Obstetric Outcomes and Delivery-Related Health Care Utilization and Costs Among Pregnant Women With Multiple Chronic Conditions

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Abstract

Our objective was to measure obstetric outcomes and delivery-related health care utilization and costs among pregnant women with multiple chronic conditions. We used 2013–2014 data from the National Inpatient Sample to measure obstetric outcomes and delivery-related health care utilization and costs among women with no chronic conditions, 1 chronic condition, and multiple chronic conditions. Women with multiple chronic conditions were at significantly higher risk than women with 1 chronic condition or no chronic conditions across all outcomes measured. High-value strategies are needed to improve birth outcomes among vulnerable mothers and their infants.

Objective

Complications from chronic conditions are a key driver of rising obstetric morbidity and mortality in the United States (1). The prevalence of chronic conditions, including multiple chronic conditions (MCCs), continues to rise among childbearing women (2,3). MCCs, defined as 2 or more chronic conditions, are associated with worse health outcomes, including death, and higher levels of health care utilization and costs among the non-pregnant adult population (4). Understanding these data influenced the development of high-value programs that improved health outcomes and lowered costs in high-risk, high-cost populations (5). Our objective was to measure obstetric outcomes and delivery-related health care utilization and costs among pregnant women with MCCs.

Methods

We conducted a retrospective, cross-sectional analysis of 2013–2014 data from the National Inpatient Sample (6), a nationally representative sample of hospital discharges in the United States. Deliveries were identified by using previous methods (7), and data for chronic conditions were abstracted by using relevant codes from the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) (8) (Box). We included 8 chronic conditions that are prevalent in the childbearing population and associated with obstetric morbidity and mortality: chronic respiratory disease, chronic hypertension, substance use disorders, pre-existing diabetes, chronic heart disease, chronic kidney disease, human immunodeficiency virus/acquired immune deficiency syndrome, and chronic liver disease (3,9).
Obstetric outcomes included preterm delivery, cesarean delivery, and severe maternal morbidity and mortality. Preterm delivery was measured by using ICD-9-CM code 644.21, and cesarean delivery was measured by using ICD-9-CM codes 740.x, 741.x, 742.x, 744.x, and 749.9. Severe maternal morbidity was measured by using standardized diagnosis and procedure codes outlined by the Centers for Disease Control and Prevention (10). Health care utilization measures included need for hospital transfer and length of stay. Delivery-associated hospital charges from the Healthcare Cost and Utilization Project’s cost-to-charge ratio files were used to calculate costs. Charge and cost estimates were adjusted for inflation to 2014 dollars.

We used multivariable logistic regression models to estimate obstetric outcomes. We generated estimates for hospital transfer, length of stay, and costs by using multivariable Poisson regression models, because these data were not normally distributed (Shapiro–Wilk test, $P < .001$ for each). All estimates were population averages generated with post-regression predictive margins and tabulated per 100 delivery hospitalizations. Models were adjusted for age, rural versus urban residence, primary insurance payer, median household income for the patient’s zip code, and hospital region. In sensitivity analyses of our cost estimates, we adjusted for age, rural versus urban residence, primary insurance payer, median household income for the patient’s zip code, and severity of health care utilization.

In this nationally representative sample of delivery hospitalizations from 2013–2014, women with MCCs had worse health outcomes, higher levels of health care utilization, and greater hospital costs associated with obstetric delivery compared with women with no chronic conditions or 1 chronic condition. In particular, the rate of severe maternal morbidity and mortality was 276% higher among women with MCCs than among women with no chronic condition or 1 chronic condition (Table 2). The rate of severe maternal morbidity and mortality among women with MCCs (6.4 per 100 delivery hospitalizations) was nearly 4 times higher than among women with no chronic conditions (1.7 per 100 delivery hospitalizations). Similarly, health care utilization and costs were highest among women with MCCs compared with those with no chronic condition or 1 chronic condition, even after controlling for obstetric outcomes and length of stay (Table 3). Women with 1 chronic condition were also at significantly higher risk than women with no chronic conditions across each outcome measured.

