Take-Home Points: Five Things to do to Improve Pediatric Sepsis Care
(In Order of Best Bang for the Implementation Buck)

1. **Create an ordering system** / order set for pediatric sepsis
    a. Consider embedding pediatric antibiotics in an existing adult sepsis order set, or create a pediatric-specific one
    b. If there is a backlog to order set creation, start with distribution of a paper antibiotic algorithm for pediatric sepsis

2. **Work on antibiotic delivery processes**. This may be more complicated than in adults because children require weight-specific dosing.

3. **Don't miss hypotension**
    a. Measure blood pressure in febrile children
    b. Know age-specific norms. If you have capacity to build an EHR alert/detection tool, start with alerts for hypotension. Our experience is that this does not lead to alarm fatigue because hypotension is rare, and actionable.
    c. Treat it: Fluid first; vasoactives should be on board within the first hour of hypotension (if fluid didn't fix it)

4. **Measure your performance***
    a. Time from order to antibiotic delivery (goal <60 min)
    b. Time from recognition/severe sepsis to antibiotics (goal <3 hours)
    c. Time from recognition to bolus start (goal < 30 min)
    d. Time from hypotension to resolution or starting vasoactives (goal <60 min)

5. **Enhance diagnosis***
    a. Although it's ideal to recognize before organ dysfunction, if you are building an alert, hypotension and high lactate are great starting points to catch the sickest patients
    b. Audit & Feedback (tell providers how they did)
    c. Initiate triage screen/EHR alert for a sepsis huddle

*Labor-intensive but effective strategies

Key Points to Remember and Teach about Pediatric Sepsis Care:

Topic	Kids Are Like Adults	Kids Are Different
Antibiotics	Give broad-spectrum antibiotics quickly!	Weight-specific dosing
Fluids	Like adults, no one knows the "perfect" amount to give each patient.	Generally, somewhere between 30-60 mL/kg is appropriate. Try to target clinical euvolemia.
Vasoactive Agents	Starting a vasoactive is preferable to allowing a patient to sit hypotensive	There is not consensus on the best first agent – start with what seems to best fit the clinical picture and adjust as needed. The majority of children benefit from **alpha** and **beta** agonists (i.e. epinephrine or dopamine). Dopamine is used commonly in children and is acceptable. Starting with either epinephrine or norepinephrine (instead of dopamine) is becoming more common.
Laboratories	Organ dysfunction ("severe sepsis") is measured with the same tests as in adults	Thresholds for dysfunction are age-specific (for example creatinine)
Lactate	High lactate should be taken seriously. >4 is considered high, >2 is intermediate. Trending lactates can be useful as in adults	Many very sick children will have low lactate levels, so do not let this reassure you too much
Definitions	Several sets of definitions exist; none are perfect. SIRS and "pSOFA" exist for children as well	New unifying definitions may be on the horizon

For More Information

Current pediatric guidelines:
https://journals.lww.com/ccmjournal/Fulltext/2017/06000/American_College_of_Critical_Care_Medicine.18.aspx

Watch Surviving Sepsis Campaign for pediatric guidelines (late 2018-early 2019):
http://survivingsepsis.org/Pages/default.aspx

The Children's Hospital Association's Improving Pediatric Sepsis Outcomes collaborative:
https://www.childrenshospitals.org/sepsiscollaborative

Traditional pediatric sepsis definitions, with age-specific organ dysfunction thresholds:
https://www.ncbi.nlm.nih.gov/pubmed/15636651

Newer proposed "pSOFA" with age-specific organ dysfunction thresholds:
https://jamanetwork.com/journals/jamapediatrics/article-abstract/2646857?redirect=true

Children's Hospital Colorado Pathways attached; for any questions, or screenshots of ordersets:
halden.scott@childrenscolorado.org

Another example of a pediatric sepsis pathway from the Children's Hospital of Philadelphia:
http://www.chop.edu/clinical-pathway/sepsis-emergent-care-clinical-pathway

Sepsis diagnosis systems used at several children's hospitals:
https://www.ncbi.nlm.nih.gov/pubmed/28583403
https://www.ncbi.nlm.nih.gov/pubmed/22929140
https://www.ncbi.nlm.nih.gov/pubmed/27604184

Age-specific hypotension:

Age	Systolic BP
0-30 days	<60 mm Hg
1-12 months	<70 mm Hg
1 year	<72 mm Hg
2 years	<74 mm Hg
3 years	<76 mm Hg
4 years	<78 mm Hg
5 years	<80 mm Hg
6 years	<82 mm Hg
7 years	<84 mm Hg
8 years	<86 mm Hg
9 years	<88 mm Hg
10 years and older	<90 mm Hg

ED Sepsis Pathway

Fever or clinical scenario consistent with infection

Suspect sepsis?

