



Stanford | **MEDICINE**
Dunlevie Maternal-Fetal Medicine
Center for Discovery, Innovation and Clinical Impact

CMQCC
California Maternal
Quality Care Collaborative

Measurement and Improvement Strategies for Reduction of Severe Maternal Morbidity: Experience from California and the United States

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California



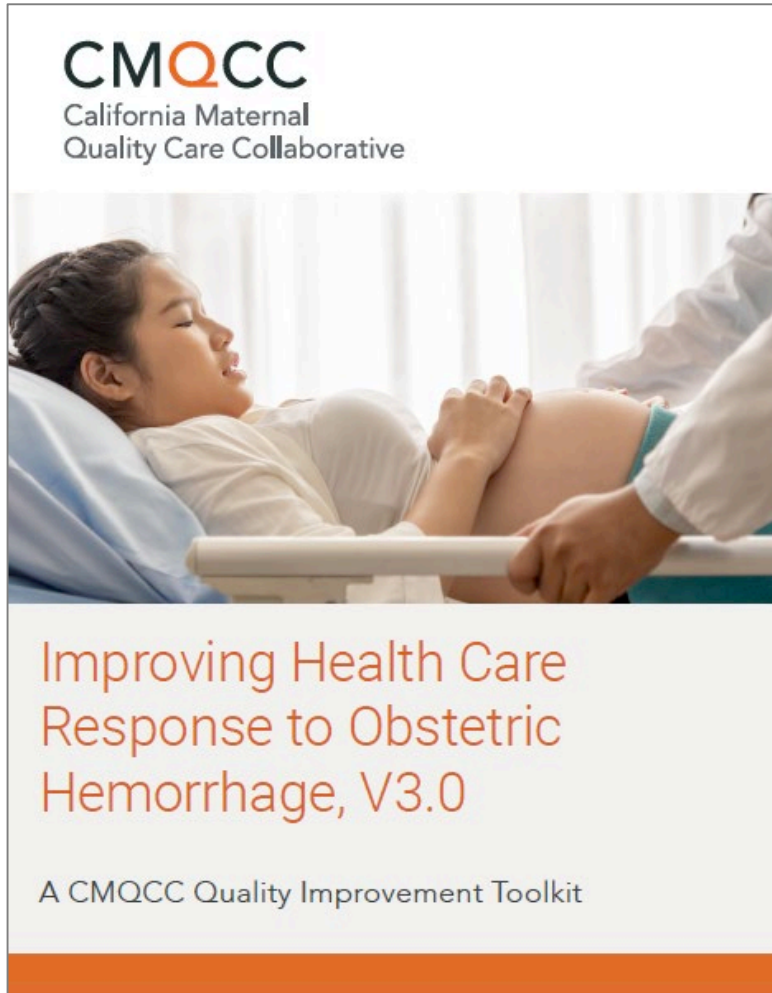
- Population: 40 million, largest US state
- 500→400k annual births (12% of all US births)
- 230→200 hospitals with maternity services
- Great diversity: races, industries, both large urban centers and rural areas

California Maternal Quality Care Collaborative

- Established in 2006
- Multi-stakeholder organization in partnership with CA Dept. of Public Health
- Developed and runs the state Maternal Mortality Review Committee with a focus on identifying QI opportunities
- Turned the findings into large-scale QI collaboratives (with 100+ hospitals at a time)



CMQCC Toolkits Provide Background Detail and Implementation Guidance



- Background and educational materials
- Sample policies, protocols, checklists
- 120-160 pages
- 6 Toolkits: HEM, HTN, VTE, Cesarean, Substance Use, Sepsis
- Used for state-wide QI collaboratives (and for individual hospital activities)

Open Source:

10,000--14,000 downloads each

Available at www.CMQCC.org

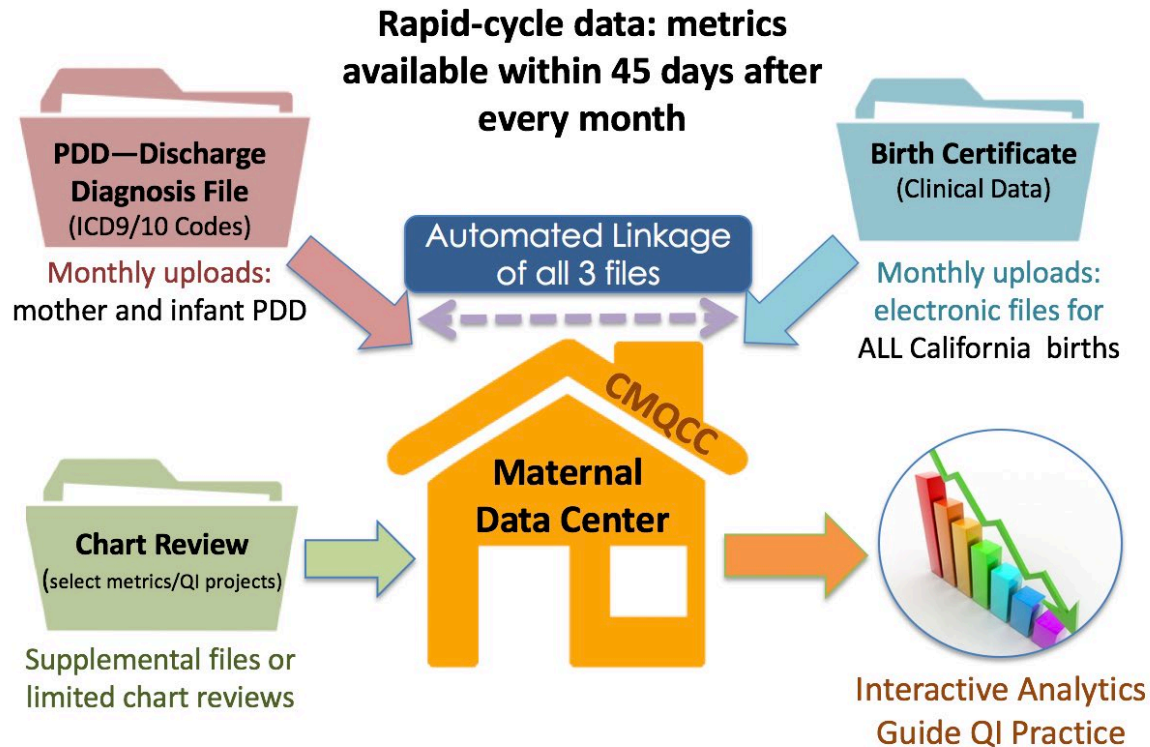


Lesson: Data Systems are Key for Large Scale QI Programs

- Collect outcome measures
- Low-cost, low-burden and fast turn-around
- Population and Hospital-level data
- Intersection of Public Health and Clinical Data
- Measures you can collect are entirely dependent on your Measure Collection System



CMQCC Maternal Data Center



MDC Features

- Utilize currently collected data
- Calculate/Report/Benchmark quality metrics
- Support QI projects
- Rapid-cycle! (within 45-60 days)
- Biggest cost (and burden) for a large-scale QI project is data collection
- Highly user-friendly with extensive support

Our Mantra: "Free the Data"

- Initiated in 2012, now with monthly data from >300 hospitals in 5 states including **100% of CA hospitals**
- Links over 1,500,000 mother/baby records each year (>120,000 records linked every month)
- Low burden, Low Cost, **High Value**



Alliance for Innovation in
Maternal Health



Multi-disciplinary coalition
based at ACOG
and funded by HRSA/HHS

AIM was initially known as
The National Partnership
for Maternal Safety

The First AIM National Safety Bundle

Consensus Statement

National Partnership for Maternal Safety *Consensus Bundle on Obstetric Hemorrhage*

Elliott K. Main, MD, Dena Goffman, MD, Barbara M. Scavone, MD, Lisa Kane Low, PhD, CNM, Debra Bingham, DrPH, RN, Patricia L. Fontaine, MD, MS, Jed B. Gorlin, MD, David C. Lagrew, MD, and Barbara S. Levy, MD

Hemorrhage is the most frequent cause of severe maternal morbidity and preventable maternal mortality and therefore is an ideal topic for the initial national maternity patient safety bundle. These safety bundles outline critical clinical practices that should be implemented in every

contain sample resources and “Potential Best Practices” to assist with implementation.

(Obstet Gynecol 2015;126:155–62)

DOI: 10.1097/AOG.0000000000000869

Published in July 2015 simultaneously in 5 society journals: Obstetrics and Gynecology, Anesthesia, Nursing, Midwifery, and Family Medicine



AIM National Safety Bundles



Hemorrhage



Hypertension



Cesarean
Reduction



Cardiac
Conditions



Substance
Use



Mental
Health



Postpartum
Transitions



Obstetric
Sepsis

What are they?