Discussion

In this nationally representative sample of delivery hospitalizations from 2013–2014, women with MCCs had worse health outcomes, higher levels of health care utilization, and greater hospital costs associated with obstetric delivery compared with women with no chronic conditions or 1 chronic condition. In particular, the rate of severe maternal morbidity and mortality was 276% higher among women with MCCs than among women with no chronic conditions. Hospital costs were highest among patients with MCCs compared with those with no chronic condition or 1 chronic condition — even after even after controlling for obstetric outcomes and length of stay. It is plausible that higher costs may have resulted from greater use of consultative or social services, data that were not captured by our methods.
A limitation of our study design is that clinicians were likely to document ICD-9-CM codes only for conditions that were addressed during a delivery hospitalization. As such, our point estimates of MCC prevalence are likely to be conservative. For example, some women with MCCs may have been misclassified as having 1 chronic condition or no chronic conditions. Total costs associated with MCCs are also likely to be larger than our estimates. For example, women with MCCs had higher rates of preterm delivery, and considerable neonatal costs are associated with preterm birth (11).

Our findings show that pregnant women with MCCs are a high-risk, high-cost population. The strong association between MCCs and worse delivery-related health outcomes found in our study suggests that MCCs may contribute to the high levels of maternal morbidity and mortality in the United States. MCCs also contribute significantly to the cost of delivery hospitalizations. Delineating the highest-risk and highest-cost combinations of conditions may provide crucial data for the development of high-value strategies to improve birth outcomes among these vulnerable mothers and their infants.

Acknowledgments

This article was supported by the National Clinician Scholars Program at the University of Michigan Institute for Healthcare Policy and Innovation and the US Department of Veterans Affairs. The authors report no conflicts of interest. Vanessa Dalton is a paid expert witness for Bayer. Michele Heisler is supported by National Institutes of Health grant no. P30 DK092926. The funder had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

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Table 1. Characteristics of Patients With No Chronic Conditions, 1 Chronic Condition, and Multiple Chronic Conditions (Unweighted \( N = 1,508,413 \)), National Inpatient Sample, 2013–2014\(^a\)

| Characteristic          | No Chronic Conditions  | 1 Chronic Condition | Multiple (≥2) Chronic Conditions |
|-------------------------|------------------------|---------------------|---------------------------------|
|                         | (\( n = 1,368,496 \)) | (\( n = 127,350 \)) | (\( n = 12,567 \))             |
| Mean age\(^b\), y       | 28.2 (28.1–28.3)       | 28.5 (28.5–28.6)    | 30.2 (30.0–30.3)                |
| Payer                   |                        |                     |                                 |
| Medicaid                | 42.9 (42.1–43.7)       | 53.2 (52.3–54.1)    | 63.8 (62.5–65.1)                |
| Private                 | 51.3 (50.5–52.2)       | 42.4 (41.4–43.3)    | 32.2 (30.9–33.5)                |
| Uninsured               | 5.8 (5.5–6.0)          | 4.4 (4.2–4.7)       | 4.0 (3.6–4.4)                   |
| Bottom income quartile\(^c\) | 27.1 (26.3–27.9) | 33.4 (32.4–34.5) | 40.4 (38.9–41.9) |
| Rural residence         | 14.1 (13.6–14.5)       | 14.6 (14.0–15.3)    | 13.7 (12.8–14.6)                |
| Hospital region         |                        |                     |                                 |
| Northeast               | 15.9 (15.2–16.7)       | 17.6 (16.6–18.7)    | 17.2 (15.7–18.8)                |
| Midwest                 | 21.2 (20.4–22.0)       | 22.1 (21.0–23.1)    | 22.2 (20.7–23.9)                |
| South                   | 38.4 (37.4–39.5)       | 38.3 (37.0–39.6)    | 39.9 (38.0–41.9)                |
| West                    | 24.5 (23.6–25.4)       | 22.0 (21.0–23.1)    | 20.6 (19.3–22.0)                |

\(^a\) All data presented as weighted percentage (95% confidence interval) unless otherwise noted.

