

Challenge sepsis.
Change lives.



Improving Pediatric Sepsis Outcomes Results and Strategies for Hospitalists

Melissa Schafer, Jean Hsu
Anu Subramony, Sarah Kandil, Katie Boyle, Justin Lockwood,
Ruth Riggs, Troy Richardson



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Learning Objectives

1. Describe sepsis arising in pediatric patients already admitted to the hospital.
2. Disseminate Improving Pediatrics Sepsis Outcomes collaborative general inpatient results.
3. Describe strategies that have worked to improve sepsis care in our hospitals.

Disclosures

Dr. Schafer and Dr. Hsu have no relevant financial disclosures



Sepsis is...

A systemic, deleterious host response to infection leading to severe sepsis and septic shock

2023 US Ped Sepsis Epidemiology Study:
10.1% mortality

SPROUT worldwide point prevalence study 2015:
25% mortality



Dellinger 2013, Weiss 2015, Magill 2023



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Improving Pediatric Sepsis Outcomes: IPSO

- Learning collaborative of 40 Children's Hospitals started in 2016
- Goal: decrease sepsis-attributable mortality and prevent hospital-onset sepsis among children through appropriate, timely, and reliable implementation of evidence-based diagnostic and clinical care processes.



Challenge sepsis.
Change lives.

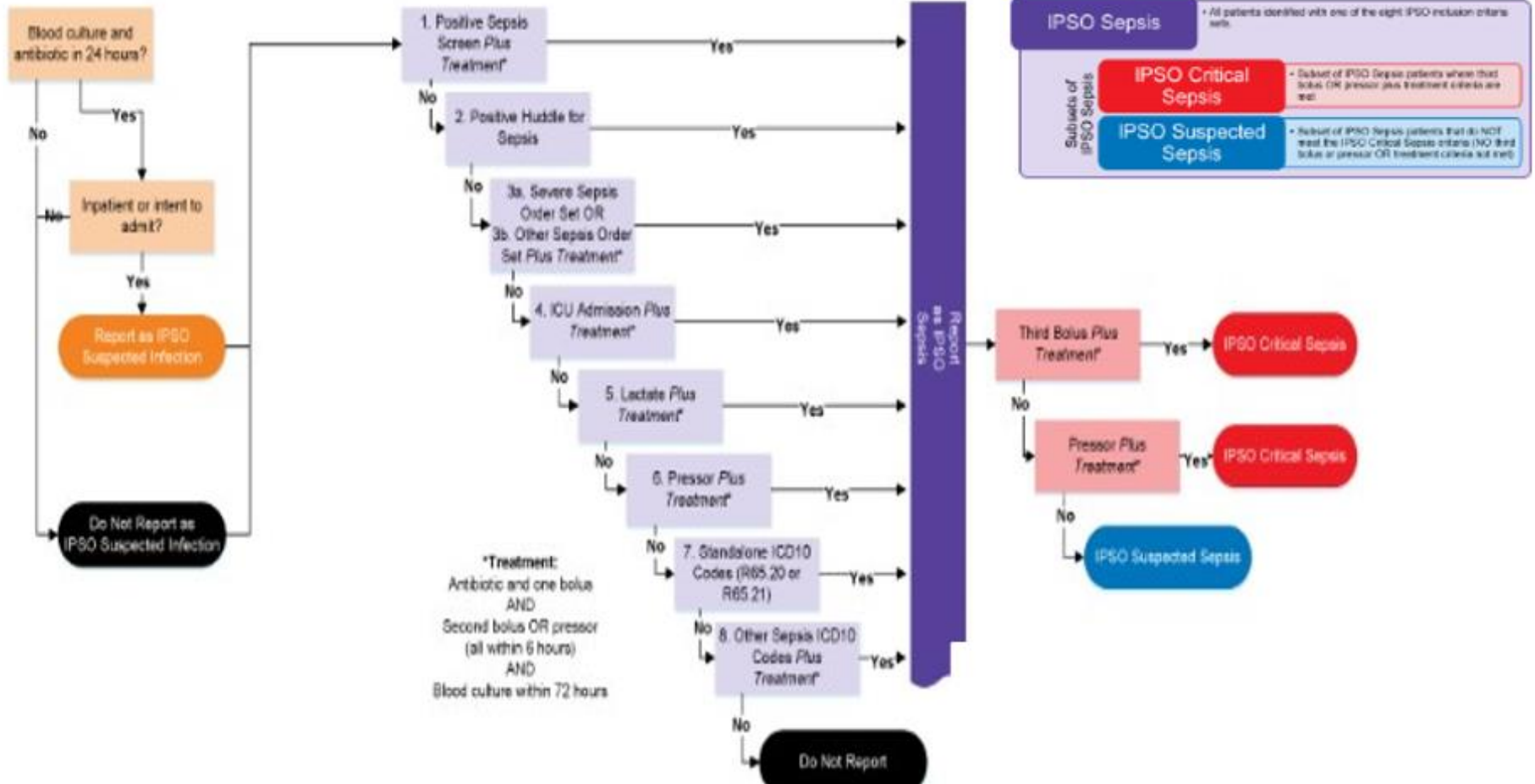


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IPSO Terminology & Definitions



Inpatient Sepsis v ED

- 10% of ED volume
- Less likely to have comorbidities or medical complexity
- More direct admissions from an outside hospital
- Less likely to require a 3rd bolus or a pressor

TABLE 1 Comparison of Clinical Characteristics of Sepsis Patients With FTZ Occurring in the Inpatient Unit Versus Those With FTZ in the ED

	Inpatient	Emergency Department	<i>P</i>
Total patients by care setting	2254	24 601	
Total patients by year			.070
2017	609 (27.0)	6529 (26.5)	
2018	733 (32.5)	8578 (34.9)	
2019	912 (40.5)	9494 (38.6)	
Age in years, median (IQR)	6.2 (1.3–13.8)	6.0 (1.7–13.2)	.320
Age group, <i>n</i> (%)			<.001
0–28 d	101 (4.5)	1027 (4.2)	
29–364 d	393 (17.4)	3272 (13.3)	
1–4 y	538 (23.9)	6869 (27.9)	
5–10 y	443 (19.7)	5396 (21.9)	
11–17 y	630 (28.0)	6179 (25.1)	
18+years	149 (6.6)	1858 (7.6)	
Comorbid conditions (any), <i>n</i> (%)	841 (37.3)	10 197 (41.4)	<.001
Technology-dependent, <i>n</i> (%)	493 (21.9)	4982 (20.3)	.067
Severe cerebral palsy, intellectual disability, <i>n</i> (%)	360 (16.0)	3716 (15.1)	.272
Indwelling central venous catheter present on arrival, <i>n</i> (%)	281 (12.5)	3400 (13.8)	.074
Immunosuppressed/ immunocompromised/ solid organ transplant/ BMT/ malignancy/ asplenia	284 (12.6)	5166 (21.0)	<.001
Transferred from outside hospital, <i>n</i> (%) ^a	368 (17.7)	1245 (5.7)	<.001
IPSO critical sepsis (%)	495 (22.0)	8235 (33.5)	<.001
Admission source, <i>n</i> (%)			<.001
From outside hospital and emergency department	90 (4.0)	1152 (4.7)	
From outside hospital only	278 (12.3)	93 (0.4)	
From emergency department only	984 (43.7)	20 583 (83.7)	
From other/unknown	902 (40.0)	2773 (11.3)	

BMT, bone marrow transplant.

^a Among episodes reporting outside hospital status.



