

Prescribers' knowledge, attitudes and perceptions about blood culturing practices for adult hospitalized patients: a call for action

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To the Editor—The clinical variables that most commonly trigger blood cultures in daily practice (eg, fever, leukocytosis) correlate poorly with bacteremia.^{1–3} Published guidelines do not provide specific recommendations for when blood cultures should be drawn.^{2,4–6} Liberal blood culture testing may result in unnecessary and potentially harmful consequences: exposure to unnecessary antibiotics, unnecessary removal of venous catheters, overestimation of central-line-associated bloodstream infections (CLABSI) and added healthcare costs.^{7,8}

We surveyed prescribers' knowledge, attitudes, and perceptions regarding blood cultures to help in developing future interventions aimed at optimizing blood culture testing of adult patients. Using the Qualtrics survey system, an 8-item electronic questionnaire was sent to 359 providers who provide clinical inpatient care at The Johns Hopkins Hospital: medical and surgical physician assistants and nurse practitioners (PAs/NPs), medicine house staff, hospitalists, intensivists and infectious disease (ID) physicians. We developed the survey and pilot-tested it among 7 prescribers for readability and relevance of specific items. Answers to questions that used a 5-point Likert scale were condensed into 2 categories: agree/strongly agree and neutral/disagree/strongly disagree. The survey was anonymous and voluntary. No incentives were offered for participation. Differences between groups were assessed with nonparametric tests (Fisher exact and Wilcoxon rank sum) using Stata version 13.0 software (StataCorp, College Station, TX). A 2-sided P value $< .05$ was considered statistically significant for all tests. The Johns Hopkins University Institutional Review Board acknowledged this study.

Overall, 109 providers (30%) completed the survey. The median number of years of work experience for respondents was 7.5 (interquartile range [IQR], 4–12) for PAs/NPs, 5 (IQR, 3.5–16) for medicine attendings (hospitalists and intensivists), and 13 (IQR, 4–17.5) for ID physicians. Only 50% of PAs/NPs responded that they would order blood cultures for a new fever in a non-ICU patient, but this proportion increased to 83% if the patient was in the ICU ($P < .01$) (Table 1). For other provider groups, $>75\%$ of respondents would obtain blood cultures for this reason regardless of patient location. House staff and PAs/NPs were more likely to obtain blood cultures for new leukocytosis in an ICU patient than for a patient not in the ICU ($P < .01$ for house staff and

$P = .02$ for PAs/NPs). The proportion of respondents who would order a follow-up blood culture for patients with *S. aureus* or gram-negative bacteremia in the preceding 24 hours was similar by role, regardless of ICU location. The prescribers more likely to order follow-up blood cultures for gram-negative bacteremia had less years of experience compared to the prescribers unlikely to order blood cultures for this indication (5.2 vs 9.1 years, respectively; $P < .01$). Single blood cultures were considered appropriate to detect bacteremia in follow-up cultures by 88% of trainees, 56% of medicine attendings, 54% of ID physicians, and 45% of PA/NPs. More than 80% of all respondents agreed that clinicians order blood cultures reflexively in response to signs and symptoms such as fever.

Most respondents ($>85\%$) believed that blood cultures are expected as part of a patient's work up, and many reported that a protocol with indications would improve blood culture ordering practices ($>80\%$ of medicine attendings and ID physicians, 72% of PAs/NPs, and 69% of house staff). Fewer respondents felt that order sets or communication among prescribers or between prescribers and nurses would improve blood-culturing practices. Concern for missing an infection was identified by $>85\%$ of respondents as a barrier to reducing the number of blood cultures in clinical practice. Respondents with fewer years of clinical experience agreed with this statement (7.3 years for those who agreed versus 10.5 for those who disagreed; $P = .04$). The consulting service was identified as a barrier to decreasing blood culture testing by 81% of attendings, 79% of PAs/NPs, 54% of ID physicians, and 51% of house staff.

Our study results suggest that decision making around blood cultures is multifactorial and is influenced by the provider's role, the provider's years of clinical experience, and patient location (ICU vs non-ICU). In this cohort, PAs/NPs had a lower tendency to order blood cultures than did providers in other roles, and ID physicians were as likely to order blood cultures than medicine attendings. Many providers thought a single set of blood cultures was adequate to detect bacteremia. This may explain trends observed in some units at our hospital, where single sets represent up to 60% of all blood cultures collected (K.C., personal communication).

In general, respondents acknowledged that febrile patients are more likely to yield positive blood cultures and the clear majority of providers indicated that they would order blood culture(s) if a patient developed a new fever. However, collecting blood during temperature spikes was not shown to increase the likelihood of documenting bacteremia.³ Clinical prediction rules to increase the positive predictive value of blood cultures have been developed; however, they have not been adopted widely in clinical practice.⁹ In pediatric ICU patients, a sepsis screening checklist and a clinical

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Table 1. Prescribers' Knowledge, Attitudes and Perceptions About Blood Culturing Practices for Adult Inpatients