\(^b\) Weighted mean (95% confidence interval).

\(^c\) Patients living in a zip code with a median household income in the bottom national income quartile.
### Table 2. Weighted National Estimates of Delivery-Related Outcomes Among Patients With No Chronic Conditions, 1 Chronic Condition, and Multiple Chronic Conditions, National Inpatient Sample, 2013–2014

| Outcome                                           | No Chronic Conditions | 1 Chronic Condition | Multiple (≥2) Chronic Conditions |
|---------------------------------------------------|-----------------------|---------------------|----------------------------------|
| **Health outcomes**                               |                       |                     |                                  |
| Preterm delivery (<37 weeks)                      | 5.7 (5.6–5.7)         | 9.7 (9.5–10.0)      | 15.1 (14.4–15.9)                 |
| Cesarean delivery                                 | 31.9 (31.7–32.2)      | 41.2 (40.8–41.6)    | 53.3 (52.3–54.2)                 |
| Severe maternal morbidity and mortality           | 1.7 (1.7–1.7)         | 3.0 (2.8–3.1)       | 6.4 (5.9–6.8)                    |
| **Health care use**                               |                       |                     |                                  |
| Hospital transfer                                 | 1.1 (0.9–1.2)         | 2.0 (1.8–2.3)       | 3.5 (3.1–4.0)                    |
| Length of stay, in days                           | 2.6 (2.6–2.6)         | 3.1 (3.1–3.2)       | 4.3 (4.2–4.3)                    |
| **Health care expenditures, $**                  |                       |                     |                                  |
| Mean charges per delivery hospitalization         | 16,000 (16,000–17,000) | 20,000 (19,000–20,000) | 28,000 (27,000–29,000)            |
| Mean cost per delivery hospitalization            | 4,500 (4,400–4,500)   | 5,600 (5,500–5,600) | 7,700 (7,500–8,000)              |

- All data presented as rate per 100 delivery hospitalizations (95% confidence interval) unless otherwise noted. Adjusted for age, rural vs urban residence, payer, national income quartile for zip code of residence, and hospital region.
- Weighted mean (95% confidence interval).
- Inflation-adjusted to 2014 US dollars.
Table 3. Weighted National Estimates of Mean Cost (95% CI)a per Delivery Hospitalization Among Patients With No Chronic Condition, 1 Chronic Condition, and Multiple Chronic Conditions, National Inpatient Sample, 2013–2014

| Model Adjustment                      | No Chronic Conditions | 1 Chronic Condition | Multiple (≥2) Chronic Conditions |
|--------------------------------------|-----------------------|---------------------|---------------------------------|
| Severe maternal morbidity and mortality | 4,500 (4,400–4,500)   | 5,500 (5,400–5,600) | 7,300 (7,100–7,500)             |
| Preterm delivery                     | 4,500 (4,400–4,500)   | 5,500 (5,400–5,600) | 7,400 (7,200–7,600)             |
| Cesarean delivery                    | 4,500 (4,400–4,600)   | 5,300 (5,200–5,400) | 6,900 (6,700–7,100)             |
| Length of stay                       | 4,500 (4,400–4,500)   | 5,500 (5,400–5,600) | 7,400 (7,200–7,600)             |
| All outcomes                         | 4,500 (4,500–4,600)   | 5,200 (5,100–5,200) | 6,200 (6,000–6,400)             |

Abbreviation: CI, confidence interval.
a Inflation-adjusted to 2014 US dollars.
b In addition to the following demographic covariates: age, rural vs urban residence, payer, national income quartile for zip code of residence, and hospital region.