Improving Maternal Sepsis Care Through Patient and Community Engagement

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Acknowledgment

- NIH/NICHD UG3/UH3 HD108053 (Contact PI)
  - Large-scale Implementation of Community Co-led Maternal Sepsis Care Practices to Reduce Morbidity and Mortality from Maternal Infection

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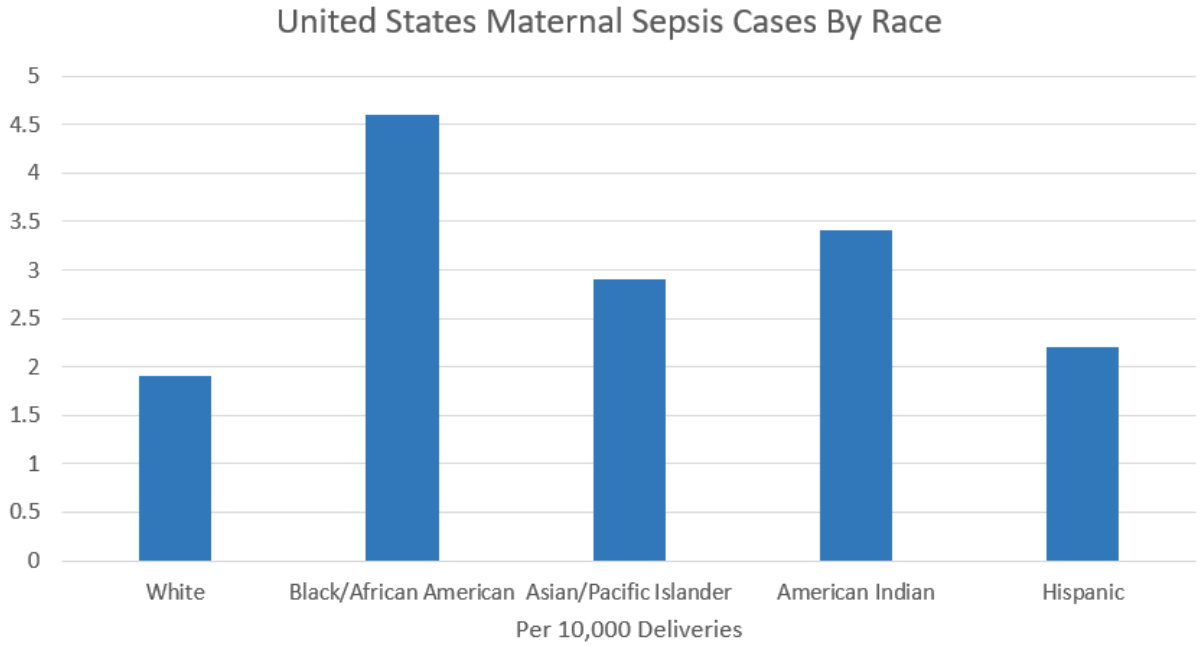
Burden of Infection on Maternal Mortality and Morbidity

- 2nd leading cause of maternal mortality (2020-2021)
- 3rd leading cause of Severe Maternal Morbidity (SMM) at delivery but it is 1st leading cause in antepartum and postpartum periods
- Significant racial inequities:



https://www.cdc.gov/maternal-mortality/php/pregnancy-mortality-surveillance, CDC DHHS, 2022
Creanga AA et al. *Obstet Gynecol 2017*
Petersen EE et al, *MMWR Morb Mortal Wkly Rep* 2019
Kendel et al. AJOG 2019

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Preventability

California	North Carolina	Michigan
39% Preventable	43% Preventable	73% Preventable

Bauer *et al. Obstet Gynecol* (2015)
Berg CJ *et al. Obstet Gynecol* (2005)
Main EK *et al. Obstet Gynecol* (2015)

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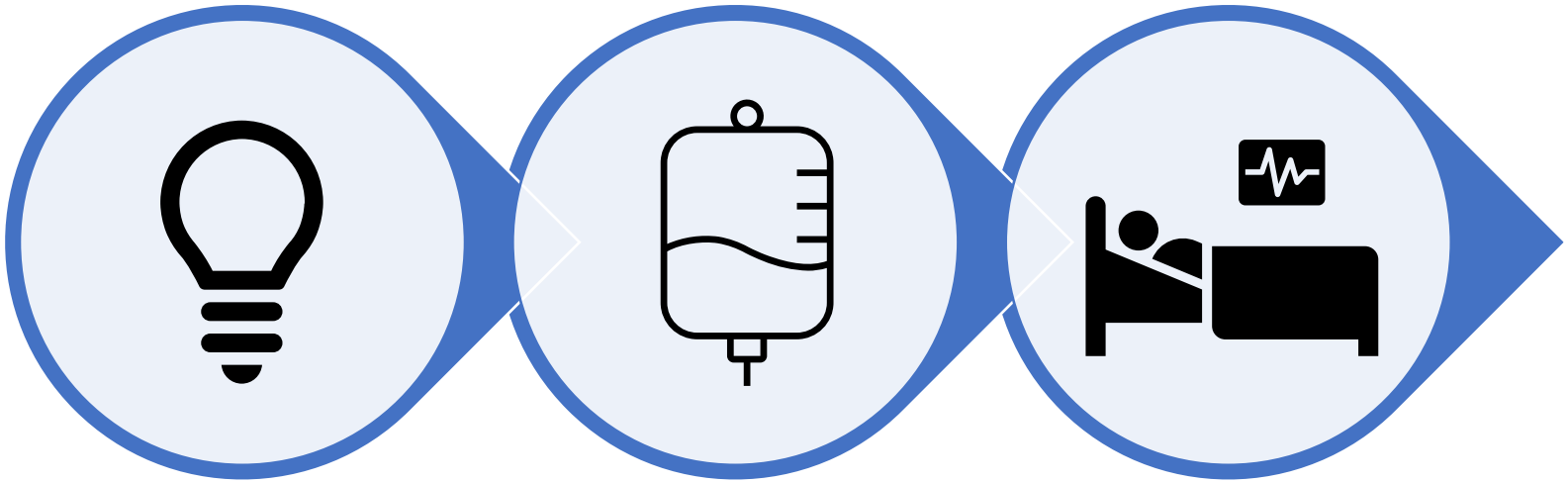
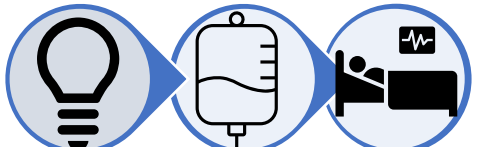
Three Deadly Delays



