Improving Pediatric Sepsis Outcomes (IPSO) at Children's of Alabama

BACKGROUND

Pediatric sepsis is a global health problem associated with significant morbidity and mortality.[1] Early goal-directed therapy (EGDT) improves sepsis outcomes and is standard of care, but requires timely identification.[2-5] EGDT consists of fluid resuscitation, blood product administration where indicated, and use of vasopressor support to restore perfusion to organs. Rapid administration of broad-spectrum antibiotics to treat the underlying infection is another key component. The Surviving Sepsis Campaign guidelines for management of pediatric sepsis also recommend "systematic screening for timely recognition of septic shock and other sepsis-associated organ dysfunction."[6]

The Improving Pediatric Sepsis Outcomes (IPSO) collaborative is a quality improvement collaborative of more than sixty children's hospitals aiming to decrease sepsis-associated morbidity and mortality.[7] To identify patients with sepsis, the collaborative utilizes pragmatic definitions focusing on the clinical decision to initiate sepsis treatment.[8] IPSO sepsis definitions are presented in **Figure 1**. IPSO focuses on five key process measures related to screening and EGDT delivery as key mechanisms for improving outcomes. These include: 1) Sepsis Screening, 2) Sepsis Huddles, 3) Order set utilization, 4) Time to first fluid bolus, and 5) Time to first antibiotic administration. Key outcome measures include sepsis attributable mortality as well as hospital-onset sepsis.

Children's of Alabama has participated in the IPSO collaborative since 2018. The first intervention, a hospital wide sepsis screening process, was implemented in May 2018. The Sepsis Coordinating Council oversees sepsis work and consists of a multidisciplinary group of nurses, administrative leaders, performance improvement experts, information technologists, pharmacists, and physicians.