- “Checklist” of items and practices for every birthing site (2-3 pages)
- Not a national protocol
- Facilities will modify content based on local resources
- Readiness
- Recognition & Prevention
- Response
- Reporting/Systems Learning
- Respectful and Equitable Care

<https://saferbirth.org/patient-safety-bundles/>



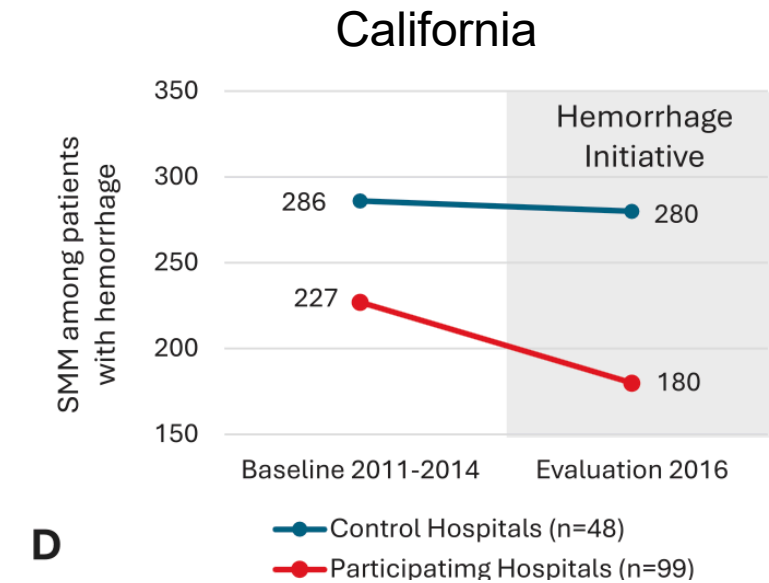
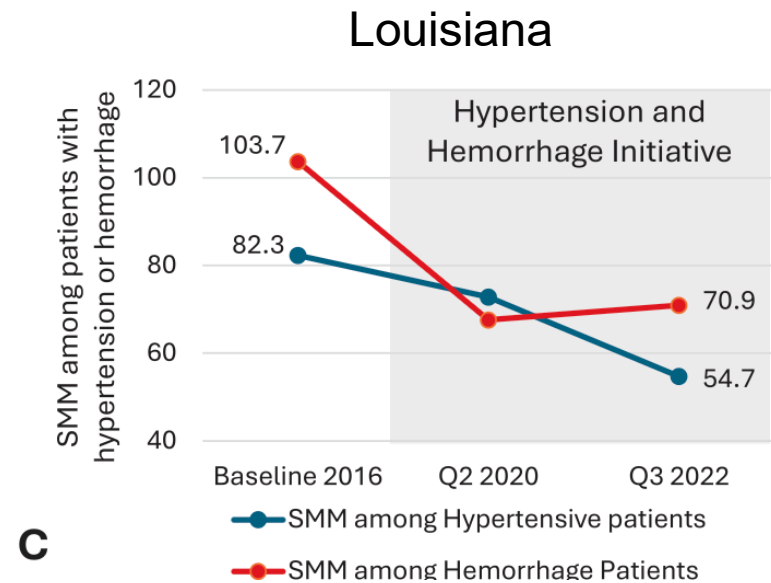
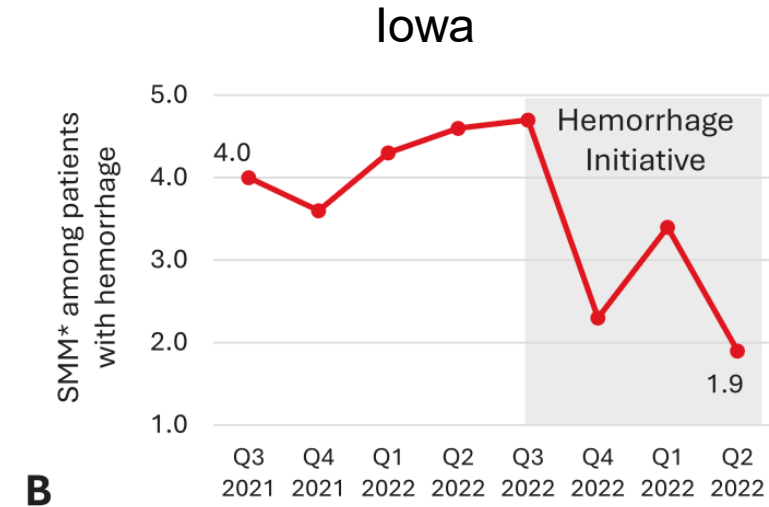
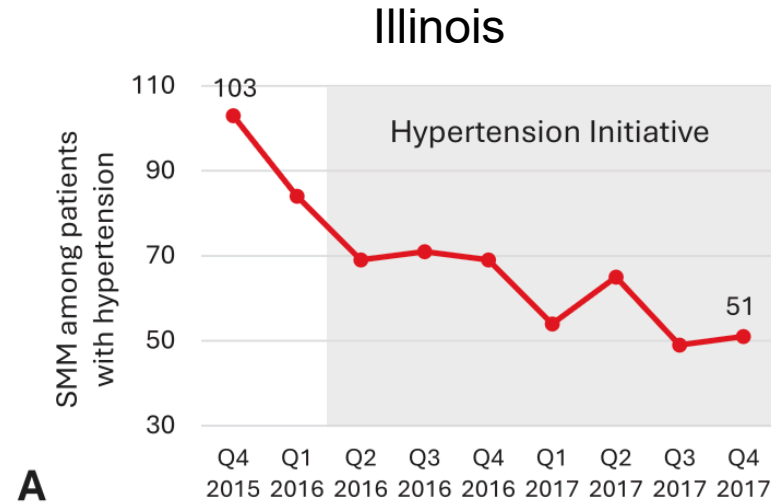
The Role of State Perinatal Quality Collaboratives in Addressing Maternal Morbidity and Mortality