Recognition

Treatment

Esclation of Care



Seacrist et al. *JOGNN* 2019
Bauer et al. *Obstet Gynecol* 2015

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Sepsis Bundle and Toolkit

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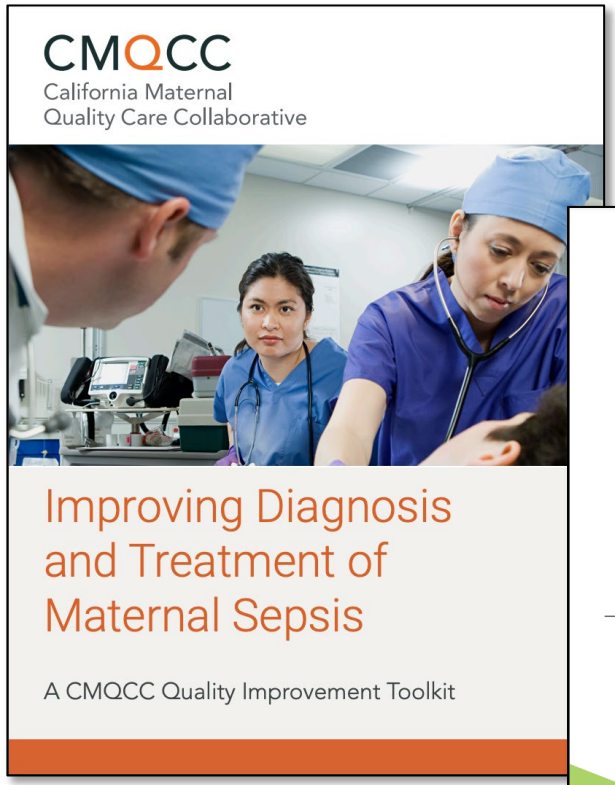

To be updated in early 2025

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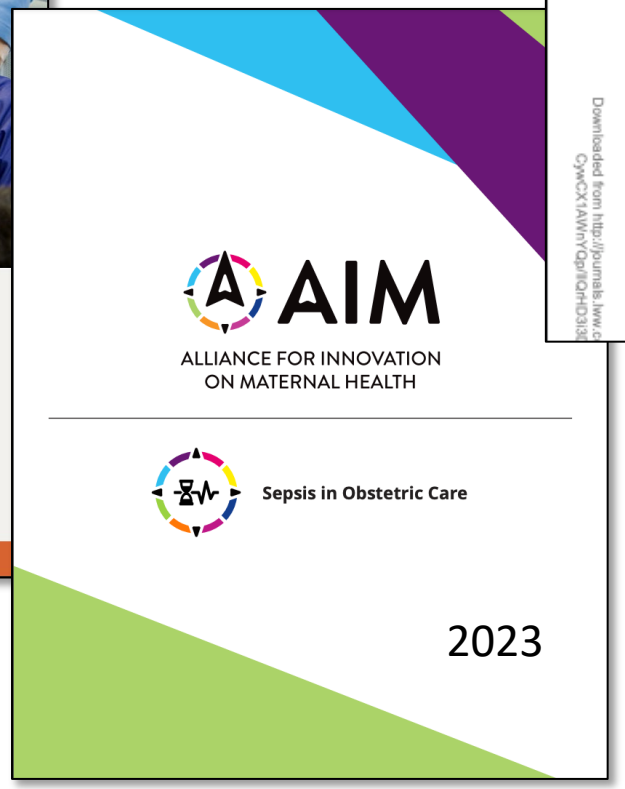

Obstet Gynecol. 2023 Sep 1;142(3):481-492.

How to address?

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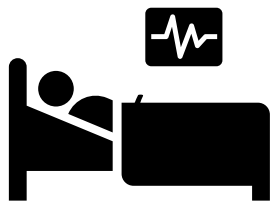
(280 days)

(365 days)



(3-4 days)

Community Engagement

- An approach to research that involves partnership, power-sharing, and direct engagement from people the research will impact

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Maternal Sepsis Community Leadership Board

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- The purpose of the Maternal Sepsis Community Leadership Board (MSCLB) is to engage in research activities designed to understand and reduce maternal morbidity and mortality from maternal sepsis while leveraging community experiences and voices.