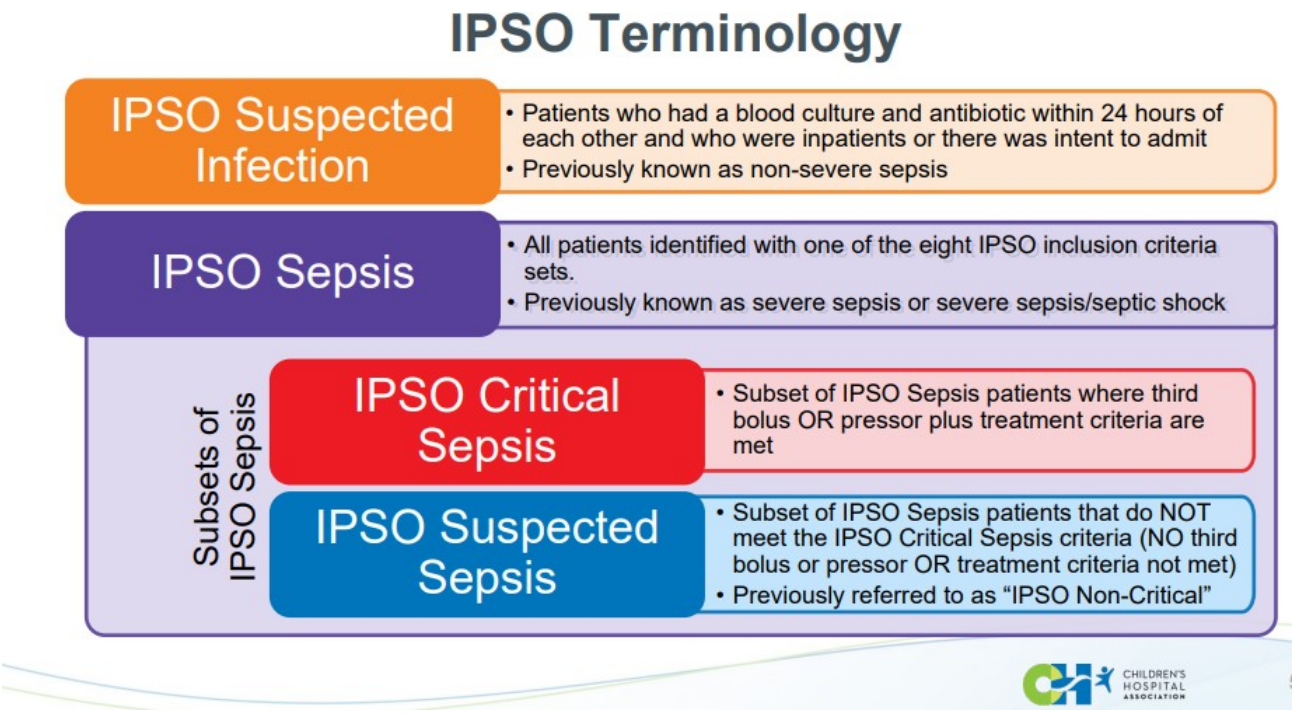


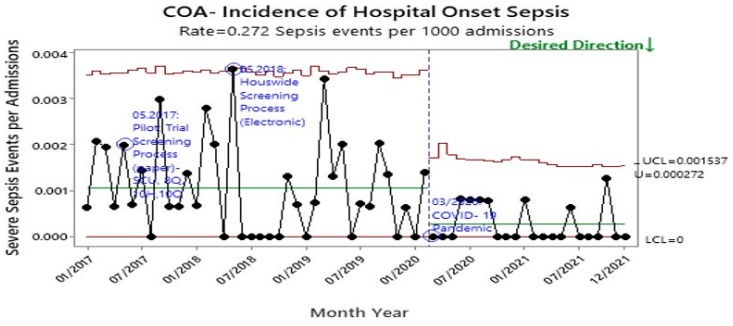
Figure 1: IPSO sepsis terminology and definitions

OUTCOMES

Hospital Onset Sepsis

Definition: onset of IPSO Critical Sepsis > 12 hours after arrival to Children's of Alabama; reported as rate per 1000 admissions

Progress: In 2017, hospital onset sepsis occurred at a rate of 1.24/1000 hospital admissions. In 2021, that rate decreased to 0.23/1000 hospital admissions (**81.5% decrease in desired direction**). As of December 31, 2021, there have been **zero episodes in 16 of the last 24 months** (66.7%). See Statistical Process Control Chart in **Figure 2**.



IPSO COLLABORATIVE

0.27/1000 admissions[1]

1.32/1000 admissions[1]

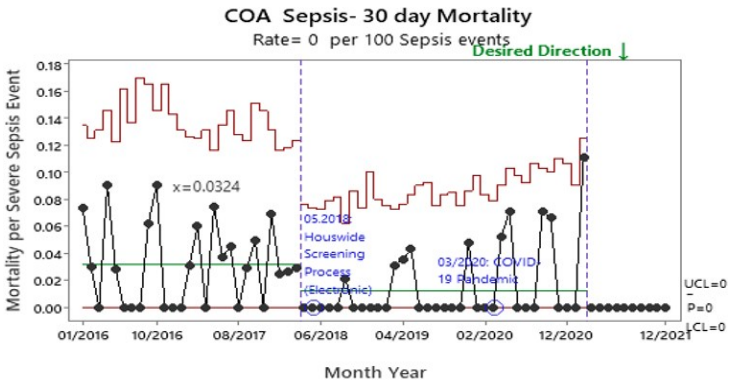
[1]Current Center Lines (mean)

Figure 2: Hospital onset sepsis at Children's of Alabama (Note: center line represents mean)

Sepsis Attributable Mortality (at Day 30)

Definition: all mortalities within 30 days of an associated with a positive sepsis trigger are reviewed by the physician champion who assigns sepsis attributable mortality; reported as a rate per 100 sepsis events

Progress: In 2017, the sepsis attributable mortality at day 30 rate was 3.45/100 sepsis events. In 2021, that rate decreased to 0.47/100 sepsis events (**86.4% decrease in desired direction**). As of December 21, 2021, there have been **zero mortalities in 10 consecutive months**. See Statistical Process Control Chart in **Figure 3**.