Outcomes Inpatient v ED

TABLE 2 Process Measures and Clinical Outcomes in for IPSO Sepsis Patients Recognized in the Inpatient Unit and in the Emergency Department

	Inpatient	Emergency Department	P
Process measures			
Sepsis recognition method used at FTZ			<.001
Sepsis screen, <i>n</i> (%)	686 (30.4)	12 189 (49.5)	
Huddle, <i>n</i> (%)	271 (12.0)	1039 (4.2)	
Order set, <i>n</i> (%)	159 (7.1)	3777 (15.4)	
Antibiotics, <i>n</i> (%)	383 (17.0)	1704 (6.9)	
Bolus, <i>n</i> (%)	755 (33.5)	5892 (24.0)	
Time from Arrival to FTZ in hours, median (IQR)	18.4 (6.3–69.8)	0.5 (0.2–1.4)	<.001
Element of sepsis care present			
Use of screen, huddle, or order set <i>n</i> (%)	1207 (53.5)	17 671 (71.8)	<.001
Sepsis screen, <i>n</i> (%)	821 (36.4)	13 262 (53.9)	<.001
Huddle, <i>n</i> (%)	610 (27.1)	5193 (21.1)	<.001
Order set, <i>n</i> (%)	358 (15.9)	11 757 (47.8)	<.001
Time to first fluid bolus, in min, ^a median (IQR)	19.0 (0.0–79.0)	25.0 (8.0–47.0)	.036
Total bolus vol in 6 h before and after FTZ, mL/kg, median (IQR)	23.4 (10.3–40.0)	40.0 (26.7–50.1)	<.001
Time to antibiotic, in min, ^b median (IQR)	89.0 (20.5–210.5)	54.0 (27.0–112.0)	<.001
Clinical outcomes			
30-d sepsis-attributable mortality, <i>n</i> (%)	45 (2.0)	346 (1.4)	.025
30-d all-cause mortality, <i>n</i> (%)	62 (2.8)	502 (2.0)	.024
Hospital days after sepsis episode, median (IQR)	9.0 (5.0–18.0)	5.0 (3.0–10.0)	<.001
Any vasopressor use, <i>n</i> (%) ^c	371 (18.0)	3022 (13.6)	<.001
Any ventilator use, includes noninvasive, <i>n</i> (%) ^c	509 (33.8)	5066 (31.5)	.076
Ventilator days, median (IQR) ^d	5.0 (2.0–10.0)	4.0 (2.0–9.0)	.134
ICU admission, <i>n</i> (%) ^c	1248 (57.6)	12 557 (54.1)	.002
ICU days, median (IQR) ^d	5.0 (2.0–9.0)	4.0 (2.0–8.0)	<.001
Hypotension within 24 h of FTZ, <i>n</i> (%)	1027 (45.6)	9626 (39.1)	<.001
Disposition to home within 30 d of FTZ, <i>n</i> (%)	1783 (79.1)	22 425 (91.2)	<.001

^a Among episodes in which first fluid bolus was not the sepsis recognition method at functional time zero.

^b Among episodes in which antibiotic was not the sepsis recognition method at functional time zero.

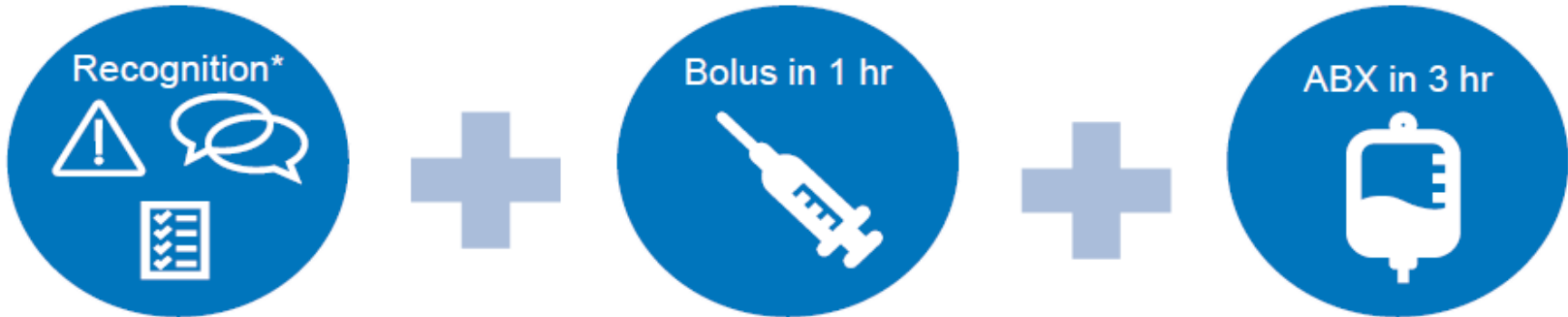
^c For episodes that reported any vasopressor use, or any ventilator use, or any ICU use, respectively.

^d Among episodes that had any ventilator days reported, or any ICU days reported, respectively.

- Less screening, more huddles
- Longer time from arrival to sepsis recognition
- Similar time to bolus, longer time to antibiotic
- More hospital days
- More ICU admissions
- More sepsis attributable mortality



What is bundle compliance?

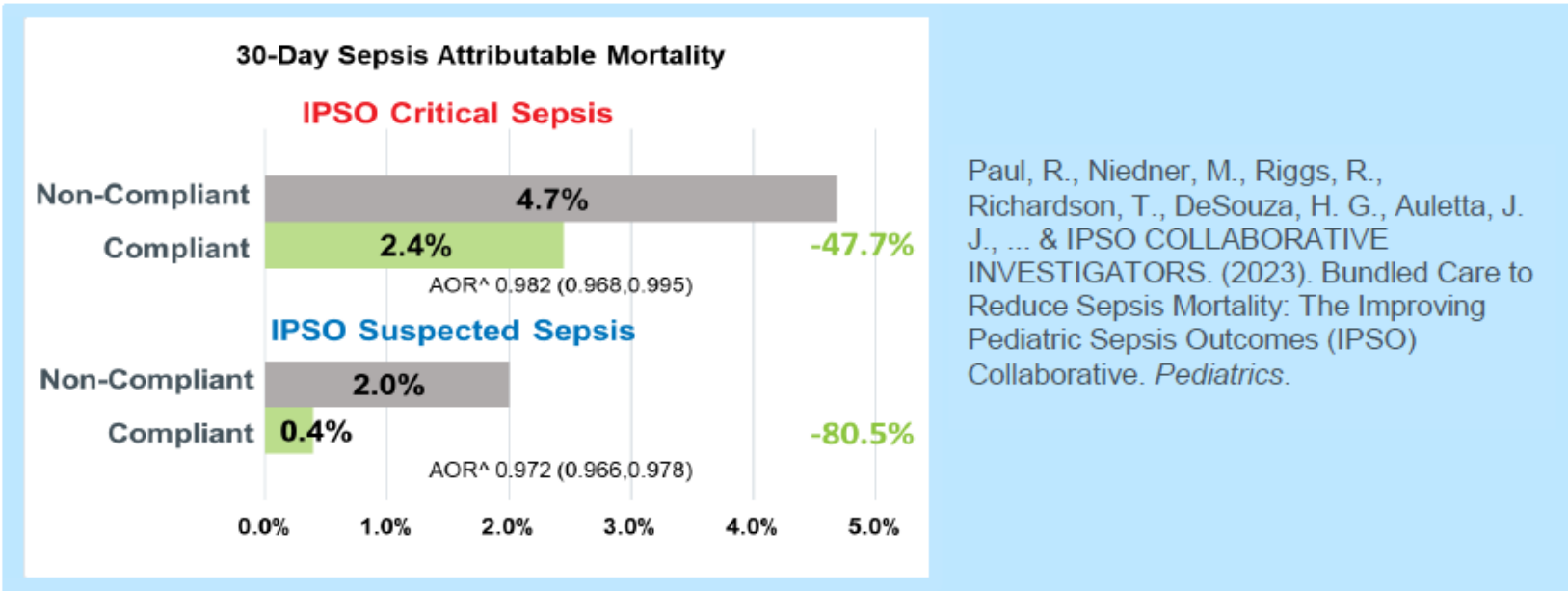


*Recognition = positive screen OR positive huddle OR order set initiated

If any element of bundle compliance is missing, the episode is non-compliant.

Why does bundle compliance matter?

An analysis of episodes demonstrated that compliance with this bundle resulted in better outcomes than did episodes that were not compliant. Below is a summary of our published results.



Paul, R., Niedner, M., Riggs, R., Richardson, T., DeSouza, H. G., Auletta, J. J., ... & IPSO COLLABORATIVE INVESTIGATORS. (2023). Bundled Care to Reduce Sepsis Mortality: The Improving Pediatric Sepsis Outcomes (IPSO) Collaborative. *Pediatrics*.