- Membership:
  - Maternal Sepsis Survivors
  - Health Equity Advocates
  - Public Health Experts
  - Community members (rural, urban, tribal communities)

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Hospital Implementation

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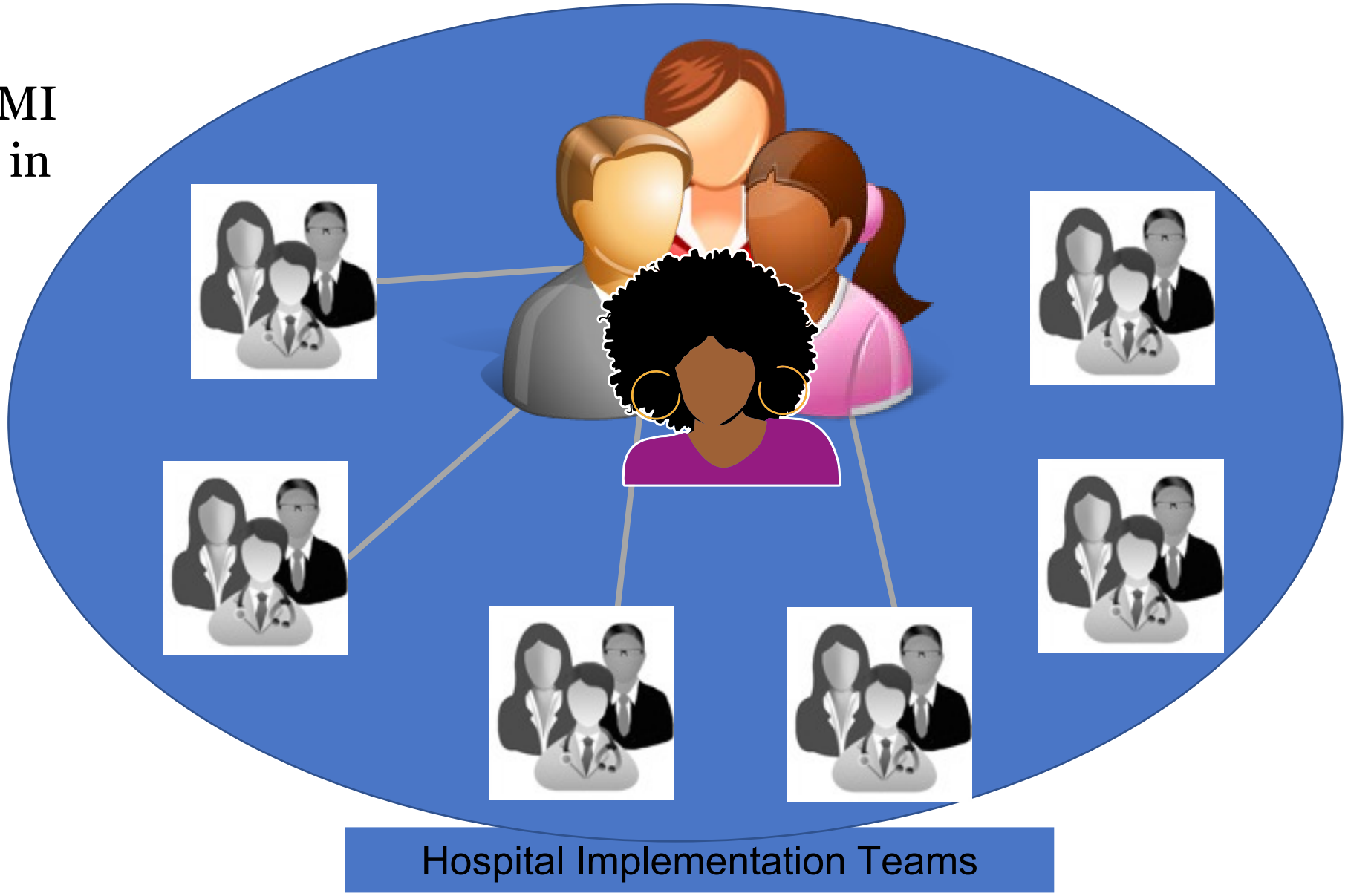
- 66 birthing hospitals in MI
- 60 hospitals in CA
- Mentorship teams
  -Doctor
  -Nurse
  -Community Leader
  -Consultant with lived experience



