The relationship between anemia and adverse obstetric and neonatal outcomes: *Implications for policy and practice*

Presenter: Sarah Gareau, DrPH
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ABOUT

USC Institute for Families in Society Authors:

Sarah Gareau, DrPH
Assistant Professor
MCH & Health Equity Evaluation Projects Team Lead

Chloe Rodriguez Ramos, MPH
Translation & Implementation Products
Coordinator

Kathy Mayfield-Smith, MBA, MA
Associate Director

Linga Murthy Kotagiri, MD, MPH
Senior Maternal and Child Health Data Manager

Ana López-De Fede, PhD
Distinguished Research Professor Emerita
Associate Director

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PRESENTER DISCLOSURE

Sarah Gareau, DrPH

(1) The following personal financial relationships with commercial interests relevant to this presentation existed during the past 12 months:

No relationships to disclose

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BACKGROUND

Previous studies have identified anemia as a risk factor for severe maternal morbidity (SMM), however, the variation in the association between anemia and SMM across different racial and ethnic groups, excluding hereditary anemias, remains less well understood.

A large-scale California study[1] revealed anemia was prevalent among minoritized birthing persons (approximately one in four), contributing to SMM disparities. Although routine prenatal CBC screening is recommended, clinical screening inconsistencies and patient delays to prenatal care exist.

1. Igbinosa, I. I., Leonard, S. A., Noelete, F., Davies-Balch, S., Carmichael, S. L., Main, E., & Lyell, D. J. (2023). Racial and Ethnic Disparities in Anemia and Severe Maternal Morbidity. *Obstetrics & Gynecology, 142(4),* 845-854.

OPEN

Original Research

Racial and Ethnic Disparities in Anemia and Severe Maternal Morbidity

Irogue I. Igbinosa, MD, Stephanie A. Leonard, PhD, Francecsa Noelette, BA, Shantay Davies-Balch, MBA, Suzan L. Carmichael, PhD, MS, Elliott Main, MD, and Deirdre J. Lyell, MD

OBJECTIVE: To evaluate antepartum anemia prevalence by race and ethnicity, to assess whether such differences contribute to severe maternal morbidity (SMM), and to estimate the contribution of antepartum anemia to SMM and nontransfusion SMM by race and ethnicity.

METHODS: We conducted a population-based cohort study using linked vital record and birth hospitalization data for singleton births at or after 20 weeks of gestation in California from 2011 through 2020. Pregnant patients with hereditary anemias, out-of-hospital births, unlinked records, and missing variables of interest were excluded.

Antepartum anemia prevalence and trends were estimated by race and ethnicity. Centers for Disease Control and Prevention criteria were used for SMM and nontransfusion SMM indicators. Multivariable logistic regression modeling was used to estimate risk ratios (RRs) for SMM and nontransfusion SMM by race and ethnicity after sequential adjustment for social determinants, parity, obstetric comorbidities, delivery, and antepartum anemia. Population attributable risk percentages were calculated to assess the contribution of antepartum anemia to SMM and nontransfusion SMM by race and ethnicity.

RESULTS: In total, 3,863,594 births in California were included. In 2020, Black pregnant patients had the high-

RESEARCH AIM

Objective:

This study sought to:

- Confirm whether the CA study findings held true in a Southeastern state, **South Carolina, where blood-related disorders are highly prevalent.** SC ranks 4th in the prevalence of sickle cell disease among Medicaid beneficiaries.[1]

- Explore the relationship between non-hereditary anemia and the following adverse maternal/neonatal outcomes:
  - SMM,
  - avoidable primary Cesarean (TJC-PC02),
  - low birthweight,
  - preterm birth, and
  - intensive care unit (ICU) admission.

1. Wilson-Frederick, S. M., Hulihan, M., & Anderson, K. K. (2019). Prevalence of sickle cell disease among Medicaid beneficiaries in 2012 (Data Highlight No. 16). CMS Office of Minority Health.

ANEMIA DEFINITION

Anemia is defined as any delivery with a diagnosis of non-hereditary anemia only, during the **pre-12 months or at the time of delivery**. Deliveries with **hereditary anemia** are **excluded** from the definition as these are not as modifiable as non-hereditary anemia cases, even if they had a diagnosis code for non-hereditary anemia.