Mortality improves with compliance: Inpatient only

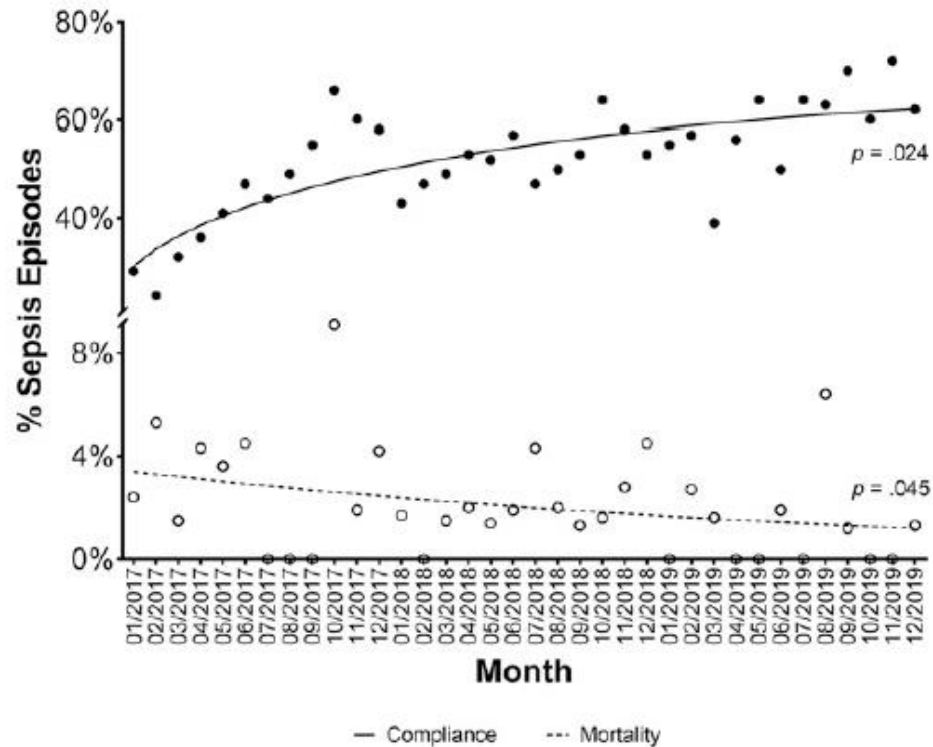
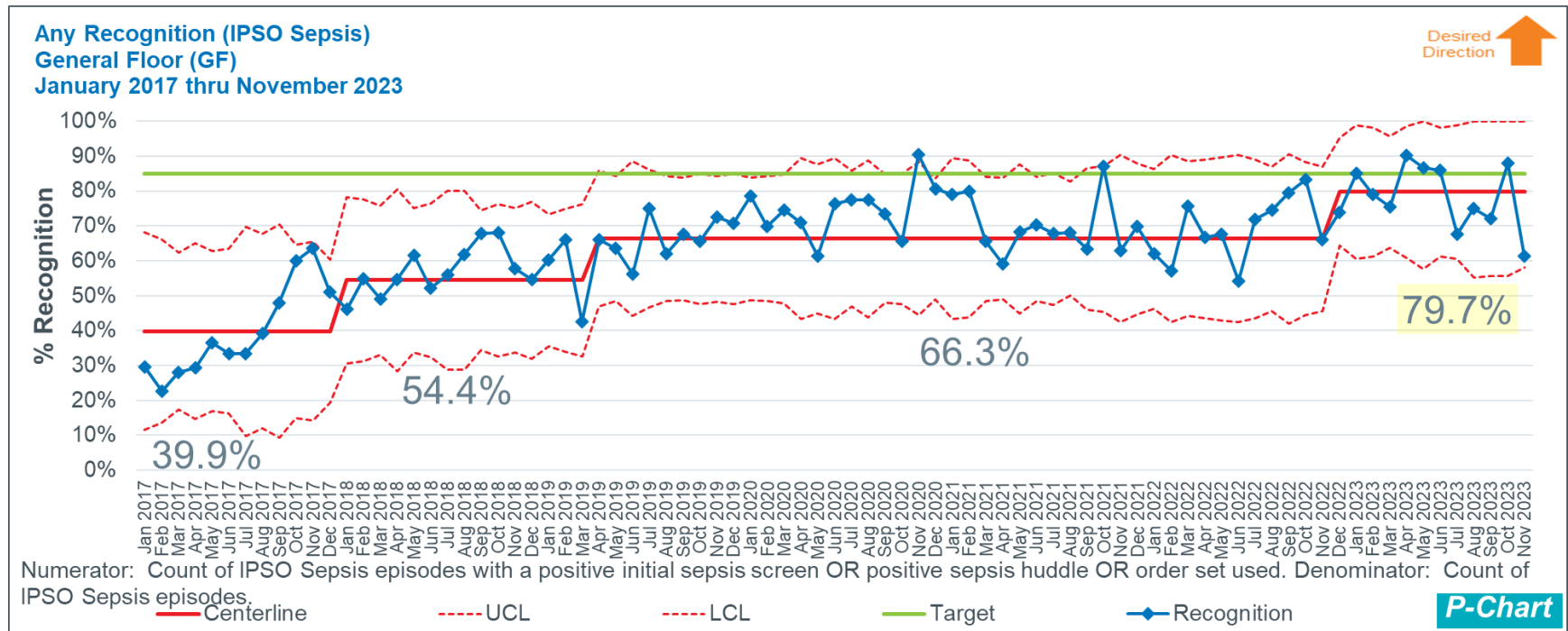


FIGURE 3 Improved bundle compliance leads to improved 30-day sepsis-attributable mortality for inpatients with sepsis.



Improvements over time: Recognition



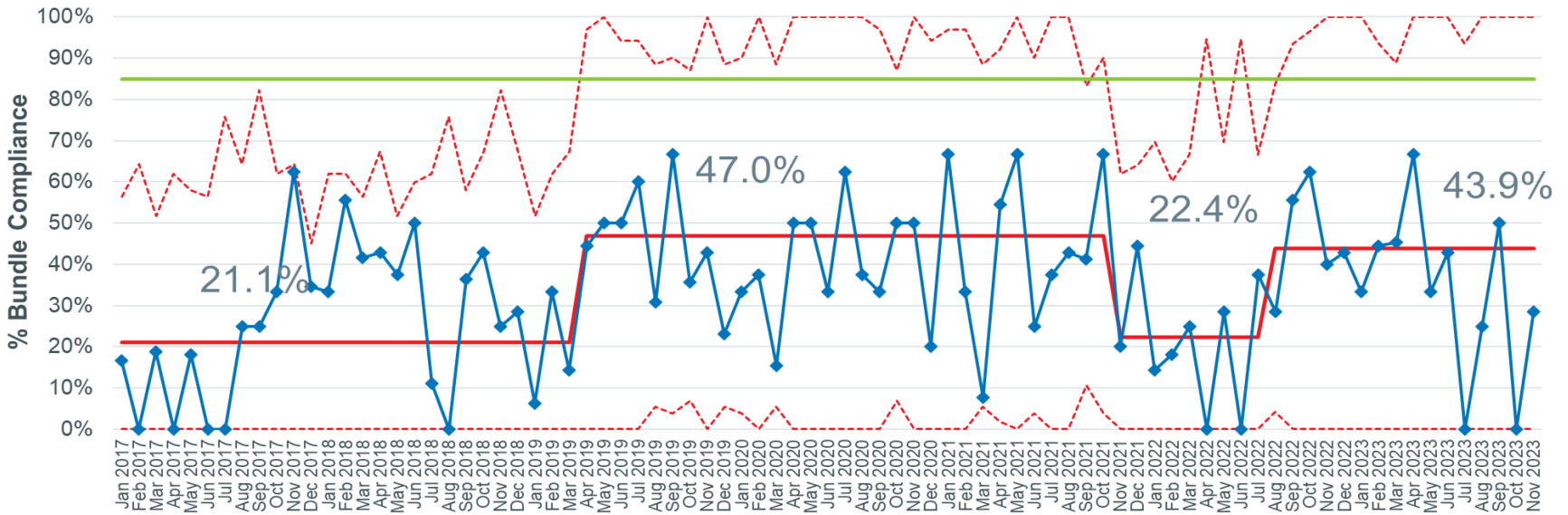
Components of inpatient recognition

Metric	Start (2017)	Final (2023)	Net
Screen	19.3%	47.5%	↑ 28.2%
Huddle	16.6%	49.4%	↑ 32.8%
Order Set	13.9%	22.1%	↑ 8.2%



Inpatient Bundle Compliance

**Bundle Compliance (Bolus 60 - ABX 180 - Recog) (IPSO Critical Sepsis)
General Floor (GF)
January 2017 thru November 2023**