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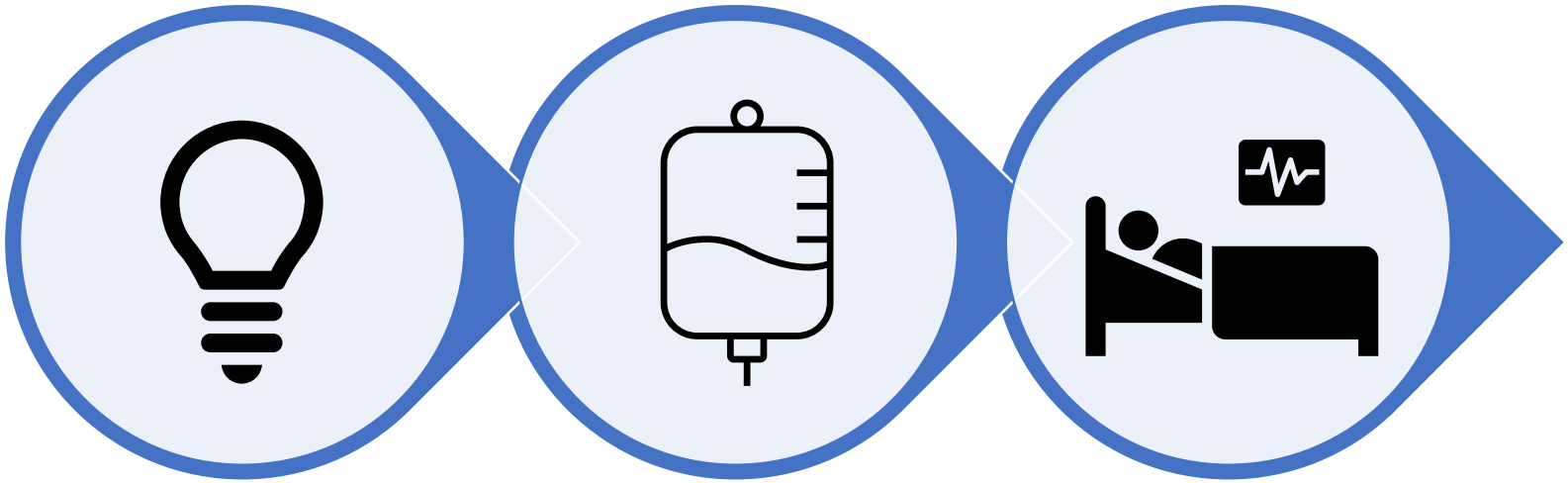

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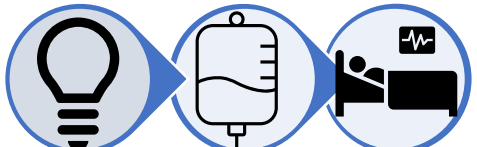

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Recognition

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Why is maternal sepsis different?

	Maternal Physiology	Sepsis
Heart rate	↑	↑
White blood cell count	↑	↓ ↑
Blood pressure	↓ ↑	↓
Lactic acid	↑	↑

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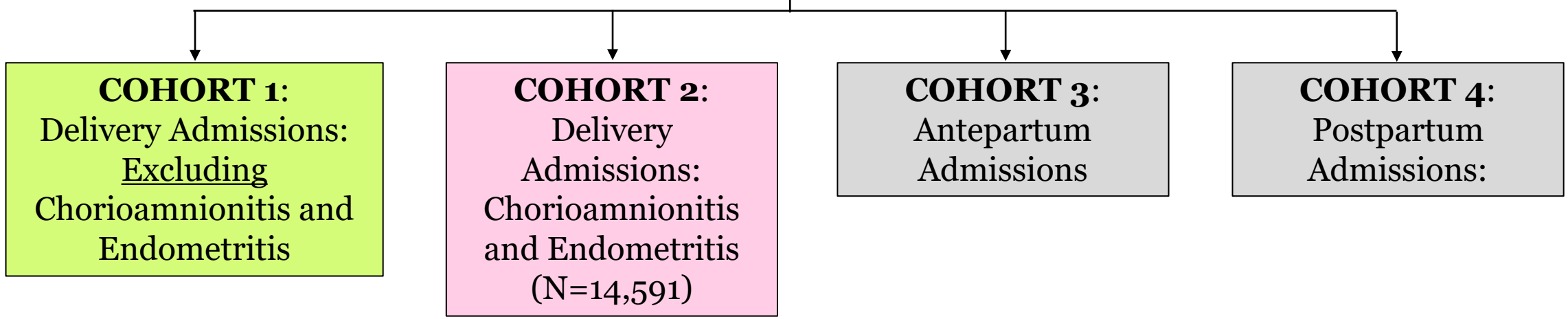
Evaluation of Screening Criteria for Maternal Sepsis: Electronic Health Record Analyses

Electronic Health Record data collected on EPIC, available using Clarity

Hospital Admissions from 71 hospitals in 12 states during the years 2016-2021 (estimated N=581,640 births)

2,900 Cases of Maternal Sepsis were identified



Main et al. Obstet Gynecol. 2024

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Study Hospitals for Delivery Admission Cohorts

Hospital Characteristics	N=59
Region	
New England: Massachusetts	5 (8.5%)
South: Arkansas, North Carolina, Texas	7 (11.9%)
Midwest: Illinois, Michigan	12 (20.3%)
Prairie: Iowa, Nebraska, North Dakota	9 (15.3%)
West: California, Washington	26 (44.1%)
Yearly Delivery Volume*	
< 500	11 (19.0%)
500-999	13 (22.4%)
1000-1999	13 (22.4%)
2000-3999	12 (20.7%)
> 4000	9 (15.5%)
Teaching Status*	
Major Teaching Hospital (OB-GYN residency core site)	11 (19.0%)
Non-teaching hospital	47 (81.0%)
City population where city is located	
< 50,000	17 (28.8%)
50,000-99,999	15 (25.4%)
100,000-249,999	10 (16.9%)
250,000-499,999	6 (10.2%)
> 500,000	11 (18.7%)