Stephanie Radke, MD, MPH, Ann Borders, MD, MSc, MPH, Veronica Gillispie-Bell, MD, MAS, King, PhD, MSW, Elliott K. Main, MD, and Suzan L. Carmichael, PhD, MS

Obstet Gynecol 2026
Jun 1;147(6):769-779

Implementation of AIM bundles in 4 states

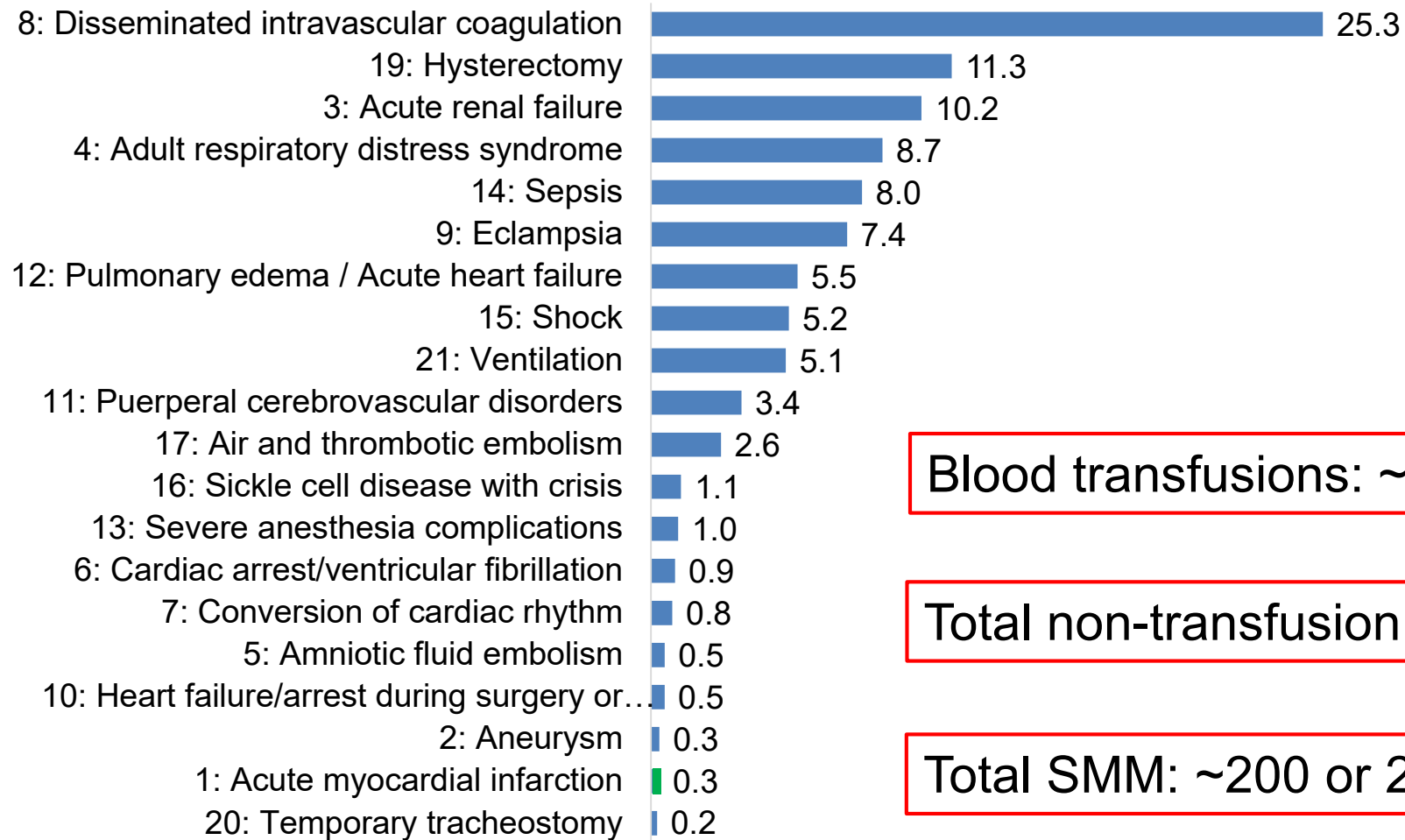
Key Outcome Metric: SMM among HEM or HTN patients