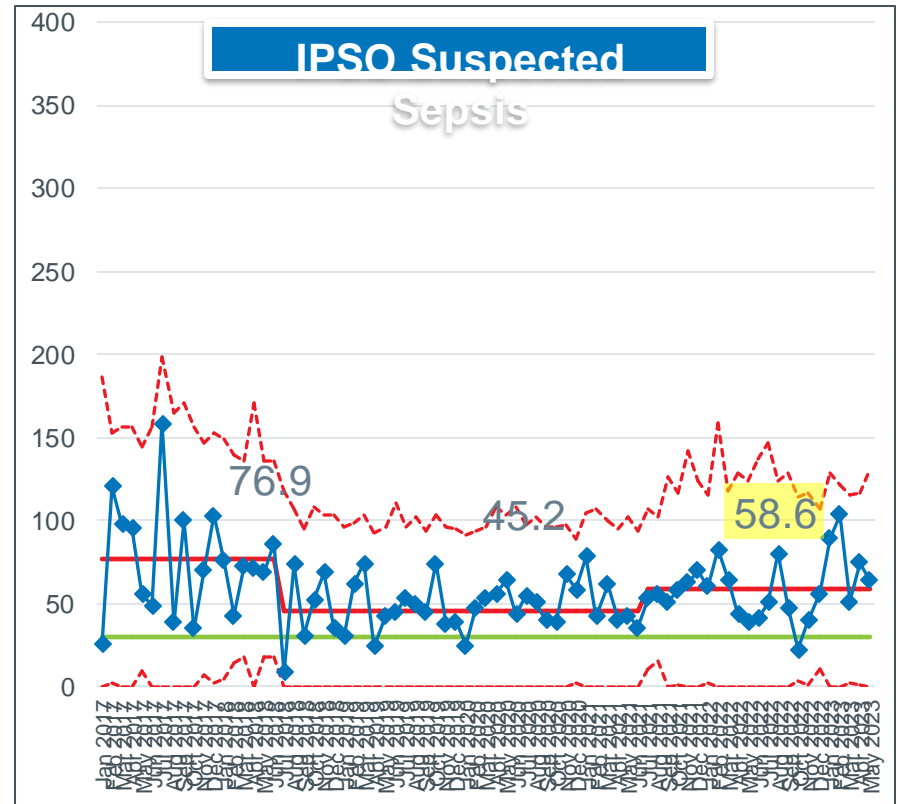
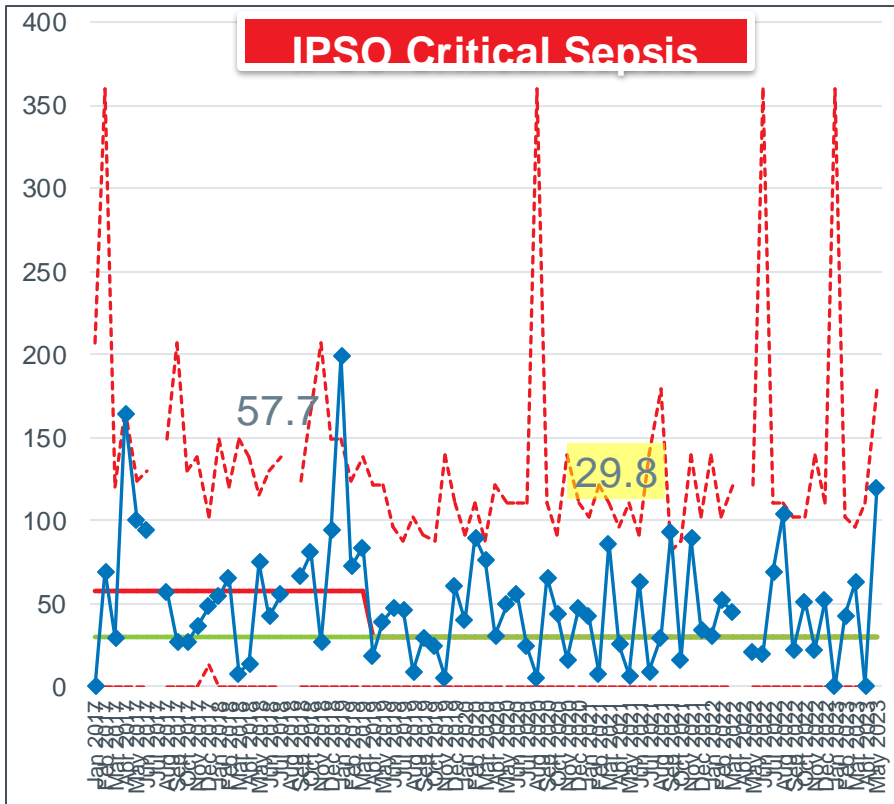
Numerator: Count of IPSO Critical Sepsis episodes with a bolus given in 60 minutes AND antibiotic given in 180 minutes AND (positive initial sepsis screen OR positive sepsis huddle OR order set used). Denominator: Count of IPSO Critical Sepsis episodes.

— Centerline - - - - UCL - - - - LCL — Target ◆ Bundle Compliance

P-Chart

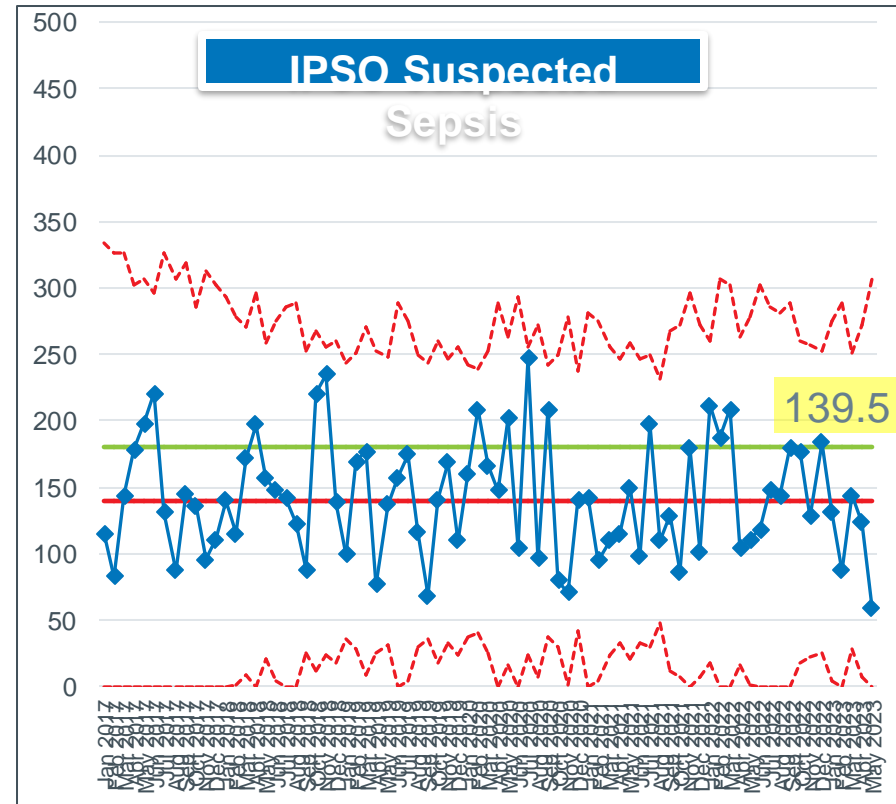
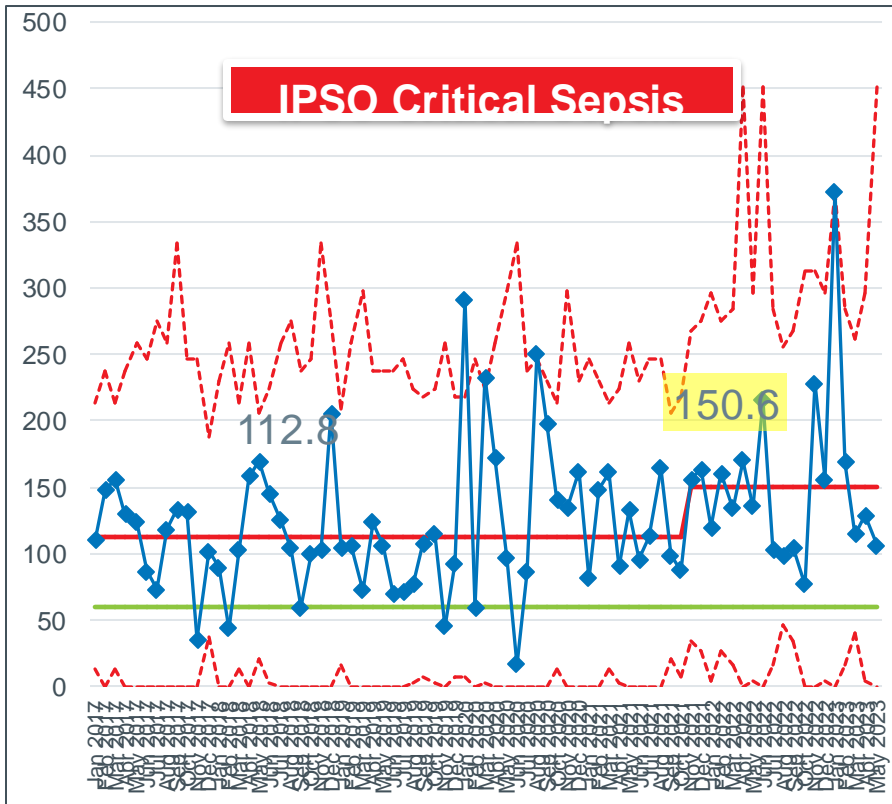


