Johns Hopkins Children's Center: Considerations to Reduce Pediatric Blood Cultures

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Context

BD Diagnostics, Inc. has reported an interruption in the production of BACTEC pediatric and adult aerobic and anaerobic blood culture bottles through September 2024. While blood cultures are the primary diagnostic test to diagnose bloodstream infections, **many blood cultures are obtained when the suspicion of a bloodstream infection is low** (for example, some common infections (community-acquired pneumonia) or signs of infection (isolated fever) are not usually associated with bacteremia), We encourage everyone to be proactive and help preserve our blood culture bottle supply.

Supporting Evidence

Multiple studies, including several conducted at the Johns Hopkins Children Center (JHCC), have demonstrated that the implementation and utilization of a clinical algorithm for fever or clinical instability safely reduces the number of blood cultures obtained in hospitalized children[1-5.] Blood culture stewardship has been implemented at more than 20 hospitals in the U.S. and U.K., as part of BrighT STAR, a JHCC-led diagnostic stewardship collaborative, that has safely reduced the number of blood cultures collected with no increases in sepsis, septic shock, mortality, length of stay, or readmissions. Additionally, these clinical decision support tools reduced broad spectrum antibiotic use by 13%[4].

Consensus Recommendations by pediatric experts support that in scenarios with low likelihood of bacteremia, blood cultures in febrile patients can be safely avoided if there are no other signs of sepsis in the following scenarios [3]:

- New fever within 24 hours of surgery
- Surveillance for ECMO, CRRT, or immunocompromised patients
- Inadvertent CVC disconnection or broken/cracked CVC without symptoms
- Immunocompetent children with viral syndrome and fever within expected time course for viral infection
- Fever and symptoms of sedative/opioid withdrawal responsive to treatment
- Persistent fever with prior negative cultures and no plan to change antibiotics

Next Steps

- ✓ Identify areas with highest blood culture utilization to focus education, intervention, and data feedback.
- ✓ Prioritize blood cultures for patients with high suspicion for bloodstream infection.
- ✓ Identify scenarios where blood cultures may be avoidable in your patient populations to decrease unnecessary blood culture utilization
- ✓ Optimize blood cultures that are obtained

Tools and Resources

The following attached JHCC tools are available to assist in determining blood culture utility:

- JHCC Pediatric blood culture algorithm (developed for hospitalized children)

Blood Culture Collection Best Practices

- ✓ Appropriate blood volumes increase the chance of isolating and identifying an organism. Inadequate blood volumes may result in false negative blood cultures and adversely affect patient outcomes.

All children > 13 kg

One (1) aerobic and one (1) anaerobic bottle sent per venipuncture or line draw (one blood culture).

Weight	Bottle	Volume
NICU	Pink capped	1 mL
<8 kg	Pink capped	2 mL
8-13 kg	Grey or Blue capped	5 mL
14-27 kg	Purple AND Grey or Blue capped	5 mL 5 mL
28-40 kg	Purple AND Grey or Blue capped	10 mL 10 mL

All children > 40 kg

Two (2) blood cultures obtained from two (2) separate peripheral venipuncture sites inoculated into aerobic and anaerobic bottles sent per septic or febrile episode.

> 40 kg	Purple AND Grey or Blue capped	10 mL 10 mL

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2. Woods-Hill CZ, Fackler J, Nelson McMillan K, Ascenzi J, Martinez DA, Toerper MF, Voskertchian A, Colantuoni E, Klaus SA, Levin S, Milstone AM. Association of a Clinical Practice Guideline With Blood Culture Use in Critically Ill Children. JAMA Pediatr. 2017 Feb 1;171(2):157-164. doi: 10.1001/jamapediatrics.2016.3153. PMID: 27942705.
3. Woods-Hill CZ, Koontz DW, Voskertchian A, Xie A, Shea J, Miller MR, Fackler JC, Milstone AM; Bright Star Consensus Authorship Group. Consensus Recommendations for Blood Culture Use in Critically Ill Children Using a Modified Delphi Approach. Pediatr Crit Care Med. 2021 Sep 1;22(9):774-784. doi: 10.1097/PCC.0000000000002749. PMID: 33899804; PMCID: PMC8416691.
4. Woods-Hill CZ, Colantuoni EA, Koontz DW, et al. Association of Diagnostic Stewardship for Blood Cultures in Critically Ill Children With Culture Rates, Antibiotic Use, and Patient Outcomes: Results of the Bright STAR Collaborative. *JAMA Pediatr*. 2022;176(7):690–698. doi:10.1001/jamapediatrics.2022.1024
5. Sick-Samuels, A., Woods-Hill, C., Fackler, J., Tamma, P., Klaus, S., Colantuoni, E., & Milstone, A. (2019). Association of a blood culture utilization intervention on antibiotic use in a pediatric intensive care unit. *Infection Control & Hospital Epidemiology, 40*(4), 482-484. doi:10.1017/ice.2019.10

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Preventing Antibiotic Resistance, Organism Transmission and Healthcare-Associated Infections in Children

Pediatric Blood Culture Decision Tool for Evaluation of Patient with Fever[1] OR Instability[2]

New symptoms[3]

Immunocompromised? [2]

Yes → **Obtain simultaneous blood culture from every lumen in use, plus a peripheral source.** [4, 5, 6, 7, 8] → **Yes** → **Order antibiotics STAT. Floor patients: use "Critically ill child" order set. ICU patients: use "Pediatric suspected sepsis" order set. These are exempt from ID approval.**

No

Concern for sepsis or bacteremia? [2]

Yes → **Obtain optimal volume blood culture, peripheral culture preferred.** [6, 7, 8] → **Yes** → **Order antibiotics STAT. Floor patients: use "Critically ill child" order set. ICU patients: use "Pediatric suspected sepsis" order set. These are exempt from ID approval.**

No

Presence of central line?