No → Not Sepsis
Consider myocarditis, PE, other mimickers

Yes → Which criteria does patient meet?

Sepsis STAT Criteria:
Fever/suspected infection
and any of the following:
- Hypotension
- Altered mentation
- New need for positive pressure ventilation
- Lactate greater or equal to 4 mmol/L
- Acute kidney injury
- New coagulopathy
- New liver dysfunction
- Acute need for resuscitation room

Sepsis Yellow Criteria:
Fever/suspected infection
and
- Immunosuppression/immunocompromise (e.g. oncology patients, organ transplant patients, patients on immunomodulators)
- Central venous catheter
- Clinically concerning symptoms: changes to capillary refill, peripheral pulse quality, concerning rashes, orthostasis

Escalate to STAT if any STAT criteria develop

1 Activate and Notify

Activate Sepsis STAT
- Verbal or paging notification per site protocol
- Use ED Sepsis STAT order set
- CR monitor, vs per order set

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2 Rapid Access

IV Access x2
- 2 Peripheral IVs with largest gauge possible – antecube is preferred
- 2nd PIV recommended for ports, double lumen large central lines do not require additional access
- If no access within 15 minutes, consider I/O

PIV or Central Line Access Immediately
- If no access after 15 minutes, consider options for escalation

Escalate to STAT if any STAT criteria develop

3 Labs

Use Order Set to Order:
- Cultures, CBC, lactate, VBG, CMP, DIC Panel, additional labs PRN

Use Order Set to Order:
- Cultures, CBC, lactate, additional labs PRN

Escalate to STAT if any STAT criteria develop

4 Consider or Push Fluids

Rapid Push/Rapid Reassess, Repeat PRN
- Set up push-pull less than 40kg
- Level 1 infuser or pressure bag for greater than or equal to 40kg
- Begin rapid infusion within 15 minutes of activation
- 20ml/kg over 10 minutes
- Immediate clinical reassessment of volume/perfusion; repeat bolus until clinical euvolemia achieved (usually 30-60ml/kg)

Consider Fluids
- Begin bolus within 15 minutes of activation
- Upgrade to STAT if bolus rate faster than 1 hour desired (more personnel required for non-pump administration)

Escalate to STAT if any STAT criteria develop

5 Antibiotics

First Dose or Consider Broadening
- Rapid, immediate antibiotics per antibiogram and order set
- Goal of less than or equal to 60 minutes from order to administration of antibiotics

First Dose or Consider Broadening
- Immediate, empiric antibiotics may be required for many Yellow patients
- May start Yellow without antibiotics if clinical re-evaluation is needed
- Use antibiogram and order set for guidance based on clinical suspicion