*One hospital each had unknown yearly delivery volume and teaching status

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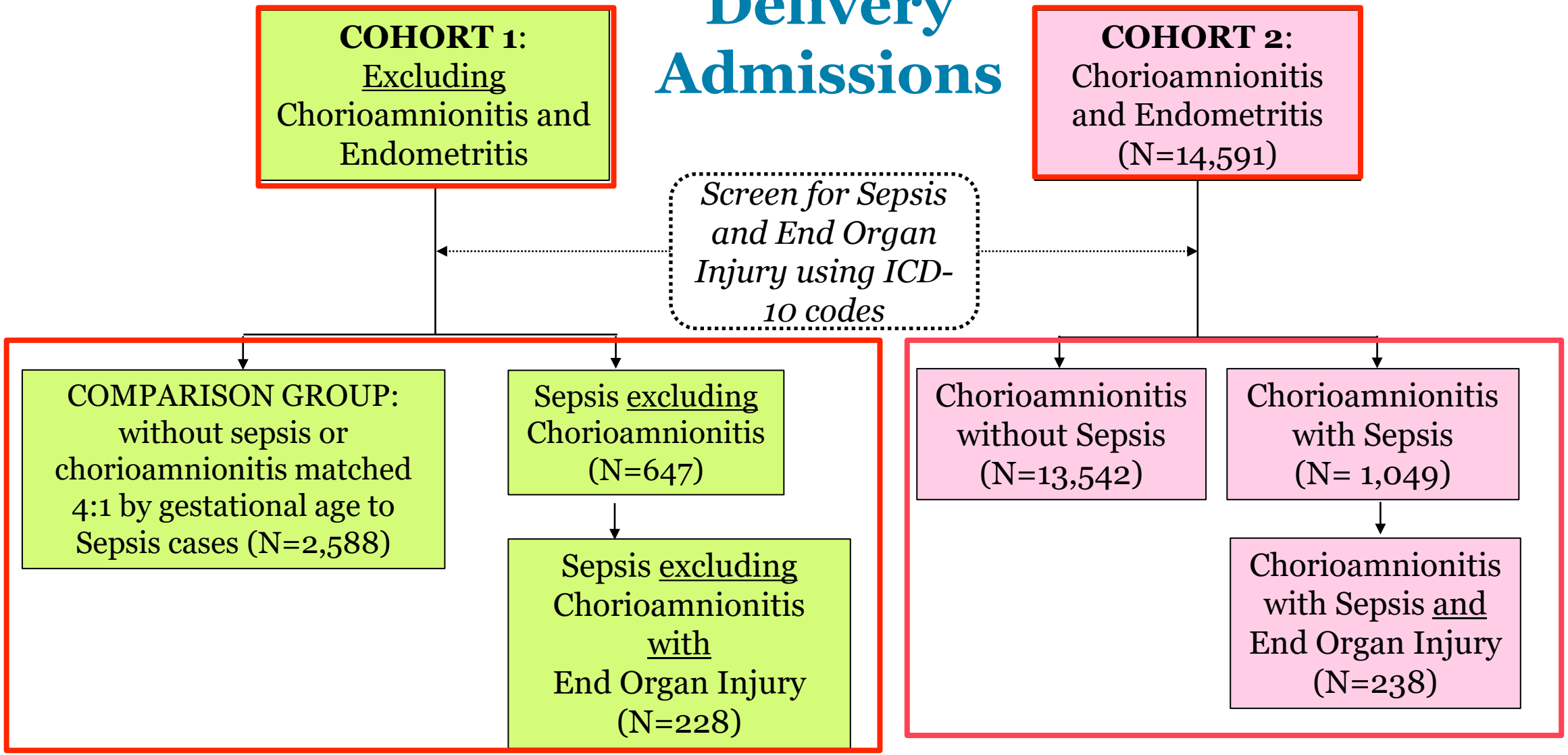
Delivery Admissions



Electronic Health Record data including vital signs, laboratory results and ICD-10 codes were collected for all patients in the six study groups.

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Sepsis Screening Systems Evaluated

Sepsis Screen in Nonpregnant Adults

Screening System and Criterion	Threshold
SIRS (Systemic Inflammatory Response Syndrome)	
WBC	< 4 or > 12
Heart rate	> 90
Respiratory rate	> 20
Temperature	< 36 or > 38
Any two	

Pregnancy Screens for Severe Morbidity

Screening System and Criterion	Threshold
MEWC (Maternal Early Warning Criteria)	
Systolic BP	< 90 or > 160
Diastolic BP	> 100
Heart rate	< 50 or > 120
Respiratory Rate	< 10 or > 24
Pulse oximetry	< 95
Temperature	< 36 or > 38
WBC	< 4 or > 15
Any one	
MEWT (Maternal Early Warning Triggers)	
Severe MEWT (1 red flag)	
Pulse	> 130
Respiratory rate	> 30
MAP	< 55
SpO2	< 90
Blood Pressure	> 160/110
Non-severe MEWT (2 yellow flags)	
Temperature	< 36 or > 38
Blood Pressure	< 85/45
Pulse	< 50 or > 110
Respiratory rate	> 24 or < 10
Pulse oximetry	< 93
Overall MEWT	

Pregnancy-Adjusted Screens for Sepsis

Screening System and Criterion	Threshold
CMQCC (California Maternal Quality Care Collaborative Sepsis Toolkit)	
WBC	< 4 or > 15
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Goal: Find the balance between Sensitivity and the Screen Positive Rate

