2026 Clinical Practice Guidelines by the Infectious Diseases Society of America (IDSA) and European Society of Clinical Microbiology and Infectious Diseases (ESCMID) on Staphylococcus aureus Bacteremia: Risk Stratification, Diagnostic Evaluation, and Management of Adults and Children

Consensus Statement 3 on Transthoracic Echocardiography in the Diagnostic Evaluation of Patients with *Staphylococcus aureus* Bacteremia

Author's name	Society	Affiliation
Catherine Liu*	IDSA	Vaccine and Infectious Disease Division, Fred Hutchinson Cancer Center and Division of Allergy and Infectious Diseases, University of Washington, Seattle, Washington
Alex Soriano*	ESCMID	Department of Infectious Diseases, Hospital Clínic of Barcelona, Barcelona, Spain. IDIBAPS, Barcelona, Spain Centro de Investigación en Red de Enfermedades Infecciosas (CIBERINFEC), Instituto de Salud Carlos III, Madrid, Spain
Vincent Le Moing*	ESCMID	Service des Maladies Infectieuses et Tropicales, CHU de Montpellier, Montpellier, France
Aubrey J. Cunnington	ESPID	Department of Infectious Disease, Section of Paediatric Infectious Disease, and Centre for Paediatrics and Child Health, Imperial College London, London, UK
J. Chase McNeil	PIDS	Department of Pediatrics, Division of Infectious Diseases, Baylor College of Medicine, Houston, Texas, US
Vance G. Fowler, Jr.	IDSA	Division of Infectious Diseases, Department of Medicine, Duke University Medical Center, Durham North Carolina USA Duke Clinical Research Institute, Durham, North Carolina, USA
Loren G. Miller	IDSA	Division of Infectious Diseases, Harbor-UCLA Medical Center and the Lundquist Institute at Harbor-UCLA Medical Center, Torrance, CA and the University of California, Los Angeles, Los Angeles, CA
Cesar Arias	IDSA	Division of Infectious Diseases, Houston Methodist Hospital, Houston, TX, United States; Center for Infectious Diseases, Houston Methodist Research Institute, Houston, TX, United States; Department of Medicine, Weill Cornell Medical College, New York, NY, United States
Thomas Benfield	ESCMID	Department of Infectious Diseases, Copenhagen University Hospital - Amager and Hvidovre, Copenhagen, Denmark

Douglas Black	IDSA	Department of Pharmacy, School of Pharmacy, University of Washington, Seattle, WA, USA
Helen W. Boucher	IDSA	Tufts University and Tufts Medicine, Boston, MA, United States
Barbara Hasse	ESCMID	Department of Infectious Diseases and Hospital Epidemiology, University and University Hospital Zurich, Switzerland
Marisa Holubar	IDSA	Department of Medicine, Division of Infectious Diseases and Geographic Medicine, Stanford University School of Medicine; Stanford, California, United States
Achim J. Kaasch	ESCMID	Institute of Medical Microbiology and Hospital Hygiene, Medical Faculty of the Otto von Guericke University Magdeburg, Magdeburg, Germany
Martin Llewelyn	ESCMID	Department of Global Health and Infection, Brighton and Sussex Medical School, Falmer, East Sussex, UK Department of Infection, University Hospitals Sussex NHS Foundation Trust, Eastern Road, Brighton, UK
Luis Eduardo López Cortés	ESCMID	Infectious Diseases and Microbiology Clinical Unit, University Hospital Virgen Macarena; Department of Medicine, School of Medicine, University of Sevilla; and Biomedicine Institute of Sevilla (IBiS)/CSIC, Seville, Spain. Centro de Investigación en Red de Enfermedades Infecciosas (CIBERINFEC), Instituto de Salud Carlos III, Madrid, Spain
Mical Paul	ESCMID	Infectious Diseases Division, Rambam Health Care Campus, Haifa, Israel The Ruth and Bruce Rappaport Faculty of Medicine, Technion - Israel Institute of Technology, Haifa, Israel
Kyle J. Popovich	IDSA, SHEA	Division of Infectious Diseases Rush University Medical Center, Chicago, IL.
Siegbert Rieg	ESCMID	Department of Internal Medicine II, Division of Infectious Diseases, Medical Centre - University of Freiburg, Faculty of Medicine, Freiburg, Germany
Mark E. Rupp	IDSA	Department of Medicine, Division of Infectious Diseases, University of Nebraska Medical Center, Omaha, Nebraska, USA.
Marc H. Scheetz	IDSA	Departments of Pharmacy Practice and Pharmacology, Pharmacometrics Center of Excellence, Colleges of Pharmacy and Graduate