Questions	ID Physicians, No. (%)	Medicine House Staff, No. (%)	Medicine Attendings, No. (%)	PA/NP, No. (%)	P Value
	(n = 20)	(n = 35)	(n = 17)	(n = 37)	
Likely to order blood cultures if the non-ICU patient					
Develops new fever	18 (90)	33 (94)	6 (75)	16 (50)	< .01
Has persistent fever AND a negative blood culture within the prior 24 h	9 (45)	14 (42)	2 (25)	9 (28)	.51
Develops new hypotension	15 (75)	27 (77)	4 (53)	11 (31)	< .01
Develops new leukocytosis	12 (60)	16 (46)	3 (37)	14 (42)	.71
Develops persistent tachycardia	3 (15)	15 (43)	0	7 (21)	.02
With <i>S. aureus</i> bacteremia in the prior 24 h	13 (69)	22 (71)	3 (70)	9 (32)	< .01
With positive blood culture with gram-negative organisms in the prior 24 h	11 (55)	26 (74)	2 (25)	11 (33)	< .01
Likely to order blood cultures if the ICU patient					
Develops new fever	18 (90)	35 (100)	8 (80)	28 (83)	.04
Has persistent fever AND a negative blood culture within last 24 h	13 (65)	23 (66)	4 (40)	17 (50)	.24
Develops new hypotension	18 (90)	32 (91)	8 (80)	18 (51)	< .01
Develops new leukocytosis	16 (80)	29 (83)	5 (50)	25 (76)	.62
Develops persistent tachycardia	9 (45)	20 (57)	2 (20)	12 (36)	.09
With <i>S. aureus</i> bacteremia in the prior 24 h	14 (70)	28 (80)	7 (70)	18 (53)	.09
With positive blood culture with gram-negative organisms in prior 24 h	12 (60)	28 (80)	6 (60)	16 (48)	.03
Agree with the following:					
All patients with new fever should get blood cultures	8 (40)	19 (54)	11 (68)	16 (43)	.67
All patients with a central line and fever should get blood cultures	14 (70)	33 (94)	15 (94)	29 (79)	.21
All patients are more likely to be positive for bacteria when they are drawn from febrile patients	14 (70)	26 (74)	11 (68)	17 (47)	.10
Single sets of blood cultures are sufficient when repeating blood cultures	12 (60)	31 (88)	9 (56)	16 (43)	< 0.01
All bacteremia cases need to have repeat blood cultures to document clearance	3 (15)	28 (80)	6 (37)	17 (46)	< 0.01
Clinicians order blood cultures reflexively in response to signs/symptoms such as fever and hypotension	18 (90)	33 (94)	11 (69)	28 (76)	0.23
Agree that the following factors influence blood culture orders:					
Order sets	14 (74)	11 (31)	10 (63)	23 (62)	< 0.01
Lack of protocol for indications for drawing blood cultures	17 (84)	24 (69)	14 (87)	27 (73)	0.409
Expectation of obtaining blood culture as part of work-up to help antibiotic decisions at a later time	17 (85)	33 (94)	13 (81)	31 (86)	0.69
Poor communication between physicians	8 (40)	4 (11)	4 (25)	16 (44)	0.01
Poor communication between physicians and nurses	6 (23)	4 (11)	2 (12)	15 (43)	0.02
Supervising physician desire for blood cultures	13 (65)	20 (57)	5 (31)	28 (78)	0.14

Note. ID, infectious disease; PA/NP, physician assistant/nurse practitioner.

decision algorithm reduced number of blood cultures without adverse events.¹⁰ Most respondents recognized that blood cultures are ordered to help with antibiotic treatment decisions. Close monitoring of broad-spectrum antibiotic use and antibiotic de-escalation should occur if interventions to limit blood culture testing are implemented.

Our study was performed at a single center and we cannot exclude volunteer bias. However, there was balanced representation from the different groups surveyed and a wide range of years of experience. In summary, more specific guidance with indications for blood cultures may help reduce unnecessary blood cultures, and interventions should include all providers, including consulting physicians.

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An electronic antimicrobial stewardship intervention reduces inappropriate parenteral antibiotic therapy

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To the Editor—A peripherally inserted central catheter (PICC) provides outpatient access to long-term parenteral antibiotics.^{1,2} Most antimicrobial stewardship systems do not have an outpatient parenteral antibiotic therapy (OPAT) program or mandatory infectious diseases (ID) consultation prior to patient discharge.³ Such programs ensure that PICC insertions are appropriate to avoid excessive antibiotic usage, line-associated complications, and antimicrobial resistance.^{4–6} Here, we report a simple intervention that identifies patients at risk for unnecessary parenteral antibiotics and recommends ID consultation.

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The intervention resulted in an 84% relative risk reduction in patients discharged with PICC insertions without ID consultation.

The study was performed at a 1,134-bed academic medical center. Between January 2016 and May 2016, 181 PICC orders were placed for parenteral antibiotics (Fig. 1A), and 172 of these included ID consultation (95%) while 9 (5%) did not. Two ID attending physicians retrospectively reviewed these 9 cases and concluded that 8 PICC insertions (89%) were inappropriate.

An electronic intervention was implemented into the PICC insertion order set in November 2016. Three prompts were inserted to ensure ID consultation for all PICC insertions for parenteral antibiotics: (1) “Will the PICC be used for IV antibiotics?” A “No” response prompted the original order set. A “Yes” prompted the following question: (2) “Is ID consulted?” A “No” prompted the statement: “ID consultation is required