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Performance of Screening Tools for Intrapartum Sepsis and Sepsis with End Organ Injury

COHORT 1: Cases *excluding* Chorioamnionitis and Endometritis						
	Sepsis by Diagnosis Codes N=647			Sepsis with End Organ Injury by Diagnosis Codes N=228		
Screening System	Screen Positive Rate	Sensitivity (95% CI)	C statistic (95% CI)	Screen Positive Rate	Sensitivity (95% CI)	C statistic (95% CI)
CMQCC	6.9%	90.6% (88.1-92.7)	0.92 (0.91, 0.93)	9.2%	96.9% (93.8-98.8)	0.94 (0.92, 0.95)
SIRS	21.3%	96.9% 95.3-98.1	0.88 (0.87, 0.89)	23.9%	98.7% 96.2-99.7	0.87 (0.86, 0.89)
MEWC	38.3%	96.9% 95.3-98.1	0.79 (0.78, 0.80)	43.9%	98.2% 95.6-99.5	0.77 (0.75, 0.79)
UKOSS	9.6%	92.0% 89.6-93.9	0.91 (0.90, 0.92)	11.6%	96.1% 92.6-98.2	0.92 (0.91, 0.94)
MEWT (overall)	15.8%	79.9% 76.6-82.9	0.82 (0.80, 0.84)	19.8%	90.8% 86.3-94.2	0.85 (0.83, 0.88)

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Performance of Screening Tools for Intrapartum Sepsis and Sepsis with End Organ Injury

COHORT 2: Chorioamnionitis and Endometritis Cases						
	Sepsis by Diagnosis Codes N=1049			Sepsis with End Organ Injury by Diagnosis Codes N=238		
Screening System	Screen Positive Rate	Sensitivity % (95%CI)	C statistic (95%CI)	Screen Positive Rate	Sensitivity % (95%CI)	C statistic (95%CI)
CMQCC	60.2%	93.6% 92.0-95.0	0.67 (0.66, 0.68)	60.2%	93.7% 89.8-96.4	0.67 (0.65, 0.68)
SIRS	86.6%	99.4% 98.8-99.8	0.56 (0.56, 0.57)	86.6%	99.2% 97.0-99.9	0.56 (0.56, 0.57)
MEWC	92.3%	97.7% 96.6-98.5	0.53 (0.52, 0.53)	92.3%	97.9% 95.2-99.3	0.53 (0.52, 0.54)
UKOSS	67.5%	95.2% 93.2-96.0	0.64 (0.63, 0.65)	67.5%	95.0% 91.4-97.4	0.64 (0.63, 0.65)
MEWT (Overall)	45.7%	78.5% 75.8-80.9	0.66 (0.65, 0.68)	45.7%	87.4% 82.5-91.3	0.71 (0.69, 0.73)

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Summary

- Intrapartum Screening:
  - Pregnancy-adjusted sepsis screening tools (CMQCC and UKOSS) have the best balance between sensitivity and false positive rates
- Chorioamnionitis/Endometritis is a challenge (~2-5% of births)
  - Very high rates of false positives
- Antepartum and Postpartum Screening (full results not shown)
  - After 20 weeks of gestation and readmission before 3 days postpartum, Pregnancy-adjusted screening tools have the best balance
  - Before 20 weeks of gestation and after 3 days postpartum, SIRS has greater sensitivity (this is also when care is usually provided in the ED)
- High screen-positive rates remain an important issue

Main et al. Obstet Gynecol. 2024
Bauer et al. Obstet Gynecol. 2024

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Outside of the Hospital

- Over 50% of cases occur during postpartum readmission
- How can we also help the patient identify when to seek care?
- How can we help the patient be listened to and feel heard?

Hensley et al. JAMA 2019

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Patient Barriers to Care

- 20 total interviews
  - 19 survivors with 8 support persons
  - 1 support person of a non-survivor
- Goals:
  - Identify barriers to care
  - Listen to patient's stories and lessons learned
  - Create solutions to address barriers

Bauer et al. Euro J Obstet Gynecol Reprod Biol. 2024

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Table 2
Demographics of interviewed maternal sepsis survivors and support persons.

Characteristics	N (%)
Age at time of sepsis	
Mean (range)	32.4 (20–40)
Year sepsis occurred	
2010–2014	2 (10 %)
2015–2019	10 (50 %)
2020–2022	8 (40 %)
Race and ethnicity	
Participants (19) *	
White	12 (63 %)
Black/African American	5 (26 %)
American Indian	2 (11 %)
Asian Pacific Islander	1 (5 %)
Hispanic	4 (21 %)
Non-Hispanic	15 (79 %)

Bauer et al. Euro J Obstet Gynecol Reprod Biol. 2024

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Bauer et al. Euro J Obstet Gynecol Reprod Biol. 2024

Patients did not remember education about warning signs

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- *"I think if when they discharged me, if they had said be on the lookout for these symptoms, if you have any of them, call and check in. If they had taken five minutes to do that, I think it would've made a huge difference."*

Bauer et al. Euro J Obstet Gynecol Reprod Biol. 2024

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Urgent Maternal Warning Signs

- AIM Cornerstone resource, originally developed by the Council for Patient Safety in Women's Health Care
- Translated into 80 languages
- Standardized patient education

www.saferbirth.org/aim-resources/aim-cornerstones/urgent-maternal-warning-signs/

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Phone Discharge Education

ADD RESOURCES TO YOUR DEVICE HOME SCREEN

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For iPhone:
Scan QR Code on reverse side and choose:
Scroll down until **"Add to Home Screen"** appears, click on: Tap **"Add"**

For Android:
Scan QR Code on reverse side and choose:

Scroll down and tap on **"Add to Home Screen"**
Tap **"Add"**

It will now appear on your home screen.