Yes → Instability with use of central line or signs of local line site infection? Concerns for contaminated or compromised line (cracked/disconnected with symptoms)?

- **Yes** → **Obtain central line culture(s) in addition to peripheral culture.** [4, 5] **Consider line removal.**
- **No** → A central line culture is not necessary. Consider central culture if the goal is to salvage the catheter if patient is found to be bacteremic. [4, 5] Alternatively, can wait to obtain a central culture if the peripheral culture is positive and will try to salvage the central line.

No → Blood cultures may not be necessary. Consider other causes of fever.

Persistent or recurrent symptoms[3]

Is there a new concern for sepsis, primary or secondary bacteremia? [2]

Yes → Obtain optimal volume blood culture, peripheral preferred.[6, 7, 8]

No

Immunocompromised? [2]

Yes → **Recommend to have a persistent fever plan with primary team and relevant consultants.** **If repeating blood culture for persistent fever, obtain a single blood culture and coordinate with other blood draws.[7]** After 72 hours of fever in a stable patient with prior negative blood cultures, repeated blood cultures are low yield may not be necessary.

No

Blood cultures may not be necessary for patients with persistent fever without other signs of sepsis/bacteremia and prior blood cultures within 48 hours, psarticularly if there is a known etiology for the fever.
Consider other causes of fever. The pediatric fever algorithm may be helpful. Consider ID consultation.

See back for footnotes

This is not an exhaustive list of devices or sources of fever. Please evaluate patient on individual basis and consider both risk factors for infections and non-infectious diagnoses.

[1] Fever/hypothermia (If multiple measurements, take 1 hour apart):

- For neonates <2 months gestational age: 38 C x1, <36 C x2, or increased need for temperature support if in isolette.
- For immunocompromised: 38 C x2 or 38.3 C x1
- For immunocompetent: 38.3 C x2, 38.5 C x1, or <36 C x2

[2] Instability or sepsis, not explained by another cause, include rigors, hypothermia, hypotension (absolute or relative in patients on anti-hypertensive medications), use of vasoactive medications, tachycardia, mental status changes, poor perfusion, worsening organ dysfunction (lactemia, metabolic acidosis, acute kidney injury), respiratory decompensation, unexplained glucose instability.

- Neonatal patients may have new or increased apnea/bradycardia events or concern for NEC/SIP.
- Immunocompromised patients (e.g., neutropenic, chemotherapy, s/p BMT within 1 year, s/p solid organ transplant, or primary immunodeficiency) may have masked signs of sepsis, particularly if chronic steroids ≥ 1 mg/kg/day.

[3] New vs. Persistent symptoms:

New symptoms - began in last 48 hours. For example, at least 48 hours since last fever.

Persistent or recurrent symptoms - The patient has had these symptoms within the past 48 hours and has undergone an initial evaluation. If the symptoms resolved and recur after 48 hours, consider a new evaluation.

[4] For patients with long-term necessary catheters (e.g., short bowel, dialysis), consider blood cultures from central line lumens and peripherally to distinguish catheter colonization from bacteremia and to inform possible salvage of the central line. If considering catheter salvage, re-culture every positive lumen daily until negative.

[5] Differential time-to-positivity can help distinguish catheter-related blood-stream infections from bacteremia unrelated to the central line. To be valid, equal volumes of blood must be obtained simultaneously from each lumen and peripheral source and inoculated in the same type of culture media. Do not let difficulty obtaining peripheral blood cultures delay initiation of antibiotics (standard is <60 min from neutropenic fever to broad-spectrum coverage).

[6] Peripheral cultures are preferred over central line culture because there is an increased risk of contamination from bacteria on the catheter that do not reflect true bacteremia (false positive). Contaminated blood cultures result in increased testing and/or procedures, length of stay, and hospital charges.

[7] For blood volumes by size, see the blood culture volume guidelines for Pediatric patients in HPO or pediatric infectious disease treatment guidelines intranet page.

[8] After 2 unsuccessful peripheral attempts, consider alternative blood sources in the following order: 1) arterial stick 2) central line culture, 3) If patient has arterial line, change the arterial line set-up before using it as the last option.

Updated 9.23.23. For internal use only. Please see website for most up-to-date version:
https://intranet.insidehopkinsmedicine.org/asp/pediatric.html
Updated by Anna Sick-Samuels and Aaron Milstone

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Blood cultures

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