Time to First Bolus



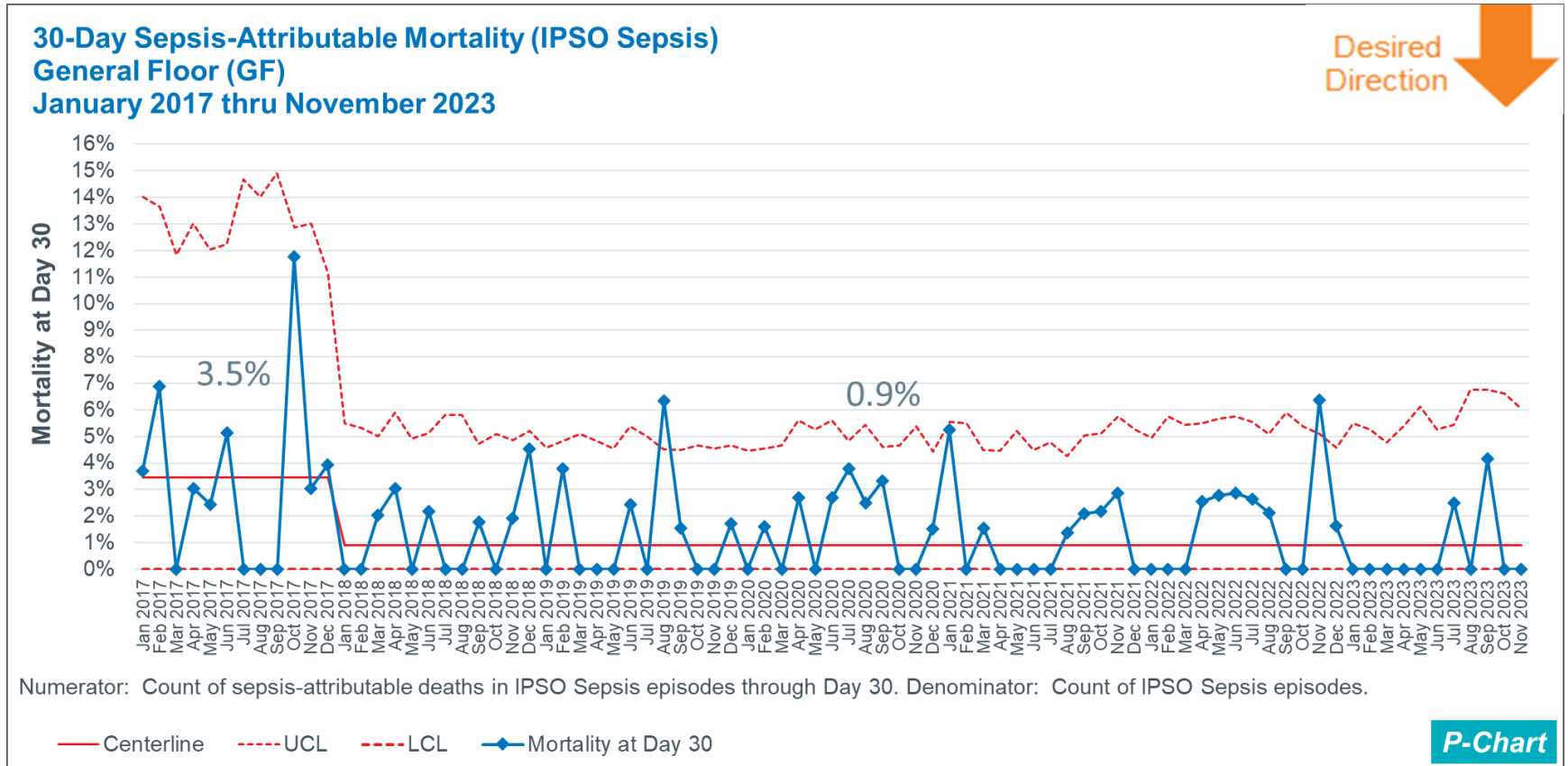
CONFIDENTIAL: IPSO Use Only. You are obliged by the IPSO Participation Agreement to keep confidential IPSO Data from other IPSO participating hospitals and the Collaborative.

Time to First Antibiotic



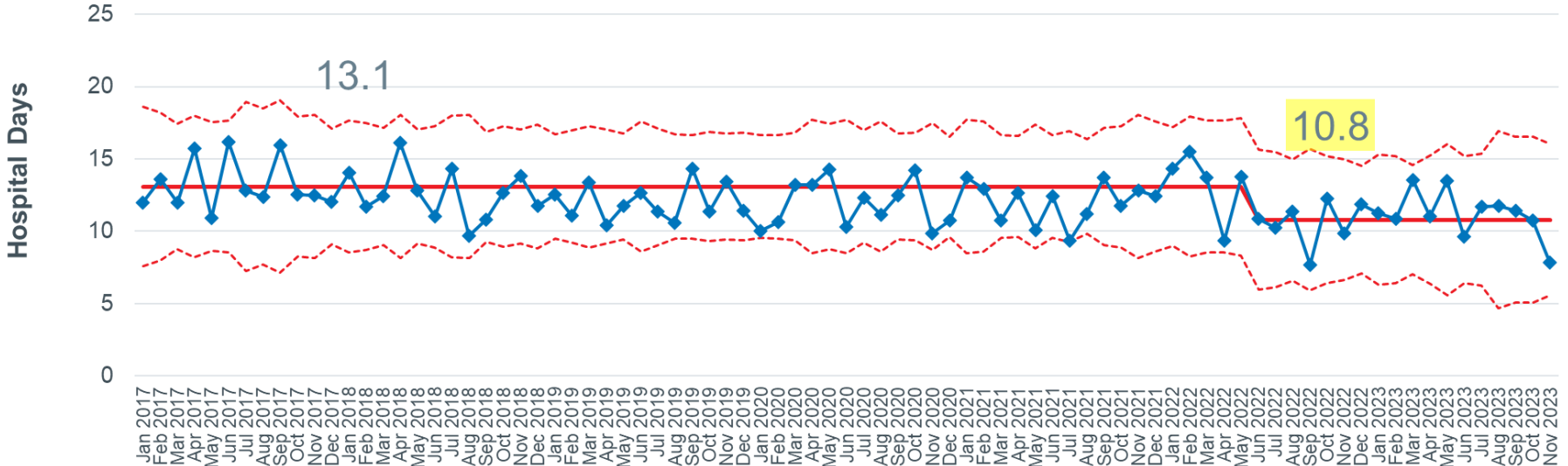
CONFIDENTIAL: IPSO Use Only. You are obliged by the IPSO Participation Agreement to keep confidential IPSO Data from other IPSO participating hospitals and the Collaborative.

30-day Sepsis Attributable Mortality



Hospital Length of Stay

Hospital Days per Sepsis Episode (IPSO Sepsis)
General Floor (GF)
January 2017 thru November 2023



Numerator: Sum of days from time zero through disposition date in IPSO Sepsis episodes. Denominator: Count of IPSO Sepsis episodes.