PATIENT AND PROVIDER RESOURCES

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PATIENTS:
Urgent Maternal Warning Signs, Advocacy Language and Actions, **and More!**

PROVIDERS:
Warning Signs Follow Up Guide, Sepsis in Obstetrics Score Calculator, **and More!**

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Community Dissemination

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Patient advocacy

- *"I wish someone would've explained the signs and how to advocate for themselves. Like if you call and they tell you don't come, still go."*

Bauer et al. Euro J Obstet Gynecol Reprod Biol. 2024

Co-Created with Community and Patients with Lived Experience

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- Advocacy Language
- Advocacy Actions

Advocacy Language

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ADVOCACY LANGUAGE: List suggestions for language to provide patients (or their support person can say) who feel they are not being heard

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ADVOCACY

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EXAMPLES OF ADVOCACY LANGUAGE

- I am very concerned and do not feel like I am being heard. What are my next steps or alternative options?
- This is really different for me. I have never felt this way in my life. For my benefit and my family's benefit I should be seen.
- I understand that some of these symptoms may be normal for pregnancy or postpartum, but I am very concerned and need to be evaluated.
- I have called a number of times and tried suggestions that have been provided, but I am not getting better.
- Can you please refer me to someone who can help me? I'm really worried.
- My doctor told me to call if I am experiencing X, Y, or Z. I am having X, Y, or Z. I would like to be seen.
- I want to speak to someone else to make sure that I do not have a serious condition. Can you please refer me to someone who will help me? I am really worried.
- I do not feel right, I am concerned that something bad is happening to me.

ADVOCACY ACTION TIPS

- Your concerns and feelings are valid, be persistent in getting the answers or care you need.
- If you have a medical emergency, please dial 911 or go to the nearest emergency room.
- Ask to speak to the charge nurse or patient relations if you are not being heard
- If you are not getting the response you need, you can go to triage or the emergency room. You do not need permission from anyone to do so.
- You can also go to a different hospital or urgent care facility if you are not receiving the care you need.
- Consider having another person to accompany you to help advocate for you (support person, family member, doula, etc.)
- Bring a list of your concerns you would like to be addressed.
- Start your concern with the effect that it is having such as the following: "I am so tired I am unable to get out of bed"; "I am having so much pain I cannot sleep"; etc.

Patient Concerns dismissed as normal

"She's dismissed there and throughout the whole stay whenever we brought these things up it was, 'you just had a baby, everything's okay. Don't worry, you just had a baby,' and that was the recurring theme throughout our stay."

Bauer et al. Euro J Obstet Gynecol Reprod Biol. 2024

But if they had asked further…

"I had no strength; I couldn't even go to the kitchen to get a glass of water"

"I was so weak; I couldn't stand up"

"I was short of breath after brushing my teeth and had to lie down on the bed"

Bauer et al. Euro J Obstet Gynecol Reprod Biol. 2024

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WARNING SIGNS FOLLOW-UP GUIDE

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BACKGROUND

These questions, tips, and red flags were created based on near-miss cases of patients who suffered severe maternal morbidity.

Many patients called in with symptoms but were met with reassurance that symptoms were typical of pregnancy or postpartum rather than follow up questions that would have identified severe illness to allow prompt treatment.

FOLLOW UP QUESTIONS

These follow up questions are suggested to evaluate when patients call with symptoms of concern.

- Please tell me in your own words what is wrong.
- Is this your first time calling about this?
- How long has this been going on?
- Is it getting better, staying the same, or getting worse?
- On a scale of 1 to 10 (worst) how bad is _____? (pain/tiredness/symptoms of concern)
- Are you able to perform your normal day-to-day activities and take care of yourself?
- Are you able to eat, drink, urinate, pass gas, have bowel movements?
- Can you explain how this is limiting you?
- What prompted you to call?
- Have you had this before?
- Can you explain how you are feeling and how this is different from your baseline?
- Are there any barriers to coming in today?

ACTION ITEMS

- If the patient does not need assessment now, explain red flag warning signs when the patient should call back or come in for evaluation.
- Express empathy and concern. Many patients reported feeling like a burden and not feeling heard and subsequently delayed calling and seeking care when symptoms worsened.
- Keep track of a list of patients to reach back out to follow up on and encourage them to call back if not improving or getting worse.

RED FLAGS (should prompt in-person evaluation)

- Patient reaching out multiple times with concerns.
- A support person calling on behalf of the patient with concerns.
- Patient requests to be seen.
- Symptoms that are worsening over time.
- Patient unable to perform activities of daily living (climbing stairs, showering, brushing teeth, holding baby, etc.)
- Signs of severe dehydration: inability to urinate, inability to make tears, abrupt stopping of milk production.
- Severe pain.