Non-hereditary anemias were inclusive of the following ICD-10 codes:

❑ D50-D53 (Nutritional anemias including Iron deficiency, Vitamin B12 deficiency & Folate deficiency)
❑ D62-D64 (Anemia due to chronic diseases and acute blood loss)
❑ O990 (Anemias complicating pregnancy during any trimester)

Hereditary anemias **excluded** are:

❑ D55-D59 (Hemolytic anemias including Sickle Cell Disorders and Thalassemia)
❑ D60-D64 (Aplastic and other anemias due to bone marrow failure)

METHODS

Study Design: Retrospective cohort study.

Time Period: January 1, 2023 - December 31, 2023 (CY2023)

Exposure: Any non-hereditary anemia diagnosis from the year prior to delivery or at delivery.

Data Source

All-payer UB-04 (IP & ED)

Birth records
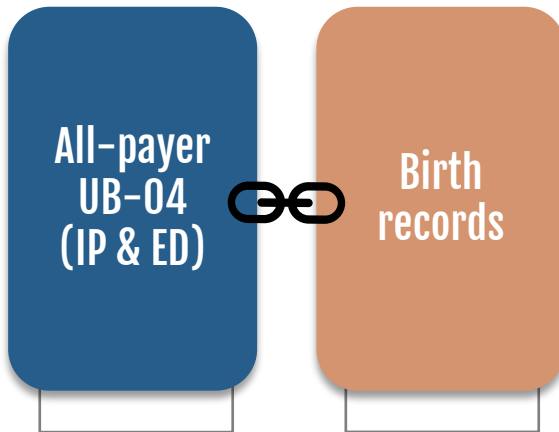
SC Revenue and Fiscal Affairs Office— Health and Demographics

SC Department of Public Health— Division of Biostatistics Vital Statistics

Outcomes:

- SMM excluding blood transfusions (20 conditions as per the current AIM definition)
- Avoidable primary Cesarean (TJC PC02)
- Low birthweight (from the birth record)
- Preterm birth (from the birth record)
- Intensive Care Unit (ICU) admission (UB-04 flag)

Confounders: Maternal age, race, payer, residence, prenatal care, pre-pregnancy BMI, parity, plurality, mode of delivery, and perinatal level.

Statistical Analysis: Multiple Logistic regression models and Cochran-Armitage trend tests.

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STUDY POPULATION

Total Deliveries

N=51,502

Birthing persons WITHOUT a diagnosis of anemia
N=34,717

Birthing persons WITH a diagnosis of anemia
N=16,785

1,587 cases of hereditary anemia excluded

Birthing persons WITHOUT a diagnosis of anemia, including hereditary anemia
N=36,304, 70%

Birthing persons WITH a diagnosis of anemia, EXCLUDING hereditary anemia
N=15,198, 30%

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FINDINGS: DELIVERY PROFILE

Approximately 1 in every 3 pregnant SC birthing persons (30%) had anemia, compared to 1 in 4 (25%) in the US.[1]
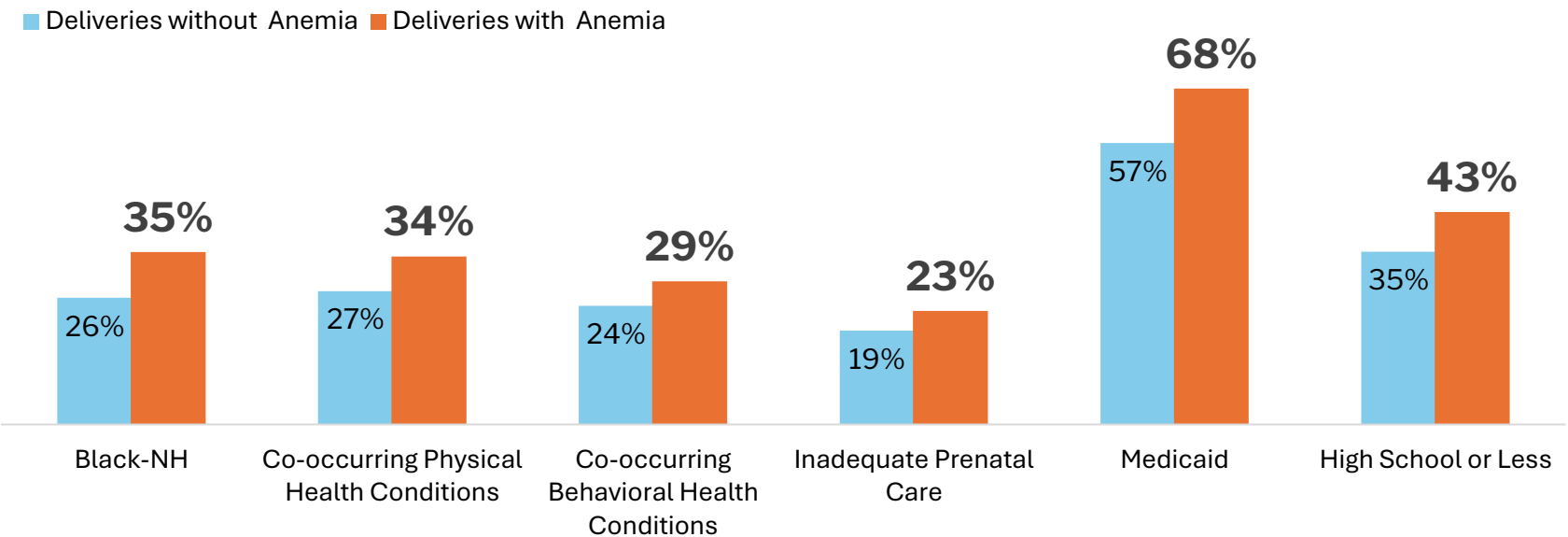