IPSO COLLABORATIVE

0% sepsis mortality[1]

1.87 % sepsis mortality[1]

[1]Current Center Lines (mean)

Figure 3: Sepsis attributable mortality at Day 30 at Children's of Alabama (Note: center line represents mean)

FIVE KEY PROCESS MEASURES

Sepsis Screening

Background: Sepsis screening was implemented in May 2018 following a pilot in May 2017. The screening process is active in all care environments except the intensive care units at Children's of Alabama. The screening process includes high risk historical factors as well as vital signs and physical exam findings. The screen occurs in triage in the Emergency Department and with every vital sign check in inpatient units.

Successes: A sustainable process was created and implemented in an organization made up of many diverse care environments that serve even more diverse patient populations.

Challenges and Barriers: The sepsis screen is anchored by the vital signs making up the Systemic Inflammatory Response Syndrome (SIRS) and the 2005 Goldstein Consensus Sepsis Criteria.[9] SIRS vital signs do not correlate with clinically diagnosed sepsis, critical care requirement, or mortality in children.[10] Pediatricians diagnose sepsis more broadly than the consensus criteria.[11] Therefore, sepsis screening founded on SIRS is likely to underperform and impact outcomes. The current screening sensitivity is 55% for 2021 (**Figure 4**). See **Future Directions** below.

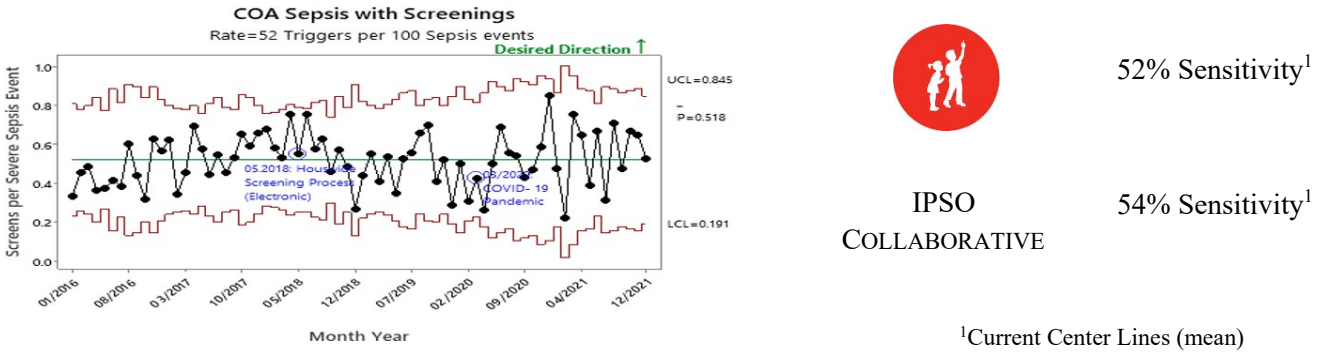


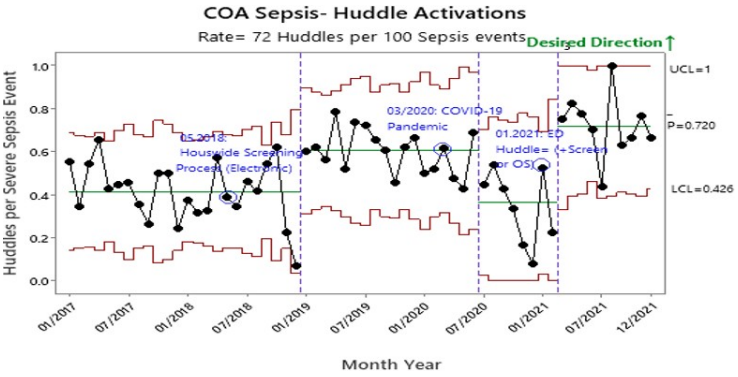
Figure 4: Sepsis screening sensitivity at Children's of Alabama (Note: center line is mean)

Sepsis Huddles

Background: A positive sepsis screen should always be followed by a huddle. This huddle should be multidisciplinary and focus on the decision to proceed with EGDT or to determine that the patient does not have sepsis. This step is essential for situational awareness and establishing a unified team plan. It develops a shared mental model.