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Treatment

Importance of prompt antibiotic therapy In Pregnant Patients

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- Antibiotics within one hour
  - 8% (95% CI 1.2% to 22.5%) mortality
- Antibiotics after one hour
  - 20% (95% CI 5.7% to 43.7%) mortality

Bauer ME *et al.* Anesth Analg (2018)

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CMQCC Toolkit

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TABLE 9. Proposed Empiric Antibiotic Coverage for Patients with Sepsis of Unknown Source (with End Organ Injury) or Septic Shock

Antibiotic Choices *Empiric coverage for sepsis of unknown source or for septic shock should include at least one antibiotic for Gram-negative and anaerobic coverage **PLUS** one for Gram-positive coverage*	**Duration**
Gram-negative plus anaerobic coverage Piperacillin/tazobactam 3.375 g IV q8h (extended infusion) or 4.5 g IV q6h **OR** Meropenem 1 g IV q8h (if recent hospitalization or concern for MDRO organisms) **OR** Cefepime 1-2g IV q8h plus metronidazole 500 mg IV q8h **OR** Aztreonam 2 g IV q8h (for women with severe penicillin allergy) Plus metronidazole 500 mg IV q8h **OR** Aztreonam 2g IV q8h plus clindamycin 900 mg IV q8h **PLUS** **Gram-positive coverage** Vancomycin 15-20 mg/kg q8h-q12h (goal trough 15-20 mcg/mL) **OR** Linezolid 600 mg IV/PO q12h (for women with severe vancomycin allergy)	7-10 days is adequate for most infections

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Systems-based solutions

- Automated dispensing system availability
- IV access
- Pharmacy
- Waiting for transport

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Escalation of Care

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Sepsis in Obstetrics Score

FIGURE 1
Sepsis in Obstetrics Score

Variable	High abnormal range				Normal	Low abnormal range			
Score	+4	+3	+2	+1	0	+1	+2	+3	+4
Temperature (°C)	>40.9	39-40.9		38.5-38.9	36-38.4	34-35.9	32-33.9	30-31.9	<30
Systolic Blood Pressure (mmHg)					>90		70-90		<70
Heart Rate (beats per minute)	>179	150-179	130-149	120-129	≤119				
Respiratory Rate (breaths per minute)	>49	35-49		25-34	12-24	10-11	6-9		≤5
SpO_2 (%)					≥92%	90-91%		85-89%	<85%
White Blood Cell Count (/μL)	>39.9		25-39.9	17-24.9	5.7-16.9	3-5.6	1-2.9		<1
% Immature Neutrophils			≥10%		<10%				
Lactic Acid (mmol/L)			≥4		<4				

Scoring template for S.O.S., a sepsis scoring system designed specifically for obstetric patients.

S.O.S., Sepsis in Obstetrics Score; SpO_2, blood oxygen saturation.

Albright. The Sepsis in Obstetrics Score. Am J Obstet Gynecol 2014.

Albright *et al. AJOG* (2014)

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Sepsis Calculator

Sepsis Obstetrics Scoring System			
Temperature (Centigrade) (° C) 36 - 38.4 C (96.8 - 101.1 F) ▼		SpO2% blood oxygen saturation >= 92% ▼	
Systolic blood pressure (mmHg) > 90 ▼		White blood count uL 5.7 - 16.9 ▼	
Heart Rate (beats per minute) <=119 ▼		% Immature Neutrophils <10% ▼	
Respiratory Rate (breaths per minute) 12 - 24 ▼		Lactic Acid (mmol/L) <4 ▼	
Calculate Sepsis Obstetrics Score (S.O.S)			

http://perinatology.com/calculators/Sepsis%20Calculator.htm

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Provider Materials

The materials below are designed to support medical professionals with educating patients about the leading signs and symptoms of severe maternal events that could lead to complications and/or death. Materials are available to help providers communicate with patients about their condition.

Southeast Michigan Perinatal Quality Improvement Coalition (SEMPQIC)

Detroit Health Equity Education Resource

Escalation of care resource: Sepsis in Obstetrics Score Calculator

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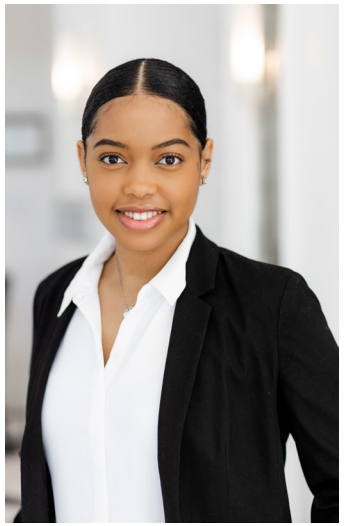
Next Steps

- Currently completing implementation in hospitals
- Data analysis to assess interrupted time series
  - Sepsis, sepsis with end organ injury codes, mechanical ventilation and hemodialysis
- Qualitative patient centered assessment of the tools

The Team

Multiple PIs, Elliott Main and Bob Sokol



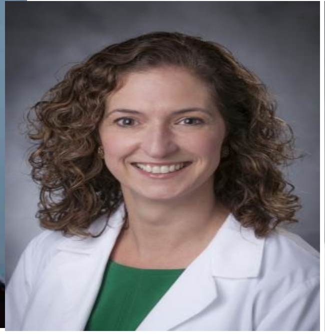
Research Coordinator, Morgan Caldwell

Community Engagement Liaison, Kendra Smith

Implementation Scientists, Melissa Rosenstein and Hayden Bosworth









Clinical Advisory Board



Maternal Sepsis Community Leadership Board








Duke Anesthesiology