1. Kang, W., Irvine, C., Wang, Y., Clark, A., Gu, Z., Pressman, E., & O'Brien, K. O. (2023), Hemoglobin distributions and prevalence of anemia in a multiethnic United States pregnant population. *The American Journal of Clinical Nutrition*,*117(*6), 1320–1330.

These six characteristics exhibited the largest statistically significant differences (**p-value < 0.05**) between birthing individuals with anemia compared to those without:

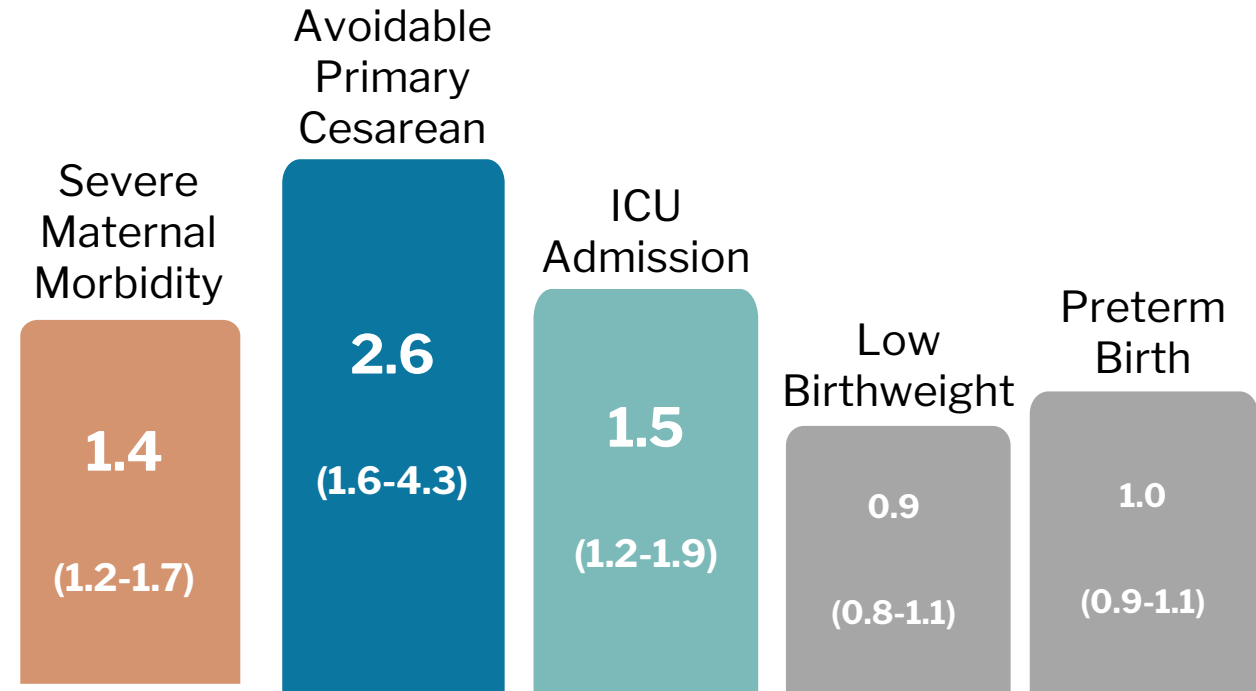### Anemia Delivery Characteristics

■ Deliveries without Anemia ■ Deliveries with Anemia

Characteristic	Without Anemia	With Anemia
Black-NH	26%	35%
Co-occurring Physical Health Conditions	27%	34%
Co-occurring Behavioral Health Conditions	24%	29%
Inadequate Prenatal Care	19%	23%
Medicaid	57%	68%
High School or Less	35%	43%