Rate of CDC SMM per 10,000 delivery hospitalizations by indicator, 2012-2019

21 indicators identified by ICD Codes (CDC 2008)



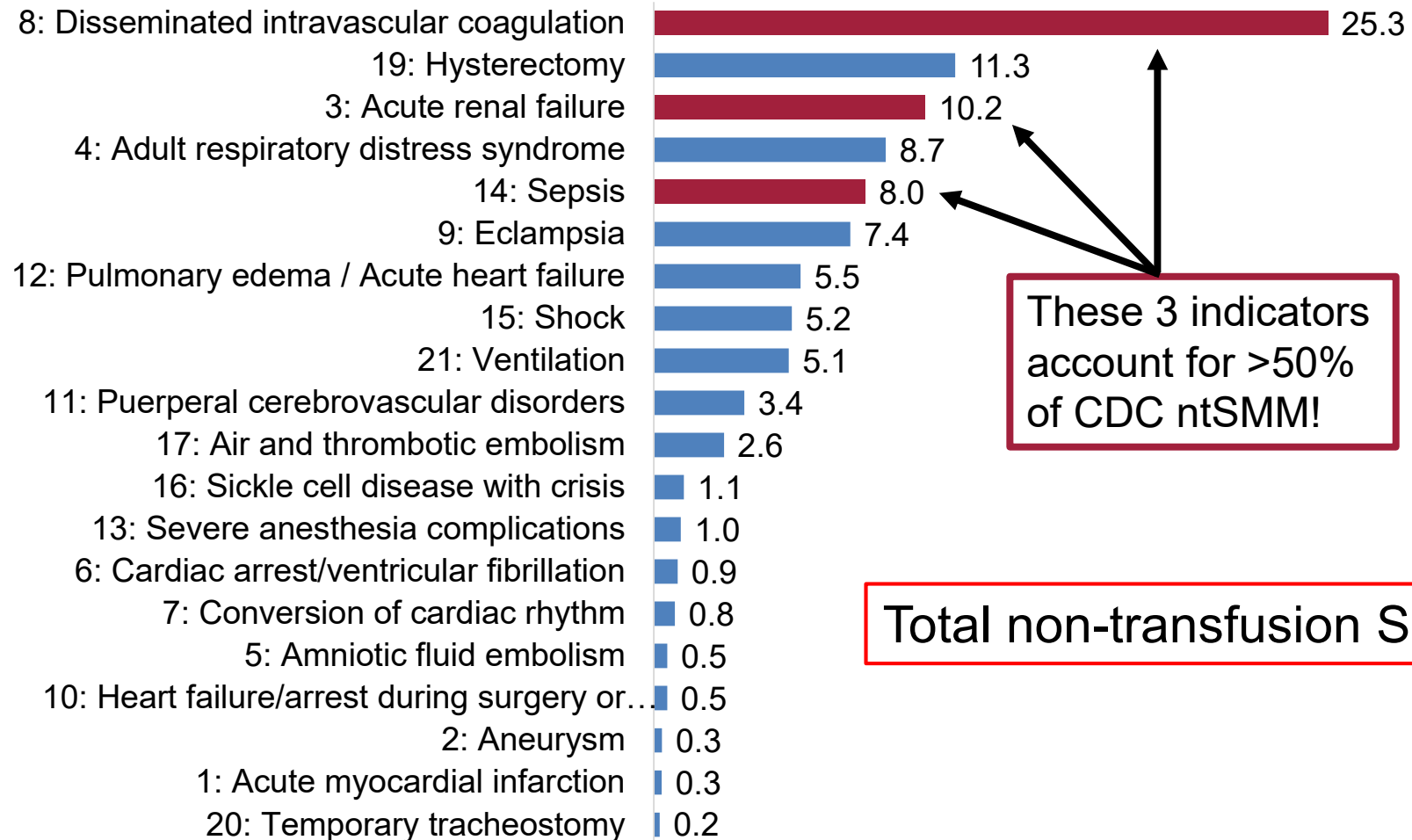
Blood transfusions: ~130

Total non-transfusion SMM: ~78

Total SMM: ~200 or 2%



Rate of CDC SMM per 10,000 delivery hospitalizations by indicator, 2012-2019





A Reminder:

SMM is a Composite of Complication Indicator Codes
often does NOT identify the Underlying Causes

- Renal Injury, DIC/Coagulopathy, Heart Failure

Each can be caused by a variety of underlying causes, most common: Hypertensive Disorders, Hemorrhage, Sepsis and Cardiovascular Disease

- The QI approach will depend on the underlying cause NOT the Complication Indicator group
- We recently developed an algorithm to identify the underlying cause of SMM cases: HEM, HTN, SEP account for >80%

Main EK, et al. Development and Application of an Algorithm to Identify the Primary Underlying Condition for Cases of Severe Maternal Morbidity. Obstet Gynecol. 2026 Jun 1;147(6):892-901.

National Measure of Severe Morbidity at the Hospital Level

- Developed jointly by the Yale CORE, The Joint Commission and CMS with over 4 years of design / testing
- Required by CMS for ALL US hospitals (2024)
 - eMeasure calculated using hospitals' **EHR data**, including ICD LOINC and SNOMED codes
- Current Specs for Severe Obstetric Complications (ePC-07)
 - Based on the code list for the CDC SMM indicator categories PLUS maternal deaths