Successes: With the exception of short decline in the last half of 2020 that was mainly due to data integrity issues, we have seen steady improvement in documented huddles. Compared to 2017, **huddles have increased by 15%** (**Figure 5**).

Challenges and Barriers: Huddles must be documented to count in the data abstraction. It is possible that more huddles occur. Further, informal discussion about a patient may not always be perceived as a true huddle. The spirit of the process is multidisciplinary communication occurring rather than documentation of that communication.



72% Huddle Compliance[1]

IPSO COLLABORATIVE

42% Huddle Compliance[1]

[1]Current Center Lines (mean)

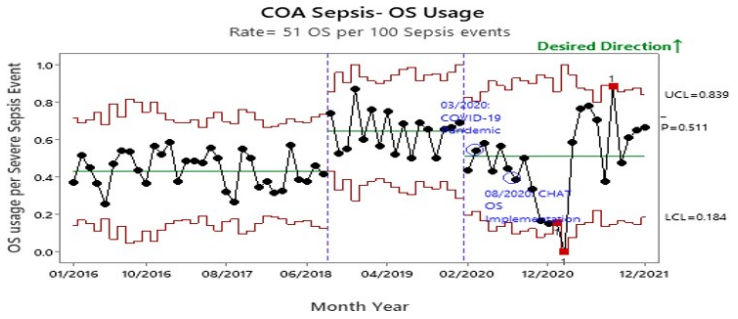
Figure 5: Sepsis Huddles at Children's of Alabama (Note: center line is mean)

Order Set Utilization

Background: Order sets function as an important cognitive support for prescribers with many competing demands. Order sets can reinforce best practice, provide clinical guidance, and may improve outcomes for a variety of diagnoses.[12-14] Additionally, they streamline the process of initiating needed therapies using an electronic medical record.

Successes: In 2020, all sepsis-related order sets were revised to align with the new Surviving Sepsis Guidelines for pediatric patients. Additionally, all antibiotic orders were coded to auto-populate the correct and most readily available dose. In 2020, given our success relative to the rest of the collaborative, our team was asked to present at the semi-annual IPSO conference about our work with order set utilization.

Challenges and Barriers: 1) Most common prescribers are residents and particularly interns. This is a group that changes every year leading to continuous re-education on the importance of order set utilization. 2) In busy and rapidly evolving care environments such as the emergency department and ICU, work flow may necessitate orders being place in piece meal fashion. 3) Evidence is constantly evolving which mandates regular updates to order sets to ensure best practice is reflected.



51% Order Set Compliance[1]

IPSO COLLABORATIVE

42% Order Set Compliance[1]

[1]Current Center Lines (mean)

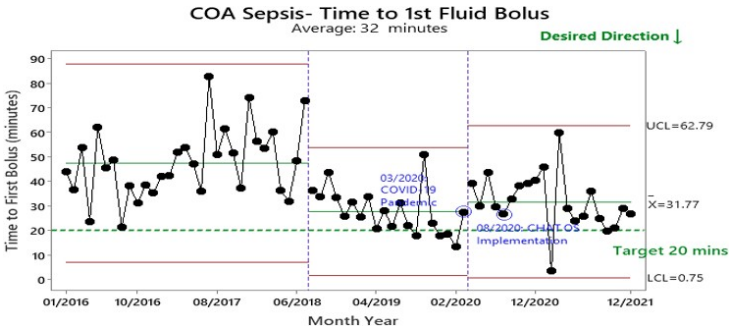
Figure 6: Order set utilization at Children's of Alabama (Note: center line is mean)

Time to First Fluid Bolus

Background: The central objective of EGDT is the restoration of perfusion to organs to prevent progressive to multi-organ dysfunction and death. Rapid fluid resuscitation is paramount to accomplish that objective. A fluid bolus should be administered within 20 minutes of sepsis diagnosis. This has been shown to decrease morbidity and mortality as part of bundled care.[15-17]

Successes: In 2017, the average time to first fluid bolus was 52 minutes. In 2021, the average was 29 minutes (**44.2% decrease in the desired direction**). Additionally, we have seen great progress as an organization in transitioning to more consistent use of the recommended lactated ringers rather than normal saline in sepsis fluid resuscitation.