		Studies, Midwestern University, Downers Grove, IL, United States
Bo Shopsin	IDSA	Department of Microbiology and Department of Medicine, Division of Infectious Diseases, NYU Grossman School of Medicine, New York, NY, USA
Luke Strnad	IDSA	Department of Medicine, Division of Infectious Diseases, Oregon Health and Science University (OHSU) and Epidemiology Programs, OHSU/Portland State University School of Public Health; Portland, Oregon, United States
Steven Y.C. Tong	ESCMID	Victorian Infectious Diseases Service, The Royal Melbourne Hospital, at the Peter Doherty Institute for Infection and Immunity, Melbourne, Australia Department of Infectious Diseases, The University of Melbourne at the Peter Doherty Institute for Infection and Immunity, Melbourne, Australia
Winfried V. Kern [+]	ESCMID	Department of Internal Medicine II, Division of Infectious Diseases, Medical Centre - University of Freiburg, Faculty of Medicine, Freiburg, Germany
François Vandenesch [+]	ESCMID	Center for Integrative Research in Infectious diseases and Immunology (CIRI), INSERM U1111, CNRS UMR5308, University of Lyon, ENS Lyon, France
Lara A. Kahale [+]	IDSA	Clinical Affairs and Practice Guidelines, Infectious Diseases Society of America, Arlington, Virginia, USA
Henry F. Chambers [+]	IDSA	Division of Infectious Diseases, Zuckerberg San Francisco General Hospital, University of California, San Francisco

*Contributed equally as first authors

[+]Contributed equally as last authors

Correspondence: Catherine Liu, Vaccine and Infectious Disease Division, Fred Hutchinson Cancer Center and Division of Allergy and Infectious Diseases, University of Washington, Seattle, Washington**,** practiceguidelines@idsociety.org

Executive Summary

Overview

Endocarditis is an important and serious complication of SAB. There is considerable variability in the use of transthoracic echocardiography (TTE) in the diagnostic evaluation of SAB. Limiting the use of TTE to patients at increased risk for endocarditis could optimize TTE resource utilization. However, there is substantial heterogeneity in the criteria used to define the risk of endocarditis, and it is unclear whether existing clinical prediction tools can be reliably used to avoid TTE.

Clinical question 3
Should a transthoracic echocardiogram (TTE) be performed in all patients with SAB?

Consensus statement for the adult population

- The panel suggests routinely performing TTE in all adults with SAB, since the panel could not identify criteria to clearly define a population at very low risk of infective endocarditis (consensus).

Remarks for the adult population

- Although there may exist a group of adult patients with SAB at very low risk of endocarditis for whom TTE may be unnecessary, criteria to define such a population have not been consistently established. As endocarditis is a serious complication among adults with SAB and TTE is non-invasive, minimal risk procedure, decisions to forego TTE in this population should be carefully considered.

Consensus statement for the pediatric population

- TTE should be routinely performed in children with SAB who have structural heart disease, prolonged bacteremia, or signs and symptoms suggestive of endocarditis, but may be omitted in the absence of such factors and with low suspicion for endocarditis (consensus).

Remark for the pediatric population

- The risk of endocarditis in neonates with SAB may be greater than in older children and requires separate consideration.

Introduction

Background
Endocarditis occurs in 10-20% of adult patients with SAB and represents one of the most serious complications of SAB, associated with substantial morbidity and mortality [1-3]. Given its prevalence, transthoracic echocardiography (TTE) has been recommended among all adult SAB patients [4, 5]. However, utilization of TTE varies widely, ranging from 30% to 67% across different adult populations [6-9]. The risk of endocarditis depends on factors such as healthcare vs community acquisition, injection drug use, presence of an intracardiac device, metastatic foci of infection, and prolonged bacteremia. In contrast, endocarditis is uncommon in children, occurring in less than 3% of otherwise healthy children with SAB [10-12]. Prioritizing TTE for patients at highest risk may help optimize resource use.

Purpose and objectives
The objective of the panel was to review the relevant literature and evidence to provide consensus statements on whether TTE should be performed in all patients with SAB.

Scope
This consensus statement is intended for use by adult and pediatric healthcare professionals including physicians, advanced practice providers, and pharmacists who care for patients with SAB.