 - **EXCLUDES** indicators Present on Admission
 - Reported with and without transfusion
 - Risk-adjusted for maternal co-morbidities



Measures of Severe Maternal Morbidity Are Now *Front and Center* in the US

- Every hospital in the US is now reporting a measure of SMM using data *direct obtained from their EHR*
- Unprecedented attention to SMM by hospitals
- Unprecedented attention to the SMM measure itself



Use of EPIC Cosmos (EHR Data from 4 million births) to Revise Severe Maternal Morbidity Measure

- Back to the WHO definition: 1) Severe organ-system dysfunction, 2) potentially life-threatening conditions and 3) ICU admission
- Revising CDC SMM indicator codes:
 - Acute Kidney Injury (AKI), Disseminated Intravascular Coagulation (DIC); Maternal Sepsis
 - Evaluate additional diagnoses
- How to best measure Severe Hemorrhage in large data sets?
- How to make ICU admission a useful indicator

Main EK, Creanga AA. Measuring Severe Maternal Morbidity: Current Practices, Challenges, and Opportunities. Obstet Gynecol. 2026 Jun 1;147(6):806-816.



“Take Home Points”

- 1) Measures and Measure Collection Systems are co-dependent
- 2) Severe Obstetric Complications is operational and is publicly reported in the U.S.
- 3) An important benefit is to identify cases for review and learning
- 4) Antepartum and Postpartum SMM are not well captured
- 5) However, all SMM /SOC Measures are “Works in Progress”
Expect specifications to be further tweaked over the next years



