,523,528)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Non-Hispanic White (n = 1,417,559)</th>
<th>Non-Hispanic Black (n = 385,031)</th>
<th>Hispanic (n = 550,771)</th>
<th>Asian or Pacific Islander (n = 149,720)</th>
<th>Native American or Alaska Native (n = 20,447)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y; weighted mean)</td>
<td>28.6 (28.5–28.7)</td>
<td>26.6 (26.6–26.7)</td>
<td>27.4 (27.4–27.5)</td>
<td>31.1 (31.0–31.2)</td>
<td>27.0 (26.7–27.2)</td>
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<tr>
<td>Insurance payer</td>
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<tr>
<td>Medicaid</td>
<td>32.9 (32.4–33.4)</td>
<td>65.8 (65.0–66.5)</td>
<td>64.3 (63.3–65.3)</td>
<td>28.3 (26.9–29.9)</td>
<td>60.5 (57.8–63.1)</td>
</tr>
<tr>
<td>Commercial</td>
<td>62.1 (61.5–62.6)</td>
<td>30.0 (29.2–30.8)</td>
<td>29.1 (28.1–30.1)</td>
<td>63.2 (61.4–65.0)</td>
<td>32.8 (30.1–35.6)</td>
</tr>
<tr>
<td>Uninsured Income</td>
<td>5.0 (4.9–5.2)</td>
<td>4.3 (4.1–4.5)</td>
<td>6.6 (6.2–7.0)</td>
<td>8.5 (7.2–9.9)</td>
<td>6.8 (5.7–8.0)</td>
</tr>
<tr>
<td>Bottom quartile*</td>
<td>21.9 (21.4–22.5)</td>
<td>49.2 (48.1–50.3)</td>
<td>37.6 (36.4–38.9)</td>
<td>13.2 (12.2–14.2)</td>
<td>40.9 (37.7–44.1)</td>
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<td>Residence</td>
<td></td>
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<tr>
<td>Rural</td>
<td>19.2 (18.7–19.7)</td>
<td>7.8 (7.3–8.3)</td>
<td>6.4 (6.0–6.8)</td>
<td>3.8 (3.2–4.5)</td>
<td>34.6 (31.7–37.7)</td>
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<td>Hospital region</td>
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<tr>
<td>Northeast</td>
<td>17.8 (17.0–18.6)</td>
<td>16.0 (14.9–17.1)</td>
<td>12.4 (11.6–13.2)</td>
<td>19.7 (17.8–21.8)</td>
<td>7.3 (6.4–8.4)</td>
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<td>Midwest</td>
<td>24.3 (23.5–25.1)</td>
<td>19.0 (17.8–20.3)</td>
<td>7.4 (6.8–8.1)</td>
<td>10.9 (9.9–11.9)</td>
<td>17.8 (15.0–21.0)</td>
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<td>South</td>
<td>38.8 (37.9–39.8)</td>
<td>56.4 (54.8–57.9)</td>
<td>37.8 (36.3–39.4)</td>
<td>21.9 (20.2–23.6)</td>
<td>29.0 (25.8–32.4)</td>
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<tr>
<td>West</td>
<td>19.1 (18.5–19.9)</td>
<td>8.7 (8.1–9.3)</td>
<td>42.4 (40.9–44.0)</td>
<td>47.5 (44.9–50.1)</td>
<td>45.9 (41.5–50.4)</td>
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<tr>
<td>Mode of delivery</td>
<td></td>
<td></td>
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<tr>
<td>Cesarean</td>
<td>32.7 (32.5–32.8)</td>
<td>36.0 (35.8–36.3)</td>
<td>32.8 (32.4–33.1)</td>
<td>33.0 (32.6–33.5)</td>
<td>30.7 (29.7–31.7)</td>
</tr>
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</table>

Data are weighted % (95% CI) unless otherwise specified.
* Represents patients living in a ZIP code with a median household income in the bottom national income quartile.
Deliveries among Native American or Alaska Native women also experienced a significantly higher prevalence of many conditions, including hypertension, diabetes, kidney disease, and SLE (P<.01 for each comparison), compared with deliveries among non-Hispanic white women. In contrast, only diabetes was identified at a higher prevalence among deliveries to Hispanic women compared with deliveries to non-Hispanic white women (P<.001 for each comparison). Deliveries to Asian or Pacific Islander women experienced either comparable or lower prevalence rates for each condition examined compared with deliveries among non-Hispanic whites.

The prevalence of substance use disorders among deliveries to Hispanic and Asian or Pacific Islander women was less than one fourth the rate identified among non-Hispanic white women (RR 0.18 [0.17–0.19], rate difference −772.3 [95% CI −792.1 to −752.4] and RR 0.17 [0.15–0.20], rate difference −777.4 [95% CI −804.3 to −750.6], respectively; P<.001 for each comparison) and the prevalence of substance use disorders among deliveries to non-Hispanic black women was approximately half the rate identified among deliveries to non-Hispanic white women: (RR 0.55 [95% CI 0.54–0.57], rate difference −419.4 [95% CI = −438.3 to −400.6]; P<.001 for each comparison). Depression was also identified at significantly higher prevalence among deliveries to non-Hispanic white women compared with deliveries in every other racial and ethnic category (P<.001 for each comparison).