NOTE: Co-occurring physical health conditions is inclusive of any IP/ED claim during the 12 months prior to delivery, at the time of delivery, or during the 12 months postpartum with any cardiovascular disease (CVD), hypertension, diabetes, or obesity. Co-occurring behavioral health conditions is inclusive of any IP/ED claim during the 12 months prior to delivery, at the time of delivery, or during the 12 months postpartum with any substance use disorder or mental health condition.

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FINDINGS: ADVERSE MATERNAL OUTCOMES

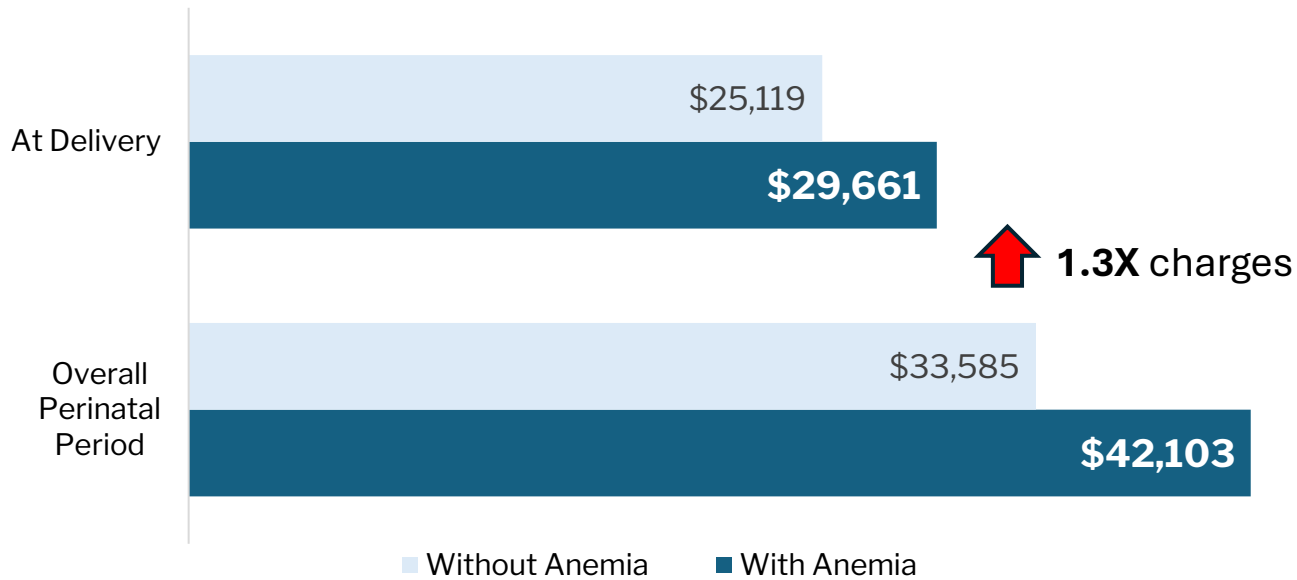Compared to those without anemia, birthing persons with anemia in the year prior to or at the time of delivery had:

- 40% higher odds of experiencing **severe maternal morbidity.**

- 160% higher odds of undergoing an **avoidable primary Cesarean.**

- 50% higher odds of having an **ICU admission**.

- **No higher odds** were identified for low birthweight and preterm births.