The target audience includes but is not limited to infectious diseases specialists, hospitalists, emergency care clinicians, intensivists, and health systems research and policymakers.

Methods

Panel composition

The four chairs of the panel were selected by the leadership of IDSA and the European Society of Clinical Microbiology and Infectious Diseases (ESCMID). Twenty-three additional panelists comprised the full panel: Nine from IDSA, 10 from ESCMID, one from the Pediatric Infectious Diseases Society (PIDS), one from the European Society for Paediatric Infectious Diseases (ESPID), one from both IDSA and the Society for Healthcare Epidemiology of America (SHEA), and one from IDSA, the Society of Infectious Diseases Pharmacists (SIDP), and the American Society of Health-System Pharmacists (ASHP). The panel included physicians and pharmacists with expertise in adult and pediatric infectious diseases and microbiology. Panelists were from diverse geographic distributions and years of clinical experience. IDSA staff oversaw all methodological, administrative, and logistical aspects of the guideline. The panel reviewed existing literature and brought in their professional experiences and clinical judgment.

Process

We considered studies assessing TTE in patients with SAB at low risk of endocarditis and studies reporting on criteria to identify patients at low risk of endocarditis.

Literature review

A medical librarian (EG) designed the literature searches and Medical Subject Headings (MeSH) terms for MEDLINE (OVID), Embase (OVID), and Cochrane. The formal literature searches were performed in July 2021, July 2023, and January 2025. Searches were limited to studies published in English. We excluded animal studies, conference/meeting abstracts, books/chapters, editorials, or correspondence. Reference lists of related articles and guidelines were reviewed for relevance to supplement the electronic searches. Title and abstract screening was done by the methodologist (LAK) and verified by 3 panelists (CL, AS, VL). Full-text screening was done by 3 panelists (CL, AS, VL). The search strategies are reported in the supplementary file.

Consensus statement development

Consensus statements were developed using an iterative, structured process that incorporated input from both topic-specific subgroups and the full multidisciplinary panel. Subgroups drafted preliminary statements based on a comprehensive review of the available literature and expert clinical judgment. The consensus statements were also developed considering the balance of benefits and harms, feasibility, and resource use, while also providing practical advice for implementation and identifying key research gaps. Draft statements were then reviewed and discussed during multiple virtual panel meetings and refined through sequential rounds of asynchronous electronic feedback. Disagreements and areas of limited agreement were systematically identified, documented, and addressed through targeted discussion and revision. Statements were modified iteratively until convergence was achieved. Final consensus for each statement was defined a priori as agreement by >75% of panel members. Consensus statements should be interpreted in the context of evolving evidence and are intended to support, not replace, individualized clinical decision making, while highlighting priorities for future SAB research.

Panel members considered whether there was sufficient evidence to support the application of the same guidance to children, or whether available evidence supported development of alternative guidance.

Results

Adults' perspective

Summary of the literature review for the adult population

We screened 1,548 titles and abstracts, identifying one cohort study assessing mortality outcomes related to TTE in SAB [9], one systematic review of studies reporting criteria for patients with SAB at low risk of endocarditis [13], and 12 studies evaluating risk scores for predicting endocarditis in SAB [8, 14-24]. We identified 2 surveys on use of TTE in SAB [25, 26].

A single retrospective, observational study by Goto et al., including 36,868 adult SAB patients in 125 Veterans Affairs hospitals in the United States, found that TTE was associated with reduced 30-day mortality (adjusted OR (aOR) 0.66; 95% CI, 0.61-0.71) [9]. TTE was also associated with reduced mortality at 90 days (RR 0.70; 95% CI 0.67-0.72) and reduced mortality or recurrent bacteremia within 90 days (RR 0.68; 95% CI 0.66-0.70) (calculated based on data shared by authors). However, this study did not stratify patients by endocarditis risk and lacked adjustment for immortal time bias.

A systematic review of eight studies suggests there likely exists a subgroup of patients at very low risk for endocarditis [13]. Common criteria included healthcare-associated SAB, absence of intracardiac prosthetic devices, short bacteremia duration (<48-72 hours), and absence of embolic events. However, heterogeneity in criteria used, reference standards, and echocardiography use (especially transesophageal echocardiography (TEE)) limit generalizability.