Compared with deliveries among non-Hispanic white women, deliveries among all other racial and ethnic minority categories experienced a higher incidence of severe maternal morbidity (Fig. 1). The greatest difference was identified in comparing deliveries to non-Hispanic black with non-Hispanic white women: (RR 0.55 [95% CI 0.54–0.57], rate difference −419.4 [95% CI = −438.3 to −400.6]; P<.001 for each comparison). Depression was also identified at significantly higher prevalence among deliveries to non-Hispanic white women compared with deliveries in every other racial and ethnic category (P<.001 for each comparison).

Blood transfusion was the most frequent severe morbidity identified across all racial and ethnic groups. Blood transfusion alone accounted for nearly three fourths of all cases of severe morbidity, ranging from an incidence rate of 98.1 (95% CI 95.7–100.6) to 179.7 (95% CI 172.9–186.4) per 10,000 delivery hospitalizations among non-Hispanic white and non-Hispanic black women, respectively.

When excluding cases in which blood transfusion was the only indicator of severe maternal morbidity, only deliveries to non-Hispanic black women had a higher incidence of severe maternal morbidity compared with deliveries among non-Hispanic white women: 50.2 (95% CI 47.6–52.9) compared with 40.9 (95% CI 39.6–42.3) per 10,000 delivery hospitalizations (RR 1.2 [95% CI 1.2–1.3], rate difference 9.3 [95% CI 6.5–12.2] per 10,000 delivery hospitalizations; P<.001 for each comparison). Hysterectomy was the only severe morbidity other than blood transfusion that occurred at a higher incidence among deliveries to women in every racial and ethnic minority category compared with deliveries among non-Hispanic white women (see Appendix 4, available online at http://links.lww.com/AOG/B169).

Deliveries to non-Hispanic black women experienced significantly higher incidence of every severe morbidity examined compared with non-Hispanic white women (P<.01 for each comparison; Fig. 2).
The largest absolute differences were identified for heart failure (RR 1.8 [95% CI 1.6–2.0], rate difference 8.0 [95% CI 6.3–9.7]); ventilation (RR 2.5 [95% CI 2.1–2.8], rate difference 6.2 [95% CI 5.0–7.5]); acute renal failure (RR 2.6 [2.2–3.0], rate difference 6.0 [95% CI 4.8–7.2]); acute respiratory distress syndrome (RR 2.0 [95% CI 1.6–2.3], rate difference 5.2 [95% CI 3.9–6.4]); and hysterectomy (RR 1.4 [1.3–1.6], rate difference 3.9 [95% CI 2.5–5.3]) per 10,000 delivery hospitalizations, respectively; \( P < .01 \) for each comparison.

Taken together, these data indicate that, if racial and ethnic minority women experienced severe maternal morbidity at the same rate as non-Hispanic white women, this would result in a 28% reduction in cases of severe maternal morbidity among racial and ethnic minority women (an estimated 8,102 fewer cases per year) and a 15% overall reduction in severe maternal morbidity. Non-Hispanic black women would see the greatest reduction, 41% (an estimated 5,212 fewer cases per year). With respect to blood transfusion specifically, if racial and ethnic minority women experienced blood transfusion at the same rate as non-Hispanic white women, this would result in a 28% reduction in cases of blood transfusion among racial and ethnic minority women (an estimated 6,456 fewer cases per year) and a 16% overall reduction in blood transfusion. Again, non-Hispanic black women would benefit the most, a reduction 41% (an estimated 4,177 fewer cases per year).

Among non-Hispanic white, non-Hispanic black, Hispanic, and Asian or Pacific Islander women, the incidence of severe maternal morbidity among deliveries complicated by physical health conditions, behavioral health conditions, and multiple chronic conditions was significantly higher compared with deliveries in which no chronic conditions were identified (Fig. 3). In almost all instances, racial and ethnic minority women experienced larger increases in severe maternal morbidity when multiple chronic conditions were identified, suggesting increased case morbidity. For instance, in comparing deliveries among non-Hispanic black with non-Hispanic white women, the rate difference for severe maternal morbidity incidence increased from 77.9 (95% CI 70.9–84.9) to 216.9 (95% CI 169.1–264.5) per 10,000 delivery hospitalizations, respectively, in comparing deliveries in which no and multiple chronic conditions were identified (\( P < .001 \); Appendix 5, available online at http://links.lww.com/AOG/B169).

