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Development and Evaluation of a Structured Guide to Assess the Preventability of Hospital-onset Bacteremia and Fungemia

Gregory M. Schrank, MD, MPH[1], **Anna Sick-Samuels, MD, MPH**[2], **Susan C. Bleasdale, MD**[3], **Jesse T. Jacob, MD, MSc**[4], **Raymund Dantes, MD, MPH**[4], **Runa H. Gokhale, MD, MPH**[5], **Jeanmarie Mayer, MD**[6], **Preeti Mehrotra, MD, MPH**[7], **Sapna A. Mehta, MD**[8], **Alfredo J. Mena Lora, MD**[3], **Susan M. Ray, MD**[4], **Chanu Rhee, MD, MPH**[9], **Jorge L. Salinas, MD**[10], **Susan K. Seo, MD**[11], **Andi L. Shane, MD, MPH, MSc**[12], **Gita Nadimpalli, MD, MPH**[13], **Aaron M. Milstone, MD, MHS**[2], **Gwen Robinson, MPH**[13], **Clayton H. Brown, PhD**[13], **Anthony D. Harris, MD, MPH**[13], **Surbhi Leekha, MBBS, MPH**[13],
CDC Prevention Epicenters Program

1.Department of Medicine, University of Maryland School of Medicine, Baltimore, MD, USA

2.Department of Pediatrics, Johns Hopkins University School of Medicine, Baltimore, MD, USA

3.Department of Medicine, University of Illinois at Chicago, Chicago, IL, USA

4.Department of Medicine, Emory University School of Medicine, Atlanta, GA, USA

5.Centers for Disease Control and Prevention, Atlanta, GA, USA

6.Department of Medicine, University of Utah School of Medicine, UT, USA

7.Department of Medicine, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, USA

8.Department of Medicine, NYU Grossman School of Medicine, New York, NY, USA

9.Department of Population Medicine, Harvard Medical School / Harvard Pilgrim Health Care Institute, Boston, MA, USA

10.University of Iowa Hospital & Clinics, Iowa City, IA, USA

11.Department of Medicine, Joan and Sanford Weil Cornell Medical College, New York, NY, USA

12.Department of Pediatrics, Emory University School of Medicine, Children's Healthcare of Atlanta, Atlanta, GA, USA

13.Department of Epidemiology and Public Health, University of Maryland School of Medicine, Baltimore, MD, USA

Corresponding Author: Gregory Schrank, 22 S. Greene St., T3N30, Baltimore, MD 21201, Phone: 410-328-3656, Fax: 410-328-6826. **Alternate Corresponding Author:** Surbhi Leekha, 110 S. Paca Street, 6th Floor, Suite 100, Baltimore, MD 21201, Phone: 410-328-1148, Fax: 410-328-0089.

Conflicts of Interest
All authors report no conflicts of interest related to this article.

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Abstract

Objective—To assess preventability of hospital-onset bacteremia and fungemia (HOB), we developed and evaluated a structured rating guide accounting for intrinsic patient and extrinsic healthcare-related risks.

Design—HOB preventability rating guide was compared against a reference standard expert panel.

Participants—Ten-member panel of clinical experts as the standard of preventability assessment. Two physician reviewers applied the rating guide for comparison.

Methods—The expert panel independently rated 82 hypothetical HOB scenarios using a 6-point Likert scale, collapsed into 3 categories: Preventable, Uncertain, or Not preventable. Consensus was defined as concurrence on the same category among ≥70% experts. Scenarios without consensus were deliberated, followed by a second round of rating.

Two reviewers independently applied the rating guide to adjudicate the same 82 scenarios in two rounds, with interim revisions. Inter-rater reliability was evaluated using the Kappa statistic.

Results—Expert panel consensus criteria were met for 52 scenarios (63%) after two rounds.

After two rounds, guide-based rating matched expert panel consensus in 40 of 52 (77%) and 39 of 52 (75%) cases for reviewers 1 & 2, respectively. Agreement between the two reviewers was 84% overall (Kappa 0.76 [95% CI 0.64, 0.88]) and 87% (Kappa 0.79 [95% CI 0.65, 0.94]) for the 52 scenarios with expert consensus.