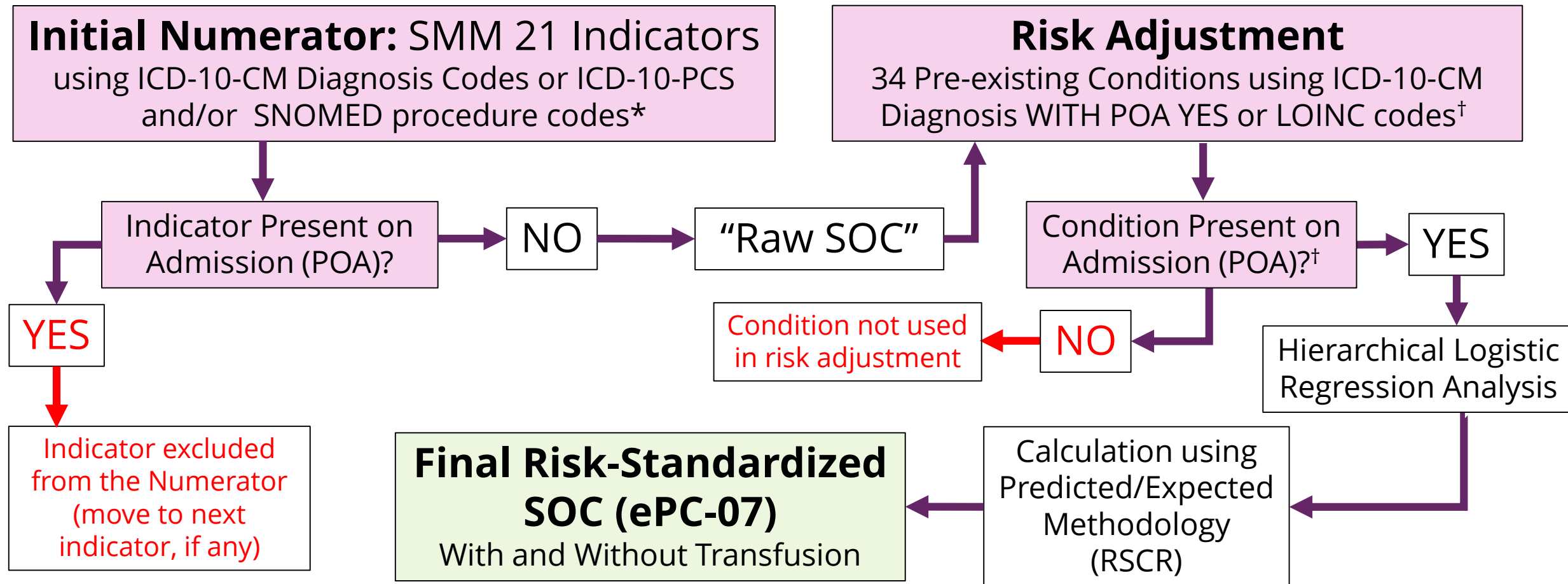
Severe maternal morbidity—actions are more important than definitions

M Knight

National Perinatal Epidemiology Unit, University of Oxford, Oxford, UK

Knight M. Severe maternal morbidity-actions are more important than definitions. BJOG. 2016 May;123(6):954. doi: 10.1111/1471-0528.13699.

Simplified Flow Chart for ePC-07 Numerator aka Severe Obstetric Complications (SOC)



*POA data is typically not documented within structured field clinical workflow but documented in claims data, so SNOMED DX codes are not included in the diagnosis value sets. The most important SNOMED procedure codes are for transfusion which is poorly coded using ICD-10-CM in some facilities.

†LOINC codes are used for laboratory results (Hct, WBC), Vital signs (P, sBP), and gestational age. Present on Admission coding is not used or required for LOINC data.



Obstetrics and Gynecology: September 2020

Original Research

An Expanded Obstetric Comorbidity Scoring System for Predicting Severe Maternal Morbidity

Stephanie A. Leonard, PhD, Chris J. Kennedy, MA, Suzan L. Carmichael, PhD, Deirdre J. Lyell, MD, and Elliott K. Main, MD

- 27 categories of medical comorbidities, comorbidities related to the current pregnancy, previous cesarean birth, and maternal age
- Performance was evaluated using California data split into developmental and validation sets and confirmed using a national Optum Clinformatics data set.
- AUC: 0.83

Editorial

Getting Risk Prediction Right



Brian T. Bateman, MD, MSc

Comorbidity scores play an important role in health services and epidemiologic research because they can be used to summarize the burden of illness in a population or to adjust for risk. They also have potential clinical utility in identifying high-risk patients who may benefit from more intensive evaluation and monitoring or from transfer to tertiary care centers for delivery. In this issue of *Obstetrics & Gynecology* (see page 440), Leonard et al¹ elegantly derive and validate a novel scoring system for use with administrative data—the “expanded obstetric comorbidity scoring system.”