6 Continued Care and Disposition

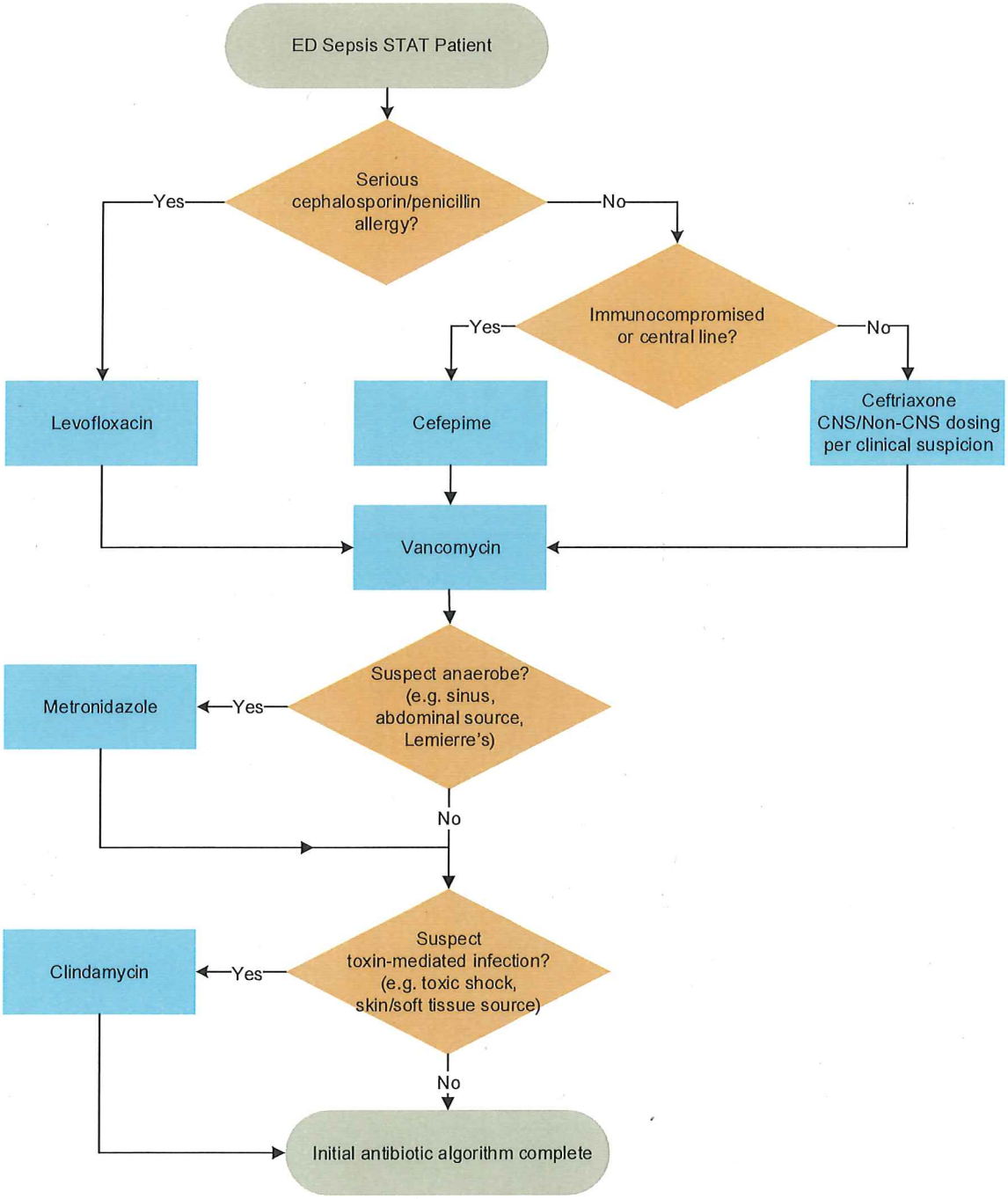
Advanced Resuscitation
- Oxygen/ventilation support as needed
- Start vasopressors within first 60 minutes of hypotension if hypotension does not respond to fluid administration
  - Dopamine/Norepinephrine/Epinephrine acceptable first-line vasopressors if available in less than 10 minutes
  - Dopamine is acceptable and rapidly available in most locations
  - Norepinephrine/Epinephrine may be used for specific clinical conditions
- Consider steroids for adrenal insufficiency or meningitis
- Source control: consider need for drainage or removal of source of infection (e.g. abscess, hardware); consult surgical services PRN

Escalate to STAT if any STAT criteria develop

Disposition Planning
- Ensure all antibiotics administered
- Review lab results
  - Identify organ dysfunction; address as appropriate
  - If lactate greater than 2 mmol/L, recheck in 2 hours
  - Correct any electrolyte, glucose derangements
- Re-assess hemodynamic stability
- If acute organ dysfunction present/unresolved, consider ICU admission

ED Disposition

ED Antibiogram for Suspected Sepsis in Patients > 60 Days



Additional Considerations:

- Check prior +cultures. For patients with history of resistant pathogens, add coverage based on historic susceptibilities.
- For patients on broad-spectrum antimicrobials, consider yeast coverage in consultation with subspecialty services.
- For patients with suspected meningitis, consider dexamethasone immediately before or shortly after first antibiotic dose.
- Consider ID consultation for allergies, history of resistance, yeast coverage or other complicating factors. Primary service should be consulted as soon as feasible.
- Ongoing care team should review and continue antibiotics as indicated.
- For CNS coverage, ceftriaxone may require dosing every 12 hours rather than every 24 hours. Please discuss at handoff.

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