Conclusions—Preventability ratings of HOB scenarios by two reviewers using a rating guide matched expert consensus in most cases with moderately high inter-reviewer reliability. While diversity of expert opinions and uncertainty of preventability merit further exploration, this is a step towards standardized assessment of HOB preventability.

Keywords

Healthcare-associated infections; preventability; health care quality

Introduction

Although central line-associated bloodstream infection (CLABSI) remains one of the core healthcare-associated infection (HAI) measures reported to the US Centers for Disease Control and Prevention's (CDC) National Healthcare Safety Network (NHSN), CLABSIs represent only a proportion of all hospital-onset bacteremia and fungemia (HOB).[1–3] Due to decreasing rates and small numbers with low variability, CLABSI may no longer discriminate between facilities as a quality metric.[4] In addition, subjectivity limitations of the CLABSI surveillance definition have led to a divergence between reported cases and relevant bedside clinical diagnoses.[5 6] As a result, prior work has examined HOB as a broader and more objective HAI outcome measure.[7–9]

The assumption that HAIs are preventable forms the basis of HAI measurement and improvement efforts.[10] Although healthcare facilities use processes such as root cause analyses to identify and improve upon aspects of care delivery that may have contributed to HAI incidence, there is no standardized method of determining the potential preventability of any type of HAI, and particularly for HOB which can have an extensive range of clinical etiologies. In the absence of an existing standardized method, we previously developed a risk matrix and used a corresponding 6-point Likert scale to rate HOB preventability based on clinical chart reviews in a pilot study.[8] However, it was unclear whether this method a) accurately captured preventability, and b) if results could be replicated between reviewers. Therefore, prior to embarking on a large multi-center study of HOB preventability through the CDC Prevention Epicenters program, we expanded on that previous work to develop a structured and more comprehensive HOB preventability rating guide, with a focus on validity and reliability.[11] The aims of this study were 1) to develop "consensus" on preventability rating of hypothetical clinical scenarios of HOB using expert panel methodology, and 2) to evaluate the performance of a structured preventability rating guide against expert consensus.

Methods

To evaluate the validity and reliability of our structured rating guide, it was necessary to first identify a reference standard for the measure of HOB preventability. We used the approach of expert panel consensus on preventability of hypothetical HOB case scenarios as the reference standard against which our structured guide could be compared.

Expert Panel composition

We assembled a 10-member panel of clinical experts in hospital medicine, pediatrics, critical care, healthcare epidemiology, and infectious diseases - with additional expertise in infections in immunocompromised and community hospital-based practice; six were affiliated with CDC Prevention Epicenters sites participating in the multi-center study of HOB and four others identified based on complementary clinical expertise.

Construction of HOB case scenarios

Hypothetical HOB case scenarios were constructed by 4 infectious diseases physicians and healthcare epidemiologists (GMS, ASS, SB, SL) based on cases at their institutions, aiming for observed distributions of HOB sources and causative organisms in prior research and clinical experience.[12,13] Scenarios were outlined using a standard template (Supplemental Figure 1). A total of eighty-two HOB case scenarios were created, representing a spectrum of sources of HOB attribution in adult and pediatric patients (Table 1).

Expert Panel Rating of HOB case scenarios and consensus development

First, each expert panelist was asked to independently review and rate each HOB case scenario using a 6-point Likert scale of preventability ranging from "Definitively or Almost Certainly Preventable" (1) to "Definitively or Almost Certainly Not Preventable" (6).[14] This scale is modeled on preventability rating of adverse events in healthcare [15] and has previously been used in healthcare epidemiology for preventability evaluation of sepsis-related mortality, healthcare-associated bloodstream infections at a French university hospital, and in our pilot study of HOB preventability in the United States.[8,16,17] Experts were instructed to assess preventability as: a) unintended bacteremia or fungemia related to medical management, b) as a failure to meet expected standard of care while accounting for a patient's risk of infection, or c) as a deficiency of known preventive measures and standards of care including diagnosis and management.