The investigators created two scores, one predicting severe maternal morbidity, as defined by the Centers for Disease Control and Prevention, and the other predicting nontransfusion-related severe maternal morbidity. To create the scores, the investigators used administrative discharge data from delivery hospitalizations in the state of California from 2016 to 2017. The assessment of 27 patient-level characteristics and comorbidities formed the basis for the scores. Comorbidities and outcomes were defined



Specific Challenges for the CDC Definition of Severe Maternal Morbidity

■ DIC

- Most frequent indicator group after transfusion-but also quite variable among hospitals and even states
- Case reviews: many cases are trivial, e.g. mild thrombocytopenia...

■ Acute Kidney Injury

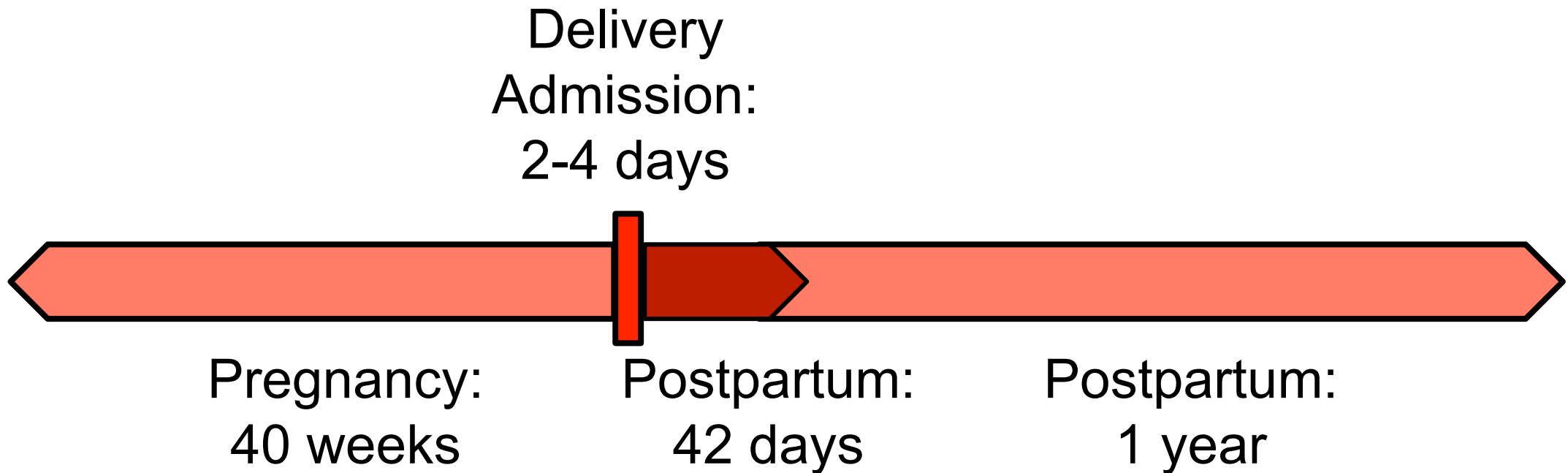
- Also frequent and variable among hospitals, likely over-coding: transient oliguria being coded as ATN (acute tubular necrosis)

■ Sepsis

- Variable adoption of international consensus SEP-3 definition for sepsis requiring end organ injury vs SIRS (California has a particularly high rate of “sepsis”)



What about Antepartum/Postpartum Periods?





Antepartum/Postpartum SMM Cases

Using longitudinal-linked admission data sets

SMM Indicator	Rate (95% CI)/10,000 Birth Hospitalizations			Total Cases Added: Antenatal and Postpartum [% of Total]	
	Antenatal	Birth	Postpartum		
Total SMM	19.8 (19.0–20.7)	186.4 (183.7–189.0)	22.6 (21.7–23.5)	42.5 (38.6–46.5) [100]	Add 22.8%
Nontransfusion SMM	17.7 (16.9–18.5)	84.7 (82.9–86.5)	20.5 (19.6–21.4)	38.3 (35.5–41.1) [89.9]	Add 31.1%
Sepsis	11.7 (11.1–12.4)	20.9 (20.0–21.8)	11.9 (11.2–12.5)	23.6 (22.0–25.2) [55.6]	Add 55.6%

Carmichael S, et al. Using Longitudinally Linked Data to Measure Severe Maternal Morbidity Beyond the Birth Hospitalization in California. Obstet Gyencol 2022; 140:150-2.