Challenges and Barriers: When a patient is identified as having sepsis, they often do not have intravenous access. The clock is already ticking. Within 20 minutes, access must be obtained (and is often quite difficult in the sickest and smallest patients) and a fluid bolus must be rapidly administered via LifeFlow® gun. Achieving this goal is no small feat and requires great skill, diligence, and teamwork.



IPSO COLLABORATIVE

All Sepsis: 32 minutes[1]

IPSO Critical: 49 minutes[1]

IPSO Suspected: 35 minutes [1]

IPSO Critical: 37 minutes[1]

IPSO Suspected: 44 minutes[1]

[1]Current Center Lines (mean); IPSO does not report this metric for "All Sepsis"

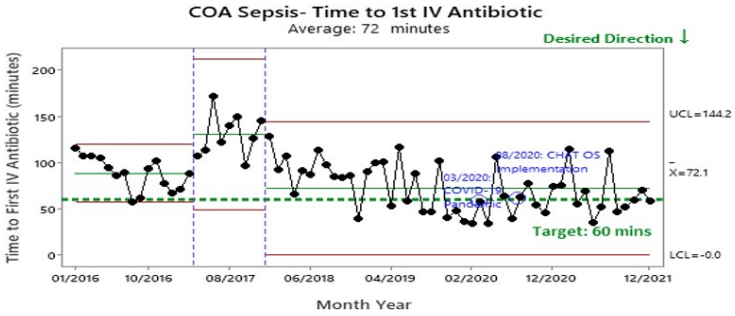
Figure 7: Time to first fluid bolus at Children's of Alabama (Note: center line is mean)

Time to First Antibiotic

Background: Like fluid resuscitation, rapid delivery of broad spectrum empiric antibiotics is a part of EGDT. The source of the infection must be treated to reverse the destructive pathophysiologic cascade of sepsis. The first dose of antibiotic should be administered within either 60 minutes or 240 minutes of sepsis diagnosis. The goal depends on illness severity. At Children's of Alabama, we hold ourselves to a higher standard – 60 minutes for all patients. This has also been shown to decrease morbidity and mortality as part of bundled care.[15-17]

Successes: In 2017, the average time to first antibiotic was 116 minutes. In 2021, the average was 67 minutes (**42.2% decrease in the desired direction**). As a balancing measure, antibiotic stewardship is monitored in the form of total antibiotic days. There has been no increase.

Challenges and Barriers: While fluid bolus administration within 20 minutes is challenging, consistently administering antibiotics within 60 minutes borders on the impossible. Intravenous access has to be obtained, but other processes must occur flawlessly as well. A prescriber must order the antibiotic with the correct dose and route. The pharmacist must approve the order and prepare the drug. The drug must be delivered to the bedside. The nurse must then administer the antibiotic. This is another example of a process that requires great skill, diligence, and teamwork.



IPSO COLLABORATIVE

All Sepsis: 72 minutes[1]

IPSO Critical: 50 minutes[1]

IPSO Suspected: 55 minutes[1]

IPSO Critical: 83 minutes[1]

IPSO Suspected: 114 minutes[1]

Figure 8: Time to administration of first antibiotic at Children's of Alabama (Note: center line is mean)

[1]Current Center Lines (mean); IPSO does not report this metric for "All Sepsis"

Unit Spotlight – Emergency Department

Our **Emergency Department** is on the **front line** and has the **greatest opportunity** to make an impact on sepsis care at Children's of Alabama. Along with that opportunity comes the enormous challenge of dealing with the huge number of non-septic patients also needing excellent care. That's not to mention that every child comes into the ED as an unknown entity and the **team must make a quick and accurate diagnosis**.