We used guidance outlined in the RAND/UCLA Appropriateness Method User's Manual to define agreement, disagreement, and development of expert consensus, using three clinically meaningful categories of preventability ratings based on the 6-point Likert scale: Preventable (1–2), Uncertain (3–4), or Not Preventable (5–6).[18] We defined the level of agreement amongst the ten-member expert panel as follows: disagreement occurred when ≥20% of experts rated a scenario 1–2 (Preventable) and ≥20% of experts rated the same scenario 5–6 (Not Preventable). In the absence of disagreement, consensus was concurrence on the same preventability category among ≥70%, and majority agreement was concurrence on the same preventability category among >50%. Case scenario review and rating were done independently by each expert panelist using an online survey and data collection tool (Qualtrics, Provo, UT). We created summaries of ratings for each scenario including median, 75th percentile, and whether criteria for consensus, majority agreement, or disagreement were met. A distribution of ratings by the panel and the individual's rating in relation to others was provided to each expert (Supplemental Figure 2).

Expert panel discussions

Using Delphi methodology, case scenarios that did not meet consensus criteria were deliberated by the expert panel via two teleconferences and a web-based discussion board (Slack Technologies, Inc., San Francisco, CA) moderated by the principal investigator (SL).[7 8 19] During discussions, panel members were asked to voluntarily offer rationale for their choices. Individual ratings were not disclosed to the group by the moderator unless explicitly offered by the individual themselves. Teleconferences were recorded with permission from all participants. Following deliberation, a second round of independent review and rating was performed of the scenarios that did not meet consensus criteria during the first round (Figure 1).

We reviewed the content of teleconference and web-based discussions to inform the development and refinement of the structured rating guide and to provide insight into the aspects of the case that were deemed to be preventable.

Structured Preventability Assessment Guide Development

In a previous pilot study of HOB preventability assessment, we conceptualized risk of developing HOB as a function of "intrinsic" or patient-related factors and "extrinsic" or healthcare-related factors. To explicitly account for both components of HOB risk, we developed a matrix to separately assign a patient's intrinsic risk of HOB and preventability related to extrinsic healthcare factors. The overall preventability of HOB was then derived as the combined effect of the intrinsic and extrinsic risk rating from this matrix and translated to the 6-point Likert scale (Figure 2). During the pilot study, limited guidance around classification of intrinsic risk and extrinsic preventability was provided and variability in reviewer assessment of risks was recognized as a limitation.[8] To overcome that limitation and minimize subjectivity of ratings, we created a more comprehensive list of clinical conditions and developed the present HOB preventability rating guide (Supplemental Appendix).

In this guide, intrinsic risk guidance was based upon the acute illness and underlying comorbidities present upon index admission and prior to the HOB event, informed by both literature review and known pathogenesis of bloodstream infections related to these conditions. Extrinsic risk accounted for preventability relative to the suspected source of infection. The guide was not made available to the reference standard expert panel.

Independent Review with Structured Preventability Rating Guide

Two additional healthcare epidemiology experts (ADH and JJ) were asked to independently review and rate the same eighty-two hypothetical case scenarios utilizing the structured guide. For each scenario, reviewers assigned an intrinsic and extrinsic health-care related risk of HOB using the guide, which informed the overall HOB preventability rating. The two reviewers were asked to provide justification for their decision making for each rating. Summaries of each scenario, including the difference between reviewers' overall preventability rating, intrinsic risk, and extrinsic health-care related risk assignments, were created.

Following the initial round of scenario rating with the structured guide, two investigators (GMS and SL) performed review of all scenario ratings where agreement between the two reviewers was not achieved and provided feedback to reviewers on any notable deviations from intended use of the guide. Reviewers' ratings were maintained as independent and not shared with the other. Reviewer feedback on the structured guide was also incorporated and the guide was refined to improve usability. This was followed by repeat independent review and rating of scenarios by the same two reviewers (Figure 1).

Statistical Analysis

For the purposes of analysis, HOB scenarios were categorized by pre-defined sources of infection, and Likert scale ratings were assigned to the appropriate category of preventability: 1–2 (preventable), 3–4 (uncertain), or 5–6 (not preventable) as previously described. For expert consensus development, descriptive analyses of expert panel and reviewer ratings were performed and summarized as consensus, majority agreement, and disagreement after each round of review. For guide-based rating by the two independent reviewers, results were compared to those of the expert panel as a reference standard. The proportion of cases (and 95% confidence intervals) where guide-based preventability category (i.e., 1–2, 3–4, or 5–6) matched expert consensus was used to calculate overall agreement, sensitivity, and specificity by preventability category. These calculations were only done for cases where expert consensus was achieved, given the lack of an available reference standard in the absence of that consensus. Inter-rater reliability of ratings by the two reviewers using the structured rating guide was evaluated using the Kappa statistic using the same preventability categories.[20,21] Analyses were performed using SAS 9.4 (SAS Institute, Cary, NC). This study was approved by the Institutional Review Board of the University of Maryland, Baltimore.

