THE IMPLICATIONS OF BACTEREMIA

DJ SHANNON, MPH, CIC, VA-BC, FAPIC

DISCLOSURES

- I, DJ Shannon, have a financial interest/arrangement or affiliation (consulting/speaker/honoraria) with one or more following organizations that could be perceived as a real or apparent conflict in the context of this presentation: Teleflex Incorporated, ICU Medical, Becton Dickinson, APIC Text, APIC Consulting, Community Health Network.

- Any discussion regarding products during the presentation is limited to information that is consistent with labeling.

OBJECTIVES

- Explore the *why* behind addressing hospital onset bacteremia
- Identify the implications of bacteremia, including diagnostic stewardship and antibiotic resistance
- Discuss additional patient impacts such as increased length of stay and *C. difficile* infection

FROM CLABSI TO HOB

CLABSI

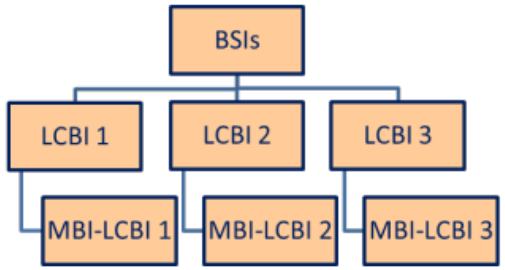
- Surveillance began around 2011 with CMS reimbursement beginning in 2013
- Well-intentioned, but inadvertently placed all focus on only bacteremia associated with central lines

Definitions Specific to Bloodstream Infection (BSI) / Central Line Associated Bloodstream Infection (CLABSI) Surveillance:

Primary bloodstream infection (BSI): A Laboratory Confirmed Bloodstream Infection (LCBI) that is not secondary to an infection at another body site (see Appendix: Secondary BSI Guide and CDC/NHSN Surveillance Definitions for Specific Types of Infection [Ch-17], urinary tract infection (UTI) [Ch-7], pneumonia (PNEU) [Ch-6], and surgical site infection (SSI) [Ch- 9].

Laboratory Confirmed Bloodstream Infection (LCBIs) Hierarchy; Types of LCBIs

(see Table 1 and Table 2):



https://www.jointcommission.org/-/media/tjc/documents/resources/health-services-research/clabsi-toolkit/clabsi_toolkit_tool_5-6_outcome_and_process_performance_measurespdf.pdf

CLABSI TO HOB

SHEA/IDSA/APIC Practice Recommendation

Strategies to prevent central line-associated bloodstream infections in acute-care hospitals: 2022 Update

Niccolò Buetti MD, MSc, PhD[1,2,a], Jonas Marschall MD, MSc[3,4,a], Marci Drees MD, MS[5,6], Mohamad G. Fakih MD, MPH[7], Lynn Hadaway MEd, RN, NPD-BC, CRNI[8], Lisa L. Maragakis MD, MPH[9], Elizabeth Monsees PhD, MBA, RN, CIC[10,11], Shannon Novosad MD MPH[12], Naomi P. O'Grady MD[13], Mark E. Rupp MD[14], Joshua Wolf MBBS, PhD, FRACP[15,16], Deborah Yokoe MD, MPH[17] and Leonard A. Mermel DO, ScM[18,19]

2. Surveillance of other types of catheters (eg, peripheral arterial or venous catheters) [11,21,22]

a. Peripheral arterial catheters, short-term peripheral venous catheters and midline catheters are not included in most surveillance systems although they are associated with risk of bloodstream infection. Future surveillance systems should consider including bloodstream infections associated with these types of catheters.

b. If considering further infection prevention interventions due to concern for an increase in infections, hospitals may want to consider extending their surveillance programs to include all types of catheters used to gauge the size of the problem.

Infusion Therapy Standards of Practice

6. QUALITY IMPROVEMENT

D. Consider expanding surveillance to include hospital-onset bacteremia as a broad-quality metric.[54,55] (IV)

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Major Article

Recommendations for change in infection prevention programs and practice

Robert Garcia BS, MT(ASCP), CIC, FAPIC[a,*], Sue Barnes RN, BSN, CIC, FAPIC[b], Roy Boukidjian MSN, CIC, NE-BC[c], Linda Kaye Goss DNP, BS, APRN, COHN-S, CIC, FAPIC[d], Maureen Spencer MEd, BSN, RN, CIC, FAPIC[e], Edward J. Septimus MD[f], Marc-Oliver Wright MT(ASCP), MS, CIC, FAPIC[g], Shannon Munro PhD, APRN, BC, NP[h], Sara M. Reese PhD, MPH, CIC, FAPIC[i], Mohamad G. Fakih MD, MPH[j], Charles E. Edmiston MS, PhD, CIC, FIDSA, FSHEA, FAPIC[k], Martin Levesque BA, BS, MPH, MBA, CIC, FAPIC[l]

Device-associated BSIs account for significant numbers of HAIs in United States health care facilities. However, the full extent of the problem is unknown because surveillance and federal reporting is currently mandated only for CLABSI events. Published studies indicate that considerable numbers of BSIs occur as a complication after placement of arterial,[117] hemodialysis,[118] midline,[119] and peripheral intravenous catheters (PIV).[120] This evidence supports a need to implement a more comprehensive prevention strategy that addresses *all* types of intravenous catheters, which could be captured using a concept known as *Hospital Onset Bacteremia* (HOB). This expanded prevention strategy should extend to settings outside of hospitals, such as home infusion, where caregiver practices are a notable infection factor.[121] It should also reflect recent learnings from the COVID-19 pandemic based on analysis of the causes for the increase in BSI during this period.[122]

CLABSI TO HOB

Hospital-Onset Bacteremia & Fungemia (HOB)

#APIC2023

- *Purpose*: Surveillance for broader reduction of bloodstream infections, regardless of organism (e.g. MRSA) or association with device (CLABSI)
- *Definitions*:
  - HOB: Blood culture collected on day 4 or later with pathogenic bacteria or fungi
  - *Complementary metrics:* Blood culture utilization, Contamination, Community-onset bacteremia & fungemia, Matching Commensal Hospital-Onset Bacteremia
- *Key Data Elements*: Microbiology,
- *Timeline:* NHSN launch 2024

WHY HOB?

Incidence of non-CLABSI HOB is more than fourfold higher than CLABSI

Mortality, length of stay, and cost, on par with CLABSI

Yu, K. C., Jung, M., & Ai, C. (2023). Characteristics, costs, and outcomes associated with central-line-associated bloodstream infection and hospital-onset bacteremia and fungemia in US hospitals. *Infect Control Hosp Epidemiol*, 1-7. https://doi.org/10.1017/ice.2023.132

WHY HOB?

	CLABSI	Non-CLABSI
Length of stay (days)		
ICU	22.5	19.6
Non-ICU	19.2	15.9
Additional costs		
ICU	$55,000	$42,095
Non-ICU	$32,759	$25,020
Mortality (unadjusted)	31.3%	28.3%

Yu, K. C., Jung, M., & Ai, C. (2023). Characteristics, costs, and outcomes associated with central-line-associated bloodstream infection and hospital-onset bacteremia and fungemia in US hospitals. *Infect Control Hosp Epidemiol*, 1-7. https://doi.org/10.1017/ice.2023.132

BUT WHAT IS HOB

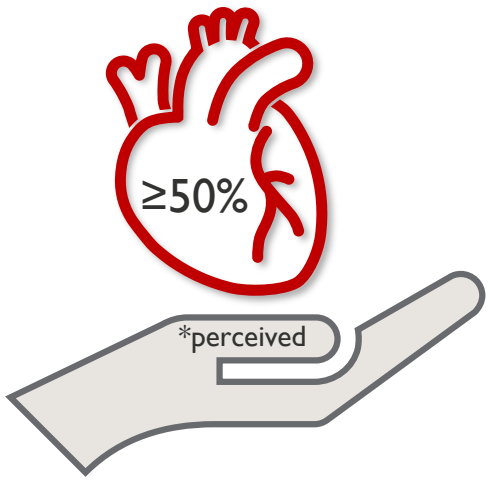
HOB METRIC

HOB Metric and Complementary Metrics

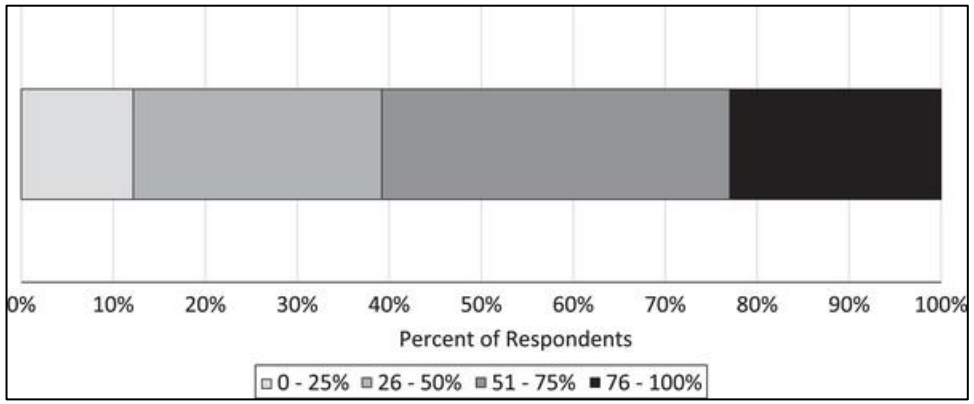
Category/Use	Event	Numerator	Denominator
	Measure Event		
Primary Metric	**HOB Event**	Pathogenic bacteria or fungi from blood culture on hospital day ≥4, (excluding patients with prior matching cultures and HOB events)	Inpatient Admissions
	Complementary Metrics		
Risk Adjustment, Diagnostic Stewardship, QI	**Blood Culture Utilization**	Testing Prevalence: Admissions with at least 1 blood culture Testing Intensity: Total blood cultures among patients with at least 1 blood culture	
QI	**Blood Culture Contamination**	Skin commensal organism in 1 of 2 blood cultures sets	Total blood culture sets
Risk Adjustment	**Community-Onset Bacteremia & Fungemia Event**	Pathogenic bacteria or fungi from blood culture prior to hospital day 4, (excluding patients with prior matching cultures and COB events)	Inpatient Admissions
Risk Adjustment, QI	**Matching Commensal Bacteremia Event**	Skin commensal from ≥2 blood cultures, AND ≥4 days of antibiotic treatment	Inpatient Admissions
Risk Adjustment, QI	**Non-Measure HOB Event**	HOB events among patients with conditions that highly predict non-preventability	Inpatient Admissions

HOB PREVENTABILITY

PREVENTABILITY



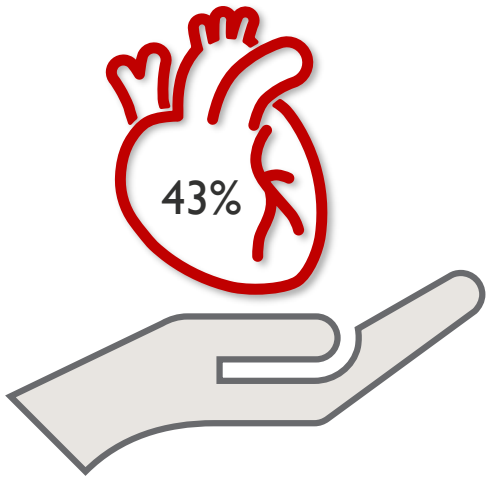
Proportion of HOB perceived as preventable under current infection prevention and clinical practices



- 23% considered ≥75% of HOB preventable
- 61% considered ≥50 of HOB preventable
  - 38% considered 51-75% preventable

Dantes RB, et al. (2019). Hospital epidemiologists' and infection preventionists' opinions regarding hospital-onset bacteremia and fungemia as a potential healthcare-associated infection metric. Infection Control & Hospital Epidemiology, https://doi.org/10.1017/ice.2019.40

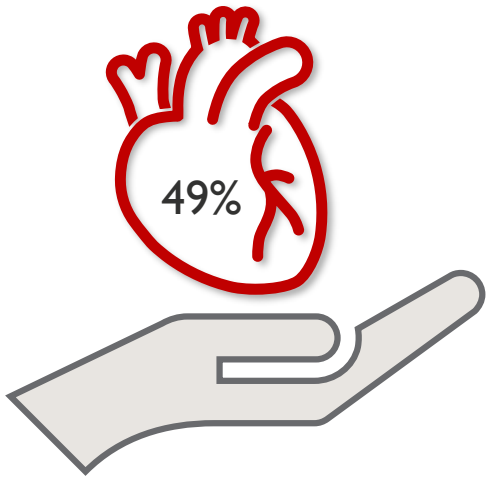
PREVENTABILITY



Preventable HOB cause	N (%)
Contaminant	55 (14.0%)
Central venous catheter (CVC)	39 (9.9%)
Surgical intervention (Surg)	26 (6.6%)
HAP/VAP	16 (4.1%)
PIV catheter-related infection (PIV)	13 (3.3%)
Miscellaneous	9 (2.3%)
CAUTI	7 (1.8%)
No source defined	4 (1.0%)

Stack, M. A., Dbeibo, L., Fadel, W., Kelley, K., Sadowski, J., & Beeler, C. (2023). Etiology and utility of hospital-onset bacteremia as a safety metric for targeted harm reduction. *Am J Infect Control*. https://doi.org/10.1016/j.ajic.2023.06.002

PREVENTABILITY



Variable	All Patients	
	No.	(%)
Total HOB events	60	(100)
Source of bacteremia or fungemia		
Skin contamination	11	(18)
CLABSI nonmucosal barrier injury	17	(28)
CLABSI with mucosal barrier injury	5	(8)
Respiratory tract	6	(10)
Peripheral IV related	3	(5)
Pyelonephritis	3	(5)
CAUTI	3	(5)
Intra-abdominal abscess or peritonitis	3	(5)
Ischemic bowel	2	(3)
Other	5	(8)
Unknown	2	(3)
NHSN-reported CLABSI	12	(20)
Secondary bloodstream infection	2	(3)

Dantes R, Rock C, Milstone AM, Jacob JT, Chernetsky-Tejedor S, Harris AD, Leekha S. Preventability of Hospital Onset Bacteremia and Fungemia: A Pilot Study of a Potential New Indicator of Healthcare-Associated Infections. Open Forum Infect Dis. 2017 Oct 4;4(Suppl 1):S182–3. doi: 10.1093/ofid/ofx163.336. PMCID: PMC5632060.

BROADENING OUR FOCUS