**DISCUSSION**

This study quantifies the magnitude of racial and ethnic disparities in the prevalence of chronic conditions among delivering women by race and ethnicity and the differential risk associated with co-morbidity and multimorbidity among deliveries to racial and ethnic minority women. Overall severe maternal morbidity, blood transfusion, and hysterectomy were identified at significantly higher frequency across all racial and ethnic minority categories, findings generally consistent with disparities identified in
Creanga et al’s\textsuperscript{16} analysis of 2008–2010 data from seven states. These data suggest that, if racial and ethnic minority women incurred blood transfusions at the same incidence as non-Hispanic white women, this would result in a 41% reduction in blood transfusion among non-Hispanic black women alone (an estimated 4,177 fewer cases per year). Blood transfusions at the time of delivery are often associated with obstetric hemorrhage. A significant proportion of obstetric hemorrhages are considered preventable,\textsuperscript{22} and improved quality of care is considered a key factor in prevention of maternal morbidity and mortality.\textsuperscript{23} The implementation of safety bundles such as the AIM Program’s Obstetric Hemorrhage Bundle\textsuperscript{24} and protocols such as the maternal early warning criteria\textsuperscript{25,26} are actionable steps that could be taken to reduce racial and ethnic disparities in obstetric hemorrhage.\textsuperscript{27}

Disparities will not be eliminated by improved quality of care alone, however, and additional study is needed regarding indications for blood transfusions among racial and ethnic minority women. For example, racial and ethnic minority women have higher rates of iron deficiency anemia and it is unclear to what degree chronic anemia, which is poorly coded in this administrative dataset, contributes to the higher rates of peripartum blood transfusion identified in the present study.\textsuperscript{28} Finally, cesarean hysterectomy is driven by prior cesarean delivery. Efforts to support intended vaginal birth among racial and ethnic minority women with help reduce cesarean hysterectomies in future pregnancies.

The increasing contribution of behavioral health conditions to cases of maternal death has recently been identified as an emerging concern by several state maternal mortality review committees and in a landmark report from the CDC Foundation, Building U.S. Capacity to Review and Prevent Maternal Deaths: Report from Nine Maternal Mortality Review Committees.\textsuperscript{29–32} The findings of this study reveal lower prevalence of behavioral health conditions among deliveries to racial and ethnic minority women, but higher case morbidity when these conditions are identified. Racial and ethnic disparities in screening and referral to treatment for maternal behavioral health conditions are understudied, but have been identified with marked consistency across a wide variety of health care services, including within obstetric care.\textsuperscript{33,34} Health systems must use universal screening and referral to evidence-based treatment for affected individuals.\textsuperscript{27} As with other chronic conditions, this should involve examining system-level disparities in current screening and referral practices. In addition, clinicians must advocate for eliminating structural disparities in access to care through
improving gaps in insurance benefits design and eligibility that may disproportionately affect racial and ethnic minority women.35

The findings of this study also support the need for enhanced screening and timely treatment for racial and ethnic minority women with chronic physical health conditions and particularly for women with multiple chronic conditions.16,36 In other areas of adult medicine, care management programs have helped improve outcomes and lower costs, among other high-risk populations.37 Future work should examine the cost-effectiveness of expanding maternity care management programs that integrate services from preconception planning through the first year postpartum, particularly among women with high-risk and multiple chronic conditions as another mechanism through which racial and ethnic disparities in maternal morbidity and mortality may be mitigated.

Our findings should be interpreted considering the limitations of our data source and study design. First, we acknowledged that it is possible some women underwent more than one delivery in the study period and each discharge record may not reflect a unique woman. As such, the unit of analysis is a delivery hospitalization, not an individual woman. Second, claims that do not generate a specific payment such as ICD-9-CM codes for chronic conditions may be associated with low sensitivity. As a result, our point estimates for clinical conditions are likely to be conservative. Next, for some categories of severe morbidity, only a small number of cases were identified because these clinical events are rare. As a result, the CIs around point estimates for some categories of conditions, particularly among deliveries to Native American or Alaska Native women, are wide. Finally, we were unable to adjust for certain obstetric risk factors (such as prenatal care access and use, presence of labor before cesarean delivery, or obesity) and certain hospital characteristics. Obesity in particular is an important predictor of maternal morbidity38 and is detected with low sensitivity in this administrative data set.39 Finally, recent work revealed that most deliveries among non-Hispanic black women occur in a concentrated set of hospitals that have higher rates of severe maternal morbidity.40 Although we cannot completely account for this issue, our findings can, nonetheless, inform the design and delivery of efforts to address severe maternal morbidity among racial and ethnic minority women.

In summary, we found substantial racial and ethnic disparities in overall severe maternal morbidity among deliveries to non-Hispanic black, Hispanic, Asian or Pacific Islander, and Native American or Alaska Native compared with non-Hispanic white women. This was largely driven by blood transfusion, yet disparities remained when excluding cases in which blood transfusion was the only severe morbidity identified. Among deliveries to women with comorbid physical and behavioral health conditions, higher case morbidity was identified among racial and ethnic minority women, and the largest disparities were identified among women with multiple chronic conditions.

REFERENCES

14. National Center for Health Statistics, Centers for Disease Control and Prevention. NCHS urban-rural classification scheme...