Results

Expert Panel Scenario Rating

After the first round of expert panel preventability rating, 29 scenarios (35%) met criteria for consensus; an additional 17 (21%) had majority agreement. Nineteen scenarios (23%) met criteria for disagreement. During panel discussion of scenarios that did not meet consensus criteria, a number of themes emerged regarding the assessment of HOB preventability. These are summarized with illustrative quotations in Table 2.

Following the second round of expert panel rating, a total of 52 scenarios (63%) met criteria for consensus (27% [n=14] preventable, 44% [n=23] uncertain, 29% [n=15] not preventable). Eighty-five percent of scenarios had at least majority agreement and two (3%) met criteria for disagreement. Expert consensus was achieved more frequently for HOB attributed to contaminants, respiratory, and surgical site infection sources than for urinary tract and central lines (Figure 3).

Independent Review using Structured Rating Guide

Following an initial round of adjudication using the rating guide, there was agreement between the two reviewers in 45 (55%) scenarios (Kappa 0.31 [95% CI 0.12, 0.49]). Reviewers acknowledged challenges in separating the concept of intrinsic from extrinsic risk in several cases. Key issues included prolonged hospitalization, patients with numerous comorbidities with dependence on multiple indwelling devices and for whom the intrinsic risk was so great that HOB seemed “inevitable”, and scenarios in which there were deviations from the expected standard of safe, quality care delivery such that considering the patient’s intrinsic risk seemed inappropriate when determining HAI preventability. Following the second round of reviewer adjudication, agreement between the two reached 84% overall (Kappa 0.76 [95% CI 0.64, 0.88]). Comparison of preventability ratings between the first and second rounds of review is demonstrated in Supplemental Figure 3.

After two rounds of rating, comparing reviewer adjudication of preventability ratings with those of the expert panel, among cases with expert consensus (n=52), guide-based rating agreed with the expert panel consensus in 40 (77% [95% CI 65%, 88%]) scenarios for Reviewer 1 and 39 (75% [95% CI 63%, 87%]) for Reviewer 2. For both reviewers, the sensitivity and specificity were higher for cases rated as preventable or non-preventable, and lower for expert panel ratings in the uncertain range (Table 3). Inter-reviewer agreement was 87% (Kappa 0.79 [95% CI 0.65, 0.94]).

Discussion

We developed a structured preventability rating guide and evaluated its performance for standardized assessment of HOB scenarios in comparison with consensus preventability ratings by a panel of healthcare epidemiology and clinical experts. Using hypothetical HOB clinical scenarios, we identified varying perspectives on HOB preventability and through Delphi methodology were able to achieve consensus in 63% of scenarios after two rounds of rating. Preventability ratings of these HOB case scenarios by two independent reviewers using a structured preventability rating guide matched expert consensus in most cases and demonstrated moderately high inter-reviewer reliability.

Iterative rating and discussion of HOB scenarios by the expert panel demonstrated differing perspectives and opinions regarding the preventability of HOB; only 35% of scenarios achieved consensus after the first round of rating. Similarly, even with use of the structured rating guide, initial agreement between the two reviewers was only 55% and despite individualized feedback to ensure use of the guide as intended, differences in assessments of preventability persisted. Complex clinical cases where there is pre-existing uncertainty – both in pathogenesis of infection and relative contribution of intrinsic and extrinsic risks – inevitably leads to differing opinions with regards to preventability and challenges in establishing consensus. This was also noted in a prior French study of preventability of healthcare-associated bloodstream infections where 25% of 196 cases with an identifiable source and related to medical management were of uncertain preventability.[17] Our findings are also consistent with prior literature showing that when evaluating other non-HAI adverse events in healthcare, the level of agreement even among expert reviewers is not high.[22] Open discussion amongst experts provided some insight into reasons for this observation. These included lack of agreement on the underlying source of infection, differences in perceived preventability of specific sources of infection, and the interaction of patient risk with healthcare risk. An expert's clinical familiarity with a particular field or specialty may also contribute e.g., a pediatrician may feel less confident in determination of preventability in an adult HOB scenario and vice versa. Lastly, collapsing the Likert scale ratings from six ordinal levels to three to determine expert consensus may also contribute to lack of agreement via measurement distortion due to some neighboring ratings being combined and other neighboring ratings being placed in separate ordinal categories.