Severe Maternal Morbidity: **1.4** (1.2-1.7)

Avoidable Primary Cesarean: **2.6** (1.6-4.3)

ICU Admission: **1.5** (1.2-1.9)

Low Birthweight: **0.9** (0.8-1.1)
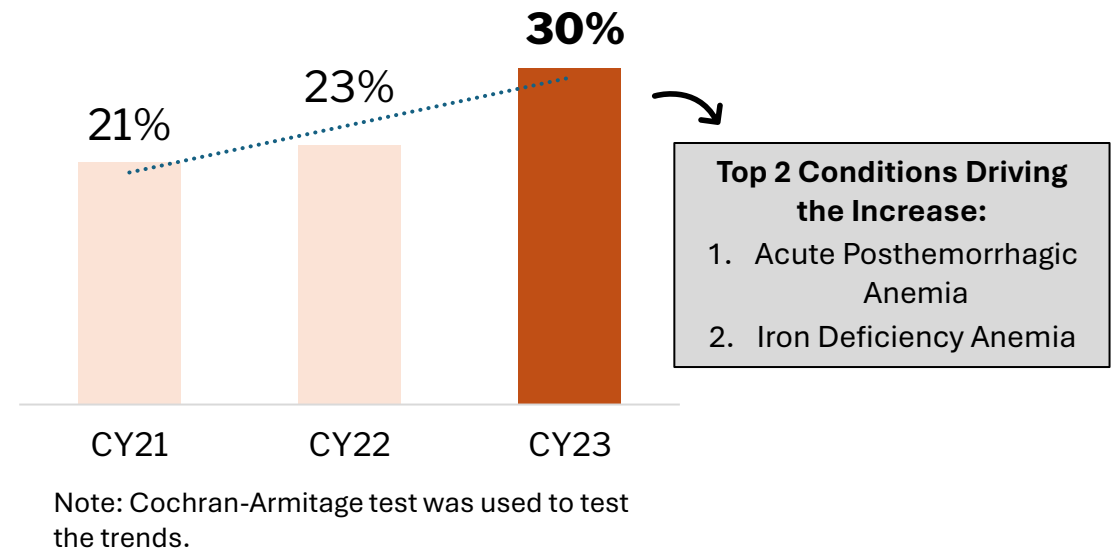
Preterm Birth: **1.0** (0.9-1.1)

Note: Logistic regression models were used to generate odds ratios and 95% confidence intervals adjusted for maternal race, age, payer, residence, parity, plurality, prenatal care, pre-pregnancy BMI, and mode of delivery .

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FINDINGS: COST AND TREND

Mean Charges

At Delivery
- $25,119 (Without Anemia)
- **$29,661** (With Anemia)

1.3X charges ↑

Overall Perinatal Period
- $33,585 (Without Anemia)
- **$42,103** (With Anemia)

■ Without Anemia ■ With Anemia

Anemia Trend (CY21-CY23)

- CY21: 21%
- CY22: 23%
- CY23: **30%**

Top 2 Conditions Driving the Increase:
1. Acute Posthemorrhagic Anemia
2. Iron Deficiency Anemia

Note: Cochran-Armitage test was used to test the trends.

Deliveries with anemia cost more compared to those without. Additionally, **anemia increased across all maternal characteristics** from CY21-CY23. Significant increases were observed among persons self-identifying as Black-NH or Hispanic, Medicaid beneficiaries, those less than 20 years of age, those who received inadequate prenatal care, and those who were underweight prior to pregnancy.

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STRENGTHS AND LIMITATIONS

STRENGTHS

- Large sample size that included all SC deliveries from calendar years 2021 to 2023 for trend tests and CY2023 for regression.

- Self-identified race and a racially diverse sample addressing the gap of underrepresentation of marginalized races in current literature.

- Included multiple adverse maternal health outcomes.

LIMITATIONS

- Potential for misclassification bias stemming from the use of ICD-10 codes to identify diagnoses.

- The causality of anemia is unclear, as we did not have access to medical/treatment records which would provide critical information regarding iron levels and hemoglobin measurements.

- Hereditary anemias, which are known to have a higher prevalence among SC birthing persons, were excluded from the study.