— Centerline - - - - UCL - - - - LCL ◆ Hospital Days

X-Bar





RESEARCH ARTICLE

Early Identification of Severe Sepsis in Pediatric Patients Using an Electronic Alert System

Uchechi Oddiri, MD,^a Grace Propper, MS, RN,^b Patricia Brill, MSN, RN,^b Brienna Reid, MSN, RN,^c Dominic Giarraputo,^c Carolyn Milana, MD^d

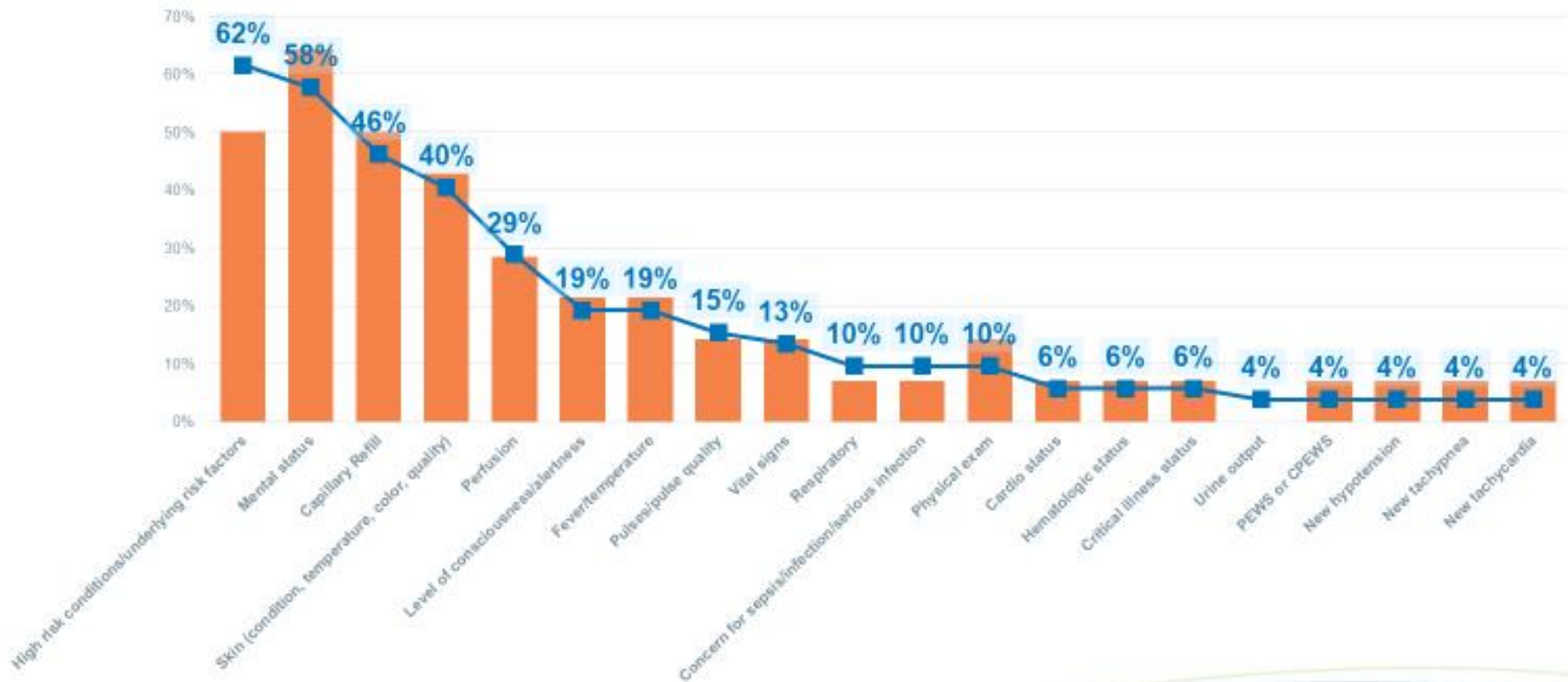
RESEARCH ARTICLE

Sepsis Prediction in Hospitalized Children: Model Development and Validation

Rebecca J. Stephen, MD, MS,^{a,b,d} Michael S. Carroll, PhD,^{a,c} Jeremy Hoge,^d Kimberly Maciorowski, RN, BSN, MS,^d Roderick C. Jones, MPH,^c Kate Lucey, MD, MS,^{a,b,d} Megan O'Connell, MSN, RN,^e Carly Schwab, BSN, RN, CPN,^e Jillian Rojas, MS, RN,^e L. Nelson Sanchez-Pinto, MD, MBI^{a,f}

Screening

What components need to be manually entered at the point of the BPA firing?

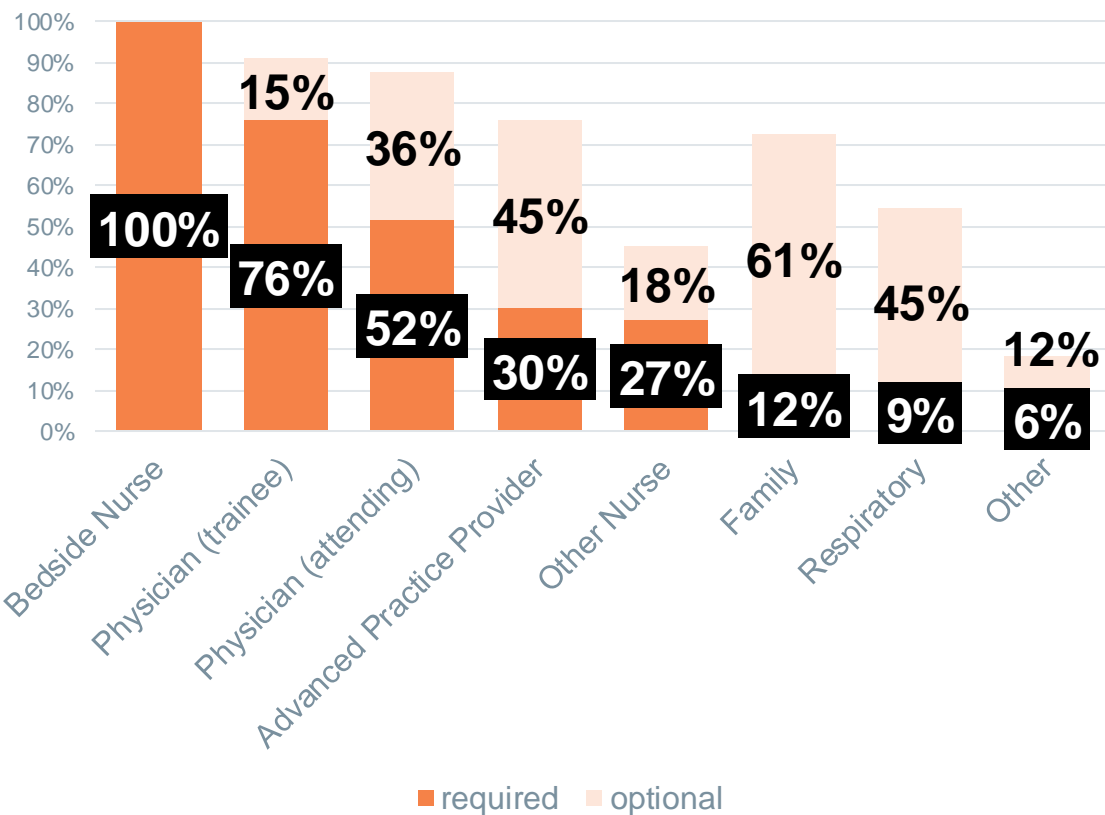


N = 14 screens with manual entry of some components on the General Floor

GF



Who participates in the sepsis huddle?



N = 33 huddles on the General Floor

GF

- Other Nurse**
 - Charge nurse (11)
 - Hospital Resource Nurse
 - Team Leader
 - Watch Nurse
- Other**
 - PICU Tech
 - Resource Nurse

Challenge sepsis.
Change lives.



Strategies at Children's Memorial Hermann: Screening

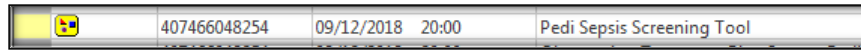
Jean Hsu

Creation of Sepsis Screen

- Prior to creation of sepsis screen, there was no trigger for calling a sepsis huddle.
- Step 1: we created a sepsis order set: ED, PICU, gen peds
 - Separate order set that alerts pharmacy to prioritize these antibiotics
 - Delivery time to order is less than 30 min
- Step 2: we created a sepsis screen
 - In 2016, started in ICU. 6 question manual screen
 - Then gen peds in 3 different “pods”. EMR live Sept 2018 for Sepsis month.