Our goals in creating and applying a risk matrix to HOB scenarios was to reduce subjectivity and variability in assessing both the risk related to underlying conditions and perceived preventability. We believe that we were able to accomplish these objectives as demonstrated both by moderate to high agreement of guide-based rating to expert consensus reference standard as well as inter-reviewer agreement for guide-based rating. However, the rating guide does not eliminate the subjectivity and uncertainty inherent in this assessment. In this regard, there were two key findings in our study. First, the reference standard of "expert consensus" against which the guide-based rating was compared was itself an elusive entity for over a third of the cases. Second, the guide performed well for the two extremes of preventable and non-preventable cases but not for those considered uncertain by the expert panel. This reflects current paradigms of HAI preventability that are largely focused on those associated with specific devices or procedures, whereas an understanding of preventability across the entire spectrum of HOB sources which have not been a focus of prior surveillance efforts (e.g., non-catheter associated UTI or non-ventilator associated pneumonia) is relatively lacking in comparison. The risk matrix additionally provided insight into whether differences in ratings by reviewers were driven by differences in patient risk versus extrinsic provision of medical care. For example, one reviewer consistently rated the intrinsic risk of patients at a higher level, thereby leading to more scenarios being categorized as "Not Preventable" as compared to their counterpart reviewer.

Despite these limitations, there are advantages to use of a standardized risk matrix both for surveillance and for use as a tool when communicating with frontline clinicians. From a surveillance perspective, measuring and understanding the “preventable” portion of HOB cases can be the basis for reducing clinically meaningful HAIs. Identifying HOB cases where there is uncertainty about preventability can be an impetus for the healthcare epidemiology field to focus on novel prevention measures based on the underlying sources of those cases.

Our findings of expert reviewer perception of preventability of these scenarios, with only 27% of consensus scenarios identified as preventable, contrasts with the general perception that HAIs are mostly preventable and underlies their inclusion as quality metrics. Our results are more closely aligned with actual data from systematic reviews of studies of interventions to reduce HAIs, which estimate preventability of HAIs in the range of 35–70% across different infections, settings, and time periods of study.[23 24] Acknowledgement of the inherent risk contributed by the patient’s presenting conditions prior to HOB events in a standardized way could help bridge the gap between those responsible for oversight of surveillance and prevention activities and bedside clinicians in expectations of the preventability of HAI events. In the future, this structured guide could be adapted for use by clinicians to evaluate HOB cases at the bedside.

A major limitation is that the case scenarios represented an artificial collection developed by the investigators, and likely skewed towards more complex presentations that may not be reflective of the entire spectrum of HOB etiologies or patient case-mix across all facility types and geographic locations. Additionally, the scenarios were intended to facilitate the development of the structured rating guide rather than assess the preventability of various HOBs by source – a larger study of real-world HOB cases is more appropriate for such analysis. However, we attempted to capture a spectrum of HOB events with respect to underlying conditions, sources, and etiologic microorganisms, including contaminants. Another concern is the inability to develop expert consensus in over a third of the cases, which limited the reference standard against which the rating guide could be evaluated. Lastly, in many scenarios, the use of a 70% threshold to define consensus led to a determination of consensus without unanimity, though other infection control and hospital epidemiology researchers have utilized a similar threshold.[25 26]