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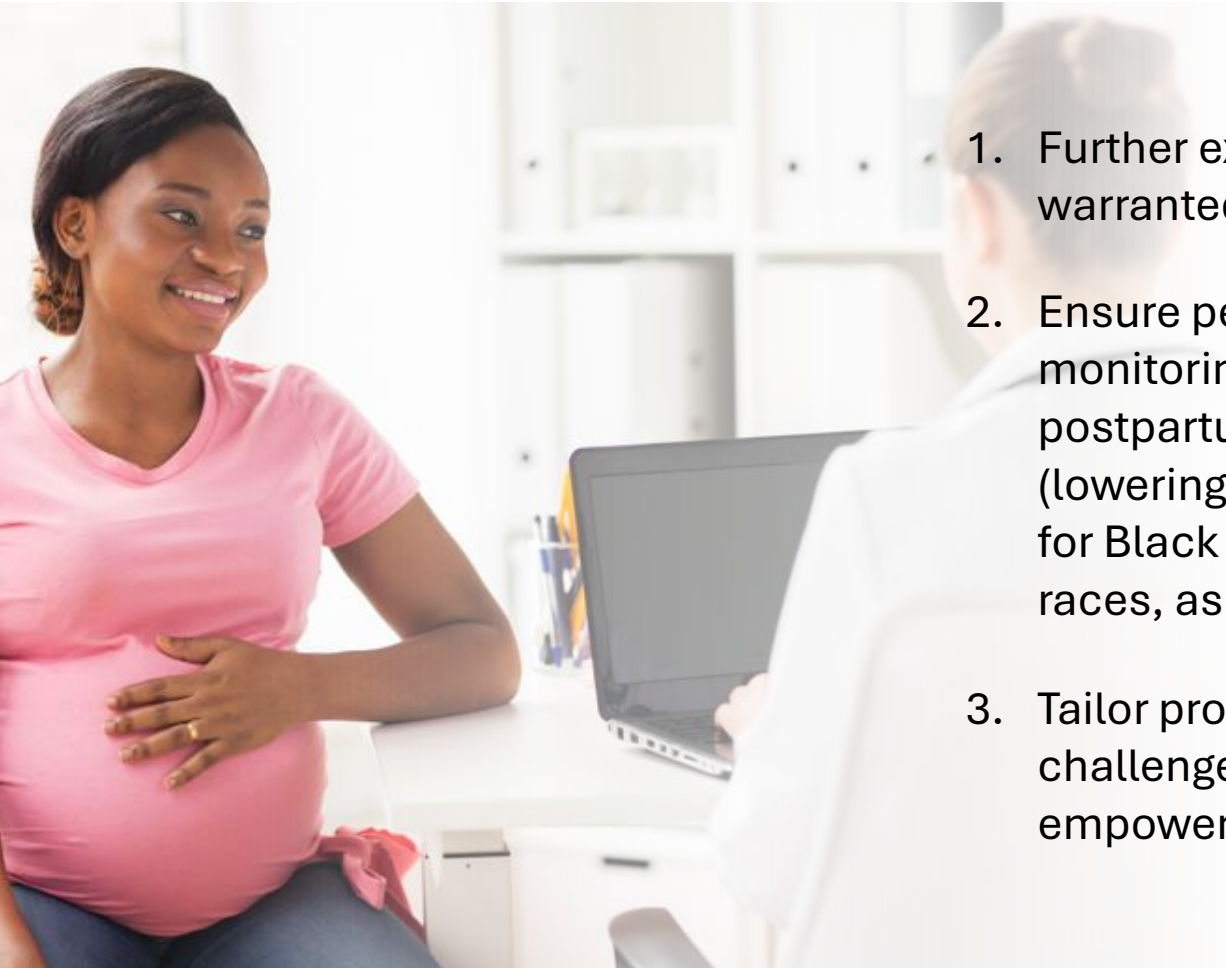*Strengthening Communities and Family Well-Being.*

CONCLUSION

- Our findings confirm the CA study.

- Anemia had a higher prevalence among:
    - Racial and ethnic minorities
    - Younger and low-income birthing persons facing social determinants of health

- Anemia resulted in higher adverse maternal outcomes and higher health care costs.

- More research is needed to assess the conditions driving the increase in anemia.

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POLICY IMPLICATIONS

1. Further examination of anemia as a driver of SMM, particularly by race, is warranted.

2. Ensure perinatal patients receive adequate anemia screening, monitoring, and treatment integration throughout pregnancy and postpartum. Emphasize recently updated **race-based guidelines** (lowering hemoglobin (Hb) cutoff levels for anemia diagnosis by 0.8g/dl for Black birthing persons to <10.2 g/dl compared to <11 g/dl for all other races, as suggested by ACOG).

3. Tailor programs to address the specific needs, cultural context and challenges faced by birthing persons self-identifying as Black-NH to empower them with knowledge/resources to manage anemia.

CONTACT

Sarah Gareau, DrPH

Assistant Professor
MCH & Health Equity Evaluation Projects Team Lead
USC Institute for Families in Society
gareau@mailbox.sc.edu

Institute for Families in Society
at the
University of South Carolina