Clinical Prediction Tools

No risk prediction tools have been specifically developed to guide use of TTE. Risk scores such as VIRSTA, PREDICT, POSITIVE, and LAUSTAPHEN aim to identify low-risk patients for whom TEE might be safely withheld (Supplementary Table 1 and Table 2) [8, 14-23]. The VIRSTA score is the most widely validated with the highest negative predictive value (97-100%); LAUSTAPHEN has a similarly high negative predictive value (>98%) and both have misclassification rates <4% in low-risk groups [17]. PREDICT and POSITIVE have negative predictive values ranging from 94.5%-100% and 92.5%-99.5%, respectively. The VIRSTA+ score (VIRSTA plus time to positivity ≤11.5 hr) achieved a negative predictive value of 100% and a negative likelihood ratio of 0 [15], but it has not been prospectively or externally validated.

Only one study assessed whether VIRSTA, PREDICT, or POSITIVE scores could safely exclude endocarditis without TTE using thresholds of < 1% risk and a negative likelihood ratio <0.05 [18]. None met these criteria; patients identified as low-risk by VIRSTA ≤2 had an endocarditis incidence of 2.2%, and TTE was associated with a lower 30-day mortality (OR 0.28, 95% CI 0.13-0.60, p =.001) [18]. Interpretation is limited by potential selection and immortal time bias.

The SABIER score is a machine learning-based tool using electronic health record data, predicts endocarditis risk at the time of blood culture positivity, with a negative predictive value of 98% [24]. Its most discriminatory features are age ≥37 to < 55, history of endocarditis, valvular heart disease, and community onset, and while prospective validation is needed, its performance characteristics are comparable to other scores.

Clinical Practice Surveys

Among 667 adult ID specialists in the U.S. and Canada, 599 (90%) would almost always perform TTE in SAB [25]. An international survey of 656 ID specialists found substantial disagreement regarding TTE in patients at low risk for endocarditis [26]. For scenarios with a VIRSTA ≤ 5 (<10% endocarditis risk), 52% favored highly exclusionary echocardiography strategies (TEE only, TTE + TEE, or TTE followed by TEE if TTE negative). For VIRSTA ≤2 (<2% risk), recommendations varied widely: 11% no echocardiography, 29% TTE only, 21% TTE first, followed by TEE only if TTE positive, 19% TTE first, followed by TEE only if TTE negative, 9% TEE only, 9% TTE and TEE.

Rationale for the consensus statement for the adult population

Balance of benefits and harm

- While some patients with SAB may have a very low risk of endocarditis, robust criteria to define this population are lacking. TTE is non-invasive with minimal risk. Missing endocarditis can lead to relapse, metastatic complications, and significant morbidity and mortality. Therefore, the panel concluded that the overall balance of benefits and harms supports routine use of TTE in adult patients with SAB.
- While TTE should be routinely performed in the evaluation of SAB, interpretation may be limited by image quality, and sensitivity is lower than TEE for diagnosis of endocarditis; please refer to Consensus Statement 4 for scenarios in which TEE should be considered.

Costs

- The costs of TTE are modest compared with the costs of readmission for relapsed SAB.

Feasibility

- TTE availability may be limited in some low- or intermediate-income countries, but when feasible, it is likely to improve outcomes comparable to high-resource settings.

Implementation Considerations for the adult population

Practical advice

- Perform TTE in adult patients with SAB as part of routine diagnostic evaluation. While data are lacking to guide the optimal timing, the panel suggests that TTE be performed as early as reasonably possible to guide management decisions.
- TTE may be omitted only on a case-by-case basis, with close monitoring and a low threshold to perform TTE if clinical status changes.
- In centers where standard of care is to proceed directly to transesophageal echocardiography (TEE), this can also be an appropriate strategy as resources permit [27].

Barriers

- Image quality may be limited by patient characteristics (e.g., body habitus, chest wall abnormalities), technical and equipment factors, and operator skill and experience.
- Additionally, interpretation of TTE images may vary based on the reader's expertise and experience.
- The sensitivity of TTE is lower than TEE, especially for prosthetic valves and intracardiac abscesses [28].

Research needs for the adult population

Clinical prediction tools for endocarditis have limitations that preclude recommending their use in routine practice to guide omission of TTE. Current risk scores cannot reliably identify patients without risk for endocarditis, and the consequences of missed diagnoses have not been prospectively evaluated. Prospective comparative studies are needed to validate whether these scores can guide safe omission of TTE. An ongoing randomized trial is evaluating echocardiography versus no echocardiography among patients with SAB and VIRSTA < 3 [29].

Pediatrics perspective

Summary of the literature review on the pediatric population

The evidence regarding the utility of echocardiography in children with SAB is largely limited to single-center observational studies. Reported rates of endocarditis in children with SAB range from <1% to 6% of cases [9-11, 29]. In many of these studies, TTE was performed selectively, often biased toward children at higher risk of endocarditis, such as those with congenital heart disease (CHD). Consequently, the true prevalence of endocarditis in the general pediatric population with SAB may be lower. Among children with structurally normal hearts, sub-analyses report endocarditis rates of approximately 3% [9, 30]. The value of TTE in otherwise healthy children with SAB without prolonged bacteremia or structural heart disease remains uncertain and likely limited. Clinical prediction tools for assessing endocarditis risk in SAB, such as POSITIVE, VIRSTA, and PREDICT have not been evaluated in pediatric populations and should not guide management until validated in children.

In otherwise healthy children, the most common foci of SAB are musculoskeletal infections including osteomyelitis and septic arthritis [30]. A survey of pediatric infectious diseases specialists demonstrated wide variability in TTE use for children with osteomyelitis and SAB; only 29% reported that they "almost always or usually" perform TTE in this context [31]. In a study of 26 children with osteomyelitis and bacteremia who underwent echocardiography, none had endocarditis [32]. These data suggest a low yield for echocardiography in uncomplicated musculoskeletal infection with SAB.

Although rare, endocarditis is an independent predictor of mortality in pediatric SAB, underscoring the importance of diagnosis in high-risk children [33]. In high-income countries, CHD is the principal risk factor for endocarditis in children, whereas rheumatic heart disease remains an important risk factor in low- and middle-income countries [34-38]. Endocarditis rates in children with SAB and CHD have been reported at 29-53% [39, 40].

Prolonged bacteremia is associated with endocarditis. In a single-center study, median SAB duration was 1 day for osteomyelitis compared to 5.5 days for endocarditis [41]; 90% of endocarditis cases involved CHD and hospital-acquired infections. Similarly, in a retrospective study, children with CHD and SAB who met Duke criteria for endocarditis had a longer bacteremia duration than those without endocarditis (median 4 vs. 1 day, $p<0.001$) [39]. Another study found that echocardiographic findings of endocarditis were independently associated with CHD and bacteremia lasting ≥ 3 days after adjusting for confounders [42]. Similar to adults, children with intracardiac devices likely represent a subgroup with increased risk for IE although specific data are limited.

Neonates and young infants have higher reported rates of endocarditis in some studies, partly related to central venous catheter use in premature infants [30, 40]. However, other studies suggest that very young age or prematurity alone is not an independent risk factor for endocarditis after adjusting for confounders [42, 43]. Clinicians should carefully weigh the risks and benefits of TTE in neonates without other endocarditis risk factors.

Rationale for the consensus statement for the pediatric population

Most previously healthy children with SAB do not develop endocarditis (< 3%) [10-12]. Considering resource utilization, TTE should be targeted to children at highest risk, including those with structural heart disease, intracardiac devices, prolonged bacteremia, or clinical signs suggestive of endocarditis [10-12].

Implementation considerations for the pediatric population

Practical advice

- Assess cardiac history and perform a thorough physical examination in all children with SAB. Significant cardiac history, concerning exam findings, or persistent bacteremia should prompt TTE.
- TTE may be safely omitted in most children with SAB who have rapid blood culture clearance in the absence of structural heart disease or other concerning features.

Barriers

- While generally well tolerated, TTE in young children may require sedation to obtain high-quality images.
- Echocardiography may be challenging to interpret in children with complex CHD, necessitating access to experienced echocardiographers in addition to personnel skilled in pediatric sedation or anesthesia.

Research needs for the pediatric population

Given current evidence limitations, multicenter studies are needed to better define the optimal use of TTE in otherwise healthy children with SAB. These studies should evaluate the diagnostic yield, risk stratification, and cost-effectiveness of TTE in low-risk pediatric populations.

Limitations

This manuscript was developed using a consensus-based methodology rather than a formal clinical practice guideline process. Although a comprehensive literature review was performed, formal systematic review methods and structured evidence grading were not required. Consensus statements reflect a synthesis of available evidence and expert clinical judgment, particularly in areas where high-quality randomized data and systematic reviews are limited. In this SAB guideline project, where clinical presentations are heterogeneous and many management questions lack definitive trial data, this approach allows translation of imperfect but clinically relevant evidence into practical consensus statements.

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Additional Information: More detailed information on the analysis and development of consensus statements is available in the Supplemental Materials document.

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