In summary, using an iterative process, we developed a structured HOB preventability rating guide that allowed a moderately high degree of agreement with a reference standard of expert panel consensus, and between reviewers, in rating preventability. While the diversity of expert opinions and uncertainty of HOB preventability merit further exploration, we demonstrated that this rating guide can be applied to a broad spectrum of HOB case scenarios, and account for underlying patient risk and the extrinsic aspects of care that contribute to HOB. A larger study of HOB evaluation using this rating guide for actual HOB events across multiple institutions is underway and will provide further insight into preventability based on HOB source and etiologic organism.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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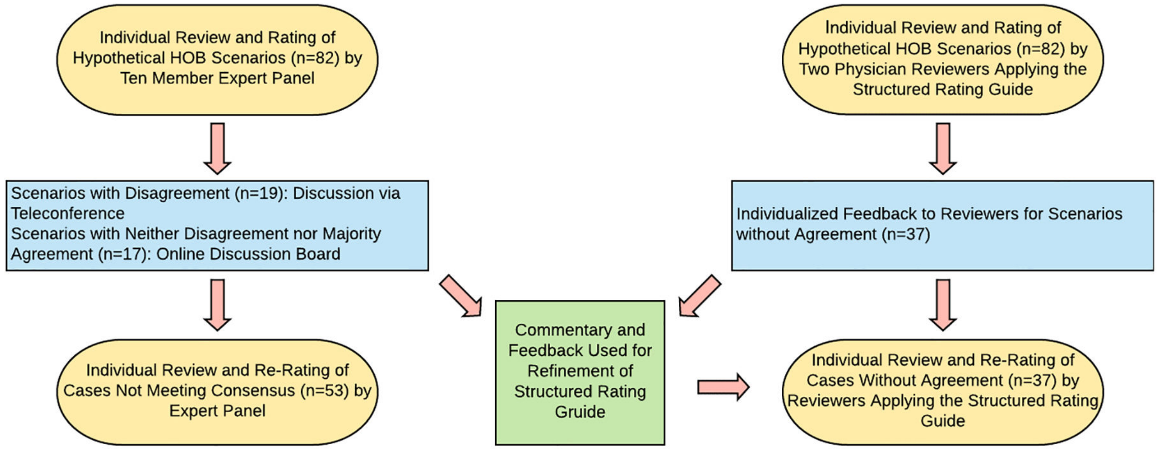

Figure 1.

Study protocol of hospital-onset bacteremia and fungemia (HOB) scenario review, discussion, and re-rating by the expert panel (left) and review, independent feedback, and re-rating by the physician reviewers (right).

		PREVENTABILITY RELATIVE TO EXTRINSIC HEALTHCARE-RELATED RISK		
		LOW	MEDIUM	HIGH
INTRINSIC RISK DUE TO UNDERLYING CONDITIONS (ACUTE ILLNESS AND CHRONIC CO-MORBIDITY)	LOW	Less likely Preventable than Not (4)	Moderately Likely to be or Probably Preventable (2)	Definitely or Almost certainly Preventable (1)
	MEDIUM	Moderately likely to be or Probably Not Preventable (5)	More Likely Preventable than Not (3)	Moderately Likely to be or Probably Preventable (2)
	HIGH	Definitely or Almost certainly Not Preventable (6)	Moderately likely to be or Probably Not Preventable (5)	More Likely Preventable than Not (3)

Figure 2.

Preventability matrix for rating of hospital-onset bacteremia and fungemia (HOB) case scenarios. Examples of intrinsic risk conditions include desquamating skin condition (high), neutropenia (high), solid organ transplant >30 days prior (medium), and acute myocardial infarction (low). Examples of preventability relative to extrinsic healthcare-related risk include temporary central venous catheter infection (high), pressure ulcers that develop or worsen during the hospital stay (high), mechanical ventilation complicated by pneumonia (medium), and infection following contaminated/dirty surgical procedures (low).