Our Emergency Department has shown sustained excellence in sepsis care, and antibiotic administration specifically, for over two years! **In 2020, they averaged 54 minutes for first dose of antibiotics. In 2021, they have averaged 56 minutes!** Two years of sustained success in the face of a national pandemic, staffing challenges, and high census is incredible and worthy of recognition.

While all team members deserve recognition, Sepsis Coordinating Council team members **Valerie Davis, MD** and **Judy Fuller, RN** deserve specific recognition. They have been instrumental in successes we have seen both in the Emergency Department and the organization as a whole. None of the successes detailed in this document would be possible without them!

Future Directions

As detailed above, our sepsis screening process can be improved. Sepsis is more than vital sign abnormalities. Sepsis is a dysregulated immune response that leads to organ dysfunction. As detailed above, the Surviving Sepsis Guidelines recommend screening for sepsis-associated organ dysfunction. Adult sepsis definitions have transitioned to an organ dysfunction model using the Sequential Organ Failure Assessment (SOFA) score. This score has been adapted to pediatrics (pSOFA) and validated to predict mortality.[18] Retrospective analysis of our screening performance and application of the pSOFA score revealed an opportunity for improved screening sensitivity and identification of patients at risk for the worst outcomes. A manuscript describing this analysis is currently under peer review. A taskforce is currently working to develop and implement a tiered screening approach that incorporates pSOFA. A proof of concept will be built and piloted in iConnect prior to incorporation into Epic.

Acknowledgements

The Sepsis Coordinating Council would like to thank the staff at Children's of Alabama! We succeed because of an organization that is united in provided the best care for children in our state. Further, we would like to acknowledge and thank the phenomenal administrative support for this work. There are too many names to list individually.

Current Sepsis Coordinating Council Members

Jeremy Loberger, MD – COA Sepsis Physician Champion; Pediatric Critical Care
Sherry Green, RN – Sepsis Coordinator; Performance Improvement
Jessica Hicks, MPH – Supervising Clinical Data Analyst, Performance Improvement
Valerie Davis, MD – Emergency Department Sepsis Physician Champion; Emergency Department
Judy Fuller, RN – Emergency Department Sepsis Nurse Champion; Emergency Department
April Yarborough, PharmD – Pharmacy
Amanda Morris, RN – Special Care Unit Nurse Educator
Brandy Reeve, RN – Nursing Administration
Ananya Manchikalapati, MD – Pediatric Critical Care Fellow
Mickinzie Morgan, MD – Pediatric Emergency Medicine Fellow
Carissa Green, RN – Information Technology
Janet Deason, PharmD – Pharmacy
Brenda Denson, PharmD – Pharmacy

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Codes Outside the ICU

Although 2020-2021 did show a marked increase of 35% of code events outside of the ICU, we were still able to decrease **PREVENTABLE CODES** by 38%. This is a remarkable achievement with The Urgent Transfer process and Watcher Patient Huddles continuing to positively impact our preventable codes outside of the ICU. The Watcher Huddles provide an avenue for addressing concerns identified by bedside staff to other healthcare disciplines. It encourages a team approach for patient care. The Urgent Transfer Process provides an expedited pathway for high risk patients to be transferred to a higher level of care. Since the implementation of the Urgent Transfer process, COA has experienced a 70% decrease in the **PREVENTABLE CODE** rates.

Unplanned Extubation (UE)

During 2021, the UE HAC team has worked alongside the ICU staff to achieve an overall decrease in all UE events. There was a 21% decrease in UE events (42 to 33), 29% decrease in the UE Rate (0.56 to 0.40), and an overall 47% decrease in NICU UE rate (0.74 to 0.39). The NICU saw 1084 more vent days in 2021 vs 2020. This past year the team also worked with radiology to implement a new process of adding chest X-Ray annotations to ensure endotracheal tube placement. This addition has helped contribute to 2021 being a successful year for the committee.