Sepsis Screening

A task fires for the RN **every four hours (8, 12, and 4)** to screen his/her patient for signs of sepsis.



The task takes the RN to I-view where the RN answers 6 simple questions.

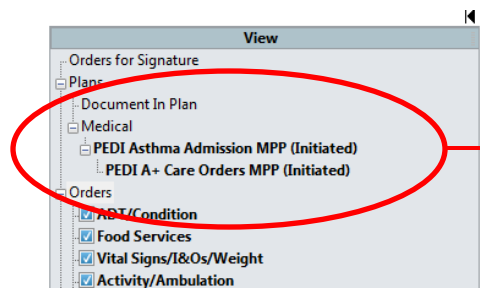
A screenshot of the Sepsis Screening Tool interface. It shows a table with columns for '05:00' and '06:00'. The table contains a list of screening questions, each with a dropdown arrow icon in the first column. The questions are:

	05:00	06:00
Pedi Sepsis Screening T...		
▾ Pedi Sepsis Screenin...		
▾ Sepsis MPP activated the last 7 days?		
▾ Any new fever/hypothermia?		
▾ Any new poor perfusion?		
▾ Any new hypotension?		
▾ Any new altered mental status?		
▾ Any new tachypnea?		
▾ Any new tachycardia?		
▾ A Sepsis huddle was called?		

	05:00	06:00
Pedi Sepsis Screening T...		
Pedi Sepsis Screenin...		
Sepsis MPP activated the last 7 days?		
Any new fever/hypothermia?		
Any new poor perfusion?		
Any new hypotension?		
Any new altered mental status?		
Any new tachypnea?		
Any new tachycardia?		
A Sepsis huddle was called?		

To answer the first question, the RN will verify what MPP's have been initiated along with the date and time

MPP's can be found in Orders/IPC.



By clicking on the MPP you can will find the date a MPP was initiated.

\$	Component	Status
	PEDI Asthma Admission MPP (Initiated)	
	Last updated on: 09/12/2018 12:20 by: [redacted]	
	ADT/Condition	

Pedi Sepsis Screening Form

	05:00	06:00
Pedi Sepsis Screening T...		
▾ Pedi Sepsis Screenin...		
◆ Sepsis MPP activated the last 7 days?	Yes	
◆ Any new fever/hypothermia?		
◆ Any new poor perfusion?		
◆ Any new hypotension?		
◆ Any new altered mental status?		
◆ Any new tachypnea?		
◆ Any new tachycardia?		
◆ A Sepsis huddle was called?		

Answering a 'Yes' to the first question completes the Sepsis Screening Tool, no further questions need to be addressed.
The patient is already being screened/treated for sepsis.

	05:00	06:00	0
Pedi Sepsis Screening T...			
▾ Pedi Sepsis Screenin...			
◆ Sepsis MPP activated the last 7 days?	No		
◆ *Any new fever/hypothermia?	◆		
◆ *Any new poor perfusion?	◆		
◆ *Any new hypotension?	◆		
◆ *Any new altered mental status?	◆		
◆ *Any new tachypnea?	◆		
◆ *Any new	◆		
◆ A Sepsis huddle was called?			

Answering 'No' to the first question opens the complete Sepsis Screen Tool with mandatory fields.
'New' is defined as any new symptom within the last 24 hours

If you answer "Yes" to any question after the first question, you will need to call a **sepsis huddle** as the patient has signs which indicate the patient may be developing sepsis.

Step 3: we created a huddle form

In 2020

ICU, gen peds

We are currently switching to EPIC this fall

Challenge sepsis.
Change lives.



Strategies at Upstate Golisano: Bedside tools

Melissa Schafer

Sepsis Protocol



Upstate Golisano Children's Hospital

- HOME
- PATIENTS & FAMILIES
- CLINICAL SERVICES
- ACADEMICS
- PROFESSIONALS
- ABOUT US

Professionals

Professionals

- Department of Pediatrics
- Adult Service/Provider
- Adult Pediatric Nursing
- University Hospital Nursing
- Adult ECHO
- Arch
- Continuing Medical Education
- Continuing Nursing Education
- Clinical Staff Services
- Forms, Bylaws, & Handbooks
- Infant Launch Pad
- Infant Report
- Infant Clinical Pathways

Pediatric Clinical Pathways

Upstate Golisano Children's Hospital has developed a number of pathways to create a shared mental model for the teams caring for children. These pathways combine the best available evidence as well as incorporating the input of multidisciplinary teams contributing to their creation. These pathways are designed to aid and support decision making, but individual patient care requirements and values may deviate from recommendations included.

Available Pediatric Pathways

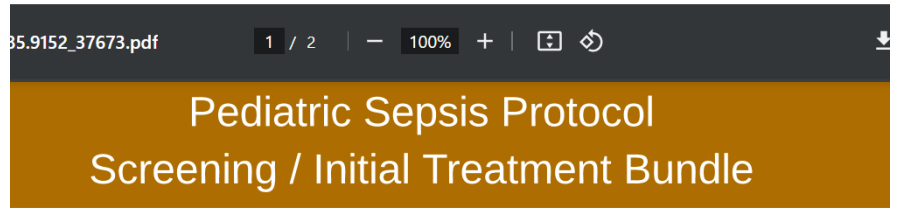
- [Acute Neurological Emergency](#)
- [Asthma](#)
- [Bronchiolitis](#)
- [Community-Acquired Pneumonia \(CAP\)](#)
- [COVID-19 - Acute](#)
- [Difficult Airway](#)
- [Eating Disorder Management Protocol](#)
- [Febrile Infant \(8-60 days of age\)](#)
- [Growth Faltering](#)

Sepsis Protocol

1-Medical Record Forms

Email Hide

IP, Peds ED, Peds HM



CRITERIA:
(age 0-19 years) in Peds with new onset of SIRS

CRITERIA:
on already under clinical change

NOTE:
Most common cause of SIRS. If in shock and etiology afebrile, treat empirically

NOTE:
Narrative has shown key steps with using bundles (huddles, order sets) and olus(es) within 1 hour and 3 hours of sepsis

ALUATION:
Identifying whether SIRS to a known or suspected infection risk factors and any RN Sepsis Huddle.

Recognition Bundle: Identification of SIRS

1. Abnormal Temp ($\geq 38.5^{\circ}\text{C}$ or $\leq 36.0^{\circ}\text{C}$) AND,
2. Abnormal HR or RR

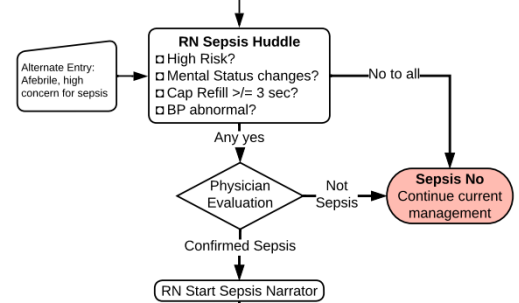
Age Group	HR	RR
0-3 mo	<80 or >190	>60
4 mo - 24 mo	>170	>40
2 yr - 5 yr	>140	>30
6 yr - 10 yr	>120	> 25
11 yr - 19 yr	> 100	>20

2020 Surviving Sepsis Guidelines
Tableau Dash

Signs of Shock:
- Poor Perfusion
- Hypotension (SBP < 70+(age x2))
- Altered Mental Status
- Organ Dysfunction


High Risk Condition

- Infant < 6 weeks or history of prematurity
- Central or indwelling catheter
- Immune suppression
- Asplenia
- Malignancy
- Post Transplant



Fluid Bolus Kit Created 2014 and Revised in 2022

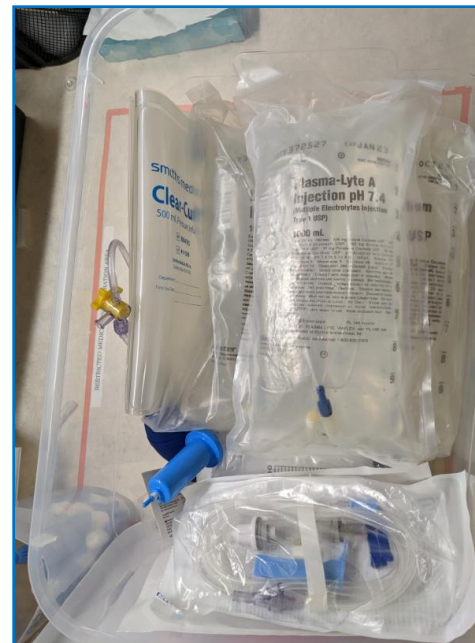
DELIVERING RAPID FLUIDS



DO NOT USE A PUMP TO DELIVER FLUIDS!!