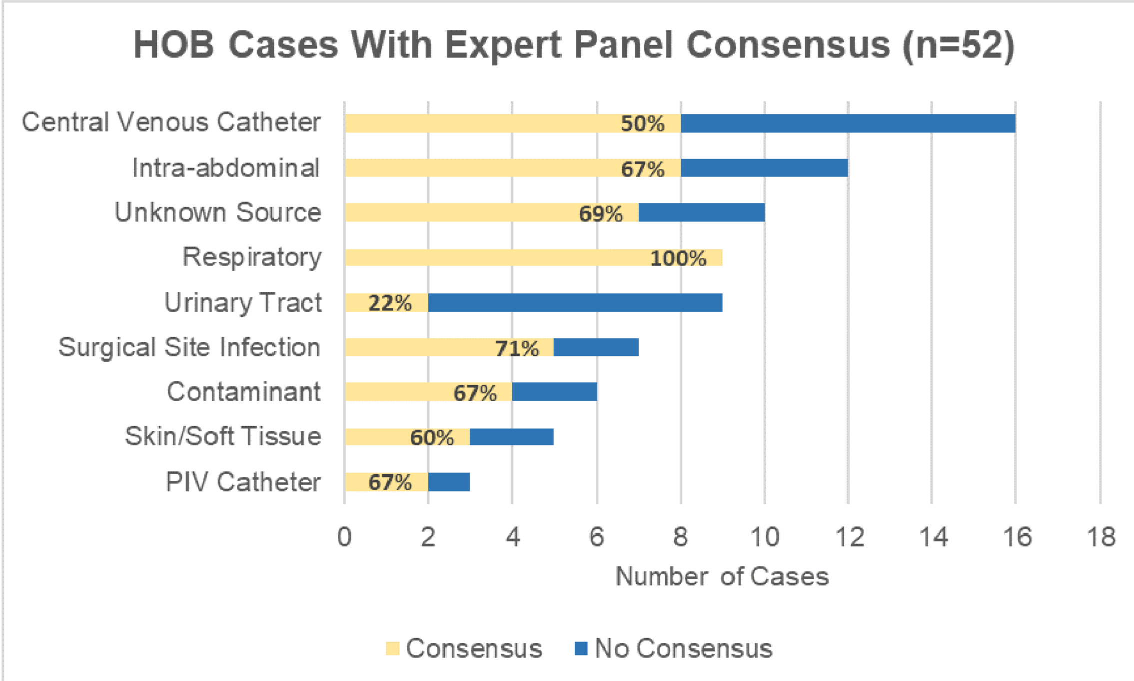

Figure 3.

Pre-defined sources of hospital-onset bacteremia and fungemia (HOB) and associated ability of expert panel to achieve consensus on preventability after two rounds of rating.

Abbreviations: PIV, peripheral intravenous

Table 1.

Characteristics of HOB Clinical Case Scenarios

Categorization and causative organisms of hospital-onset bacteremia and fungemia (HOB) hypothetical clinical case scenarios constructed by infectious disease physicians and healthcare epidemiologists for review by an expert panel and independent review by physician reviewers using a structured rating guide.

HOB Clinical Case Scenarios, n=82	**n (%)**
Adult	64 (78%)
Pediatric	18 (22%)
HOB Source of Attribution	
Central venous catheter	16 (20%)
Intra-abdominal	12 (15%)
Respiratory	9 (11%)
Urinary tract	9 (11%)
Unknown source	9 (11%)
Surgical site infection	7 (8%)
Contaminant	7 (8%)
Skin/Soft tissue	5 (6%)
Other	8 10%
Organisms Identified in Index HOB	
Enterococcus spp.	14 (15%)
Staphyloccoccus aureus	10 (11%)
Coagulase-negative *Staphylococcus* spp.	9 (10%)
Candida spp.	9 (10%)
Enterobacter spp.	8 (9%)
Pseudomonas aeruginosa	7 (7%)
Klebsiella spp.	7 (7%)
Streptococcus spp.	6 (6%)
Escherichia coli	6 (6%)
Other	18 (19%)

Abbreviations: HOB, hospital-onset bacteremia and fungemia.

Table 2.

Themes Identified During HOB Scenario Rating Discussions

Themes that emerged during hospital-onset bacteremia and fungemia (HOB) scenario rating discussion by expert panel along with selected quotations from individual experts.