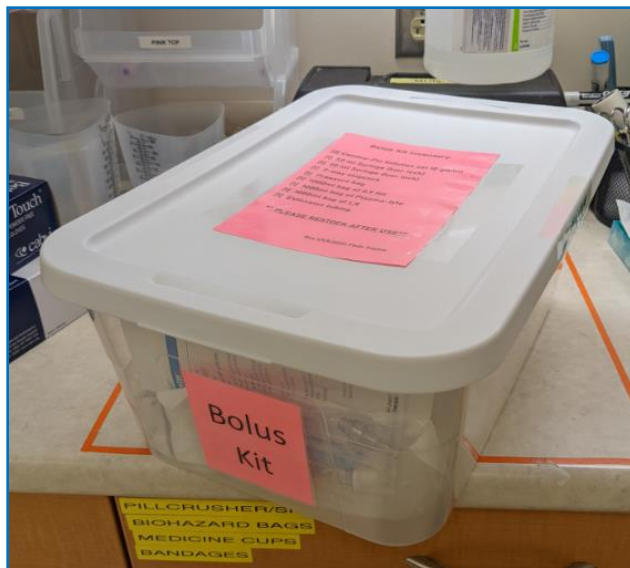
USE PUSH PULL METHOD, PRESSURE BAG, or RAPID INFUSER

Change in recommendations for balanced fluids, validated practice, adopted by Sepsis Committee



Standard contents

- 1- 1000 mL NS
- 1- 1000 mL LR
- 1---1000 mL Plasmalyte
- 2 -- 10 drop set IV tubing
- 1--60 cc Syringe (luer lock)
- 1--30 cc Syringe (luer lock)
- 2--3 way stopcock
- 1--pressure bag



One for every med room

Pediatric Sepsis Kit

Feedback from front line:

Delays of 1-3 hours (especially vancomycin) when no peds pharmacy is in house

Plan: Create sepsis kit to meet the bundle timeframe

Do: Kits created, changed protocol cards, and available on override

Study:

Some use for F&N or febrile infants considered acceptable.

No lazy pulls! No med errors.

Act: Adopted.

2021 kit time to abx. avg: 34 min
(60 min when kits not used)

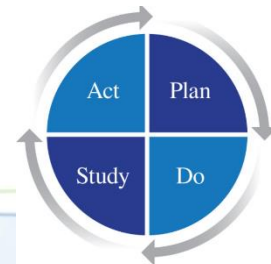
Pediatric Sepsis Antimicrobial Medications

Patient Name: Cora Lee Adt Patient MRN: 6060290
Patient Weight: 14.3 kg "Weight Confirmed" (INITIALS) (INITIALS)

Drug	Reconstitution	Dosing Information	Dosing
cefTRIAxone* 100 mg/mL	Use 1,000 mg vial (8) add 9.8 mL SWFI to each vial, yielding 100 mg/mL.	For patient < 14 days old 60 mg (0.5 mL)/kg For patients ≥ 14 days old 100 mg (1 mL)/kg Max Dose = 2,000 mg IV push over at least 5 minutes.	14.3 mL (1,430 mg) **above calculated dose is based on age**
ampicillin 100 mg/mL For patients less than or equal to 6 weeks old	Use 1,000 mg vial, add 9.4 mL SWFI, yielding 100 mg/mL.	50 mg (0.5 mL)/kg Max Dose = 1,000 mg IV Push over 3-5 minutes	7.2 mL (715 mg)
piperacillin-tazobactam (Zosyn) 225 mg/mL	Use 4,500 mg vial, add 20 mL SWFI, yielding 225 mg piperacillin-tazobactam / mL. (200 mg piperacillin and 25 mg tazobactam/mL)	112 mg (0.5 mL)/kg Max Dose = 3,375 mg piperacillin-tazobactam Infuse over 30 minutes	7.1 mL (1,601.6 mg) Further dilute in DSW or NS as per below: < 1,880 mg in 25 mL 1,881-3,375 mg in 50 mL
vancomycin 50 mg/mL	Using 1,000mg vial, add 20 mL SWFI, yielding 50 mg/mL.	15 mg (0.3 mL)/kg Max Dose = 1,000 mg Infuse over 60 minutes	4.3 mL (214.5 mg) Further dilute in DSW or NS as per below: < 125 mg in 25 mL 126-250 mg in 50 mL 251-500 mg in 100 mL 501-1,000 mg in 250 mL

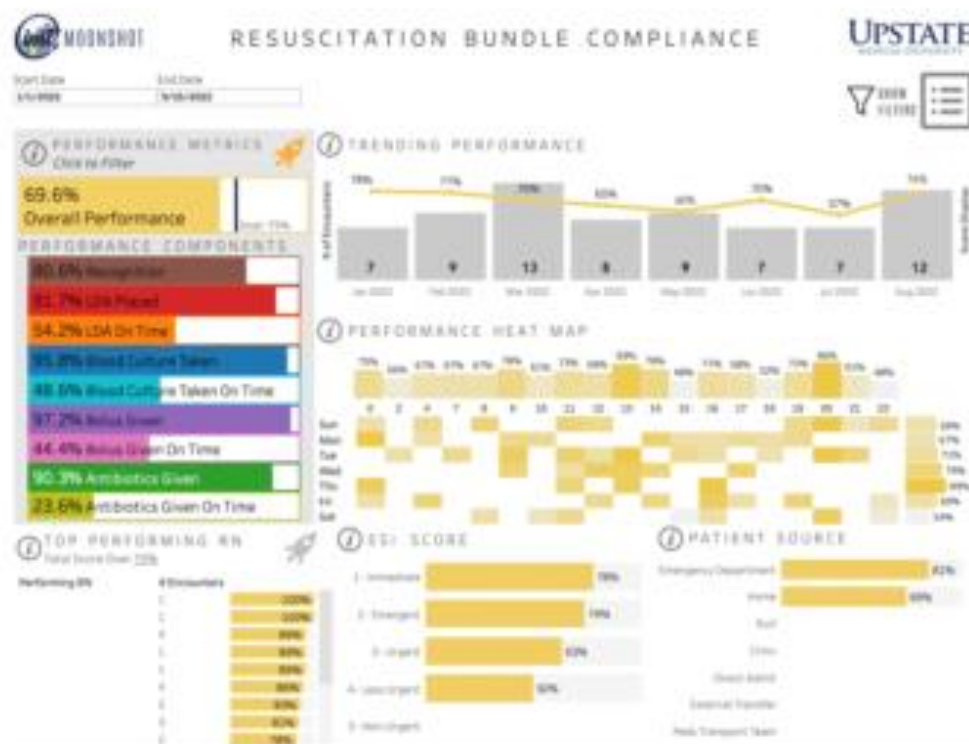
*Concomitant administration of cefTRIAxone with calcium or calcium containing fluids including LR is contraindicated in newborns < 28 days. For patients > 28 days old, concomitant administration with calcium containing fluids is only permissible through separate infusion lines (not y-site).

Doses rounded to the nearest 0.1 mL.



Bundle Compliance Dashboard

- At a glance performance overview
- Drill down by case and staff member
- Highlights high performers



There is always another opportunity

Melissa Schafer SchaferM@Upstate.edu

Jean Hsu jean.hsu@uth.tmc.edu

Next Sepsis Community of Practice Webinar:

Sustaining Sepsis Performance Improvement

Date/Time: September 18, 2024 1p ET (12p CT | 11a MT | 10a PT)

Presenters:

Deborah R. Campbell, Vice President, Clinical Strategy and Transformation,
Kentucky Hospital Association

Stephanie Lavin, Quality Improvement Coordinator, Cook Children's Health
Care System

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Questions and Answers