Expert Panel Discussion Topic	Illustrative Quotations
Long-term Indwelling Central Venous Catheters	"[This was] hard to prevent, and it is debatable whether the line should be replaced or maintained. In some patients, lines are life preserving and this is a central line infection in a very complex patient with a very long hospital stay." "… there is less evidence to support prevention practices for line maintenance. Potentially the care team was doing all of the right things and despite that, the bacteremia still occurred…. The further out you are from insertion, it may be harder to prevent." "Removal of device could have prevented [the bacteremia] but patient clearly needs the device. No direct evidence of lapses in care of the line."
Surgical Site Infections After Complex Surgical Procedures	"[There is] always a risk with surgery, but potentially with optimal surgical technique the risk would be lower." "Surgeons often tell me that in many cases there is nothing that can be done to prevent these complications. Some differences in technique may affect the rate of complications. This is a surgical site infection that may have been preventable, and just happened to have a bloodstream infection." "The nature of the surgery itself was quite complicated. How can you effectively prevent an infection in someone that is so high risk?"
Urinary tract infection related to retention after indwelling urinary catheter removal	"…ongoing issues with retention for several days before symptoms of infection, which is the preventable component of the case." "Concerning in this case is the high post void residual. Something could have been done to prevent this from happening, potentially re-insert the foley." "With pressure in hospitals to remove foley catheters, potentially the wrong patient was chosen to have the foley removed." "The foley catheter was appropriately removed and the patient was also appropriately started on intermittent straight catheterization."
Patients with complex medical or surgical presentations at high risk for infection	""Nightmare" case, very hard both to judge and to prevent." "Very high-risk underlying disease. There is always something that could have been done differently, but the patient has such [significant comorbidity] that it may not be preventable." "In some cases, surgeons would avoid operating on a patient like this because they are at such high risk of complications." "I felt this was such a complex and compromised patient who required multiple devices over a prolonged hospitalization, [they were] at very high risk of a bacteremia."
Vascular catheter infection in patient with desquamating skin condition	"I think that when I read about hx of stem cell transplant and chronic GVHD of skin, it seemed to me that despite best efforts for skin care, bacteremia can happen due to interruptions in skin barrier." "Putting a PIV in an area with active skin rash is a great set up for bacteremia (as you all know). My reading of the scenario had me imagining that this was a patient who should not have had PIVs at all because of his skin problems or at least I was imagining that the HCWs who placed the PIVs didn't appreciate the risks of the non-intact skin and may have chosen particularly bad spots to place the PIVs. Not sure what the better options are though and really depends on the individual patient."
Blood Culture Contamination	"You can prevent positive blood cultures by not drawing blood cultures to begin with." "All contaminant cultures are preventable if appropriate technique is used." "With a peripheral blood draw, contaminants should be preventable." "If the bacteremia is a false positive, however, then it leans towards preventable due to blood culture technique and the underlying indication/need for blood cultures."
Delay in diagnosis or management	"I rated this one a 2 ("moderately likely to be preventable") since it seems that he was brewing an intra-abdominal infection starting on day 5–6, yet no abdominal imaging was done until day 8 (and it seems his symptoms on day ~6 were mistakenly attributed to UTI). If his intra-abdominal process were detected earlier and treated, then his bacteremia could probably have been prevented." "I initially felt patient was at higher risk of an abdominal SSI with the feculent contamination due to gunshot wound and, but as…….points out, this should have increased the suspicion for abdomen to have been considered as a probable source of infection with earlier imaging/intervention on day 6 with temp and WBC. If addressed, might have prevented the bacteremia." "Complicated case and complicated injury, a setup for infection so this is not definitively preventable. Leaned toward preventability because there was high drain output for 72 hours, so potentially a delay in recognizing peritonitis and there could have been an earlier intervention."

Expert Panel Discussion Topic	Illustrative Quotations
HOB Without Known Source	“If the patient had developed a true bacteremia with an unknown source, then I would move my score toward non-preventable”

Abbreviations: HOB, hospital-onset bacteremia and fungemia.

Table 3.

Performance of the Structured Preventability Assessment Guide

Performance characteristics of the structured preventability assessment guide for the rating of hospital-onset bacteremia and fungemia (HOB) hypothetical clinical case scenarios compared to reference expert panel with consensus.

		Expert Panel Consensus Preventability Rating		
		Preventable (n=14)	**Uncertain (n=23)**	**Not Preventable (n=15)**
Reviewer 1 (n=52)	Sensitivity (%)	100	52.2	86.7
	Specificity (%)	86.8	96.6	81.1
Reviewer 2 (n=52)	Sensitivity (%)	100	47.8	100
	Specificity (%)	94.7	100	73
		(n=14)	**(n=18)**	**(n=13)**
Reviewer 1 & 2 Agreement (n=45)	Sensitivity (%)	100	50	100
	Specificity (%)	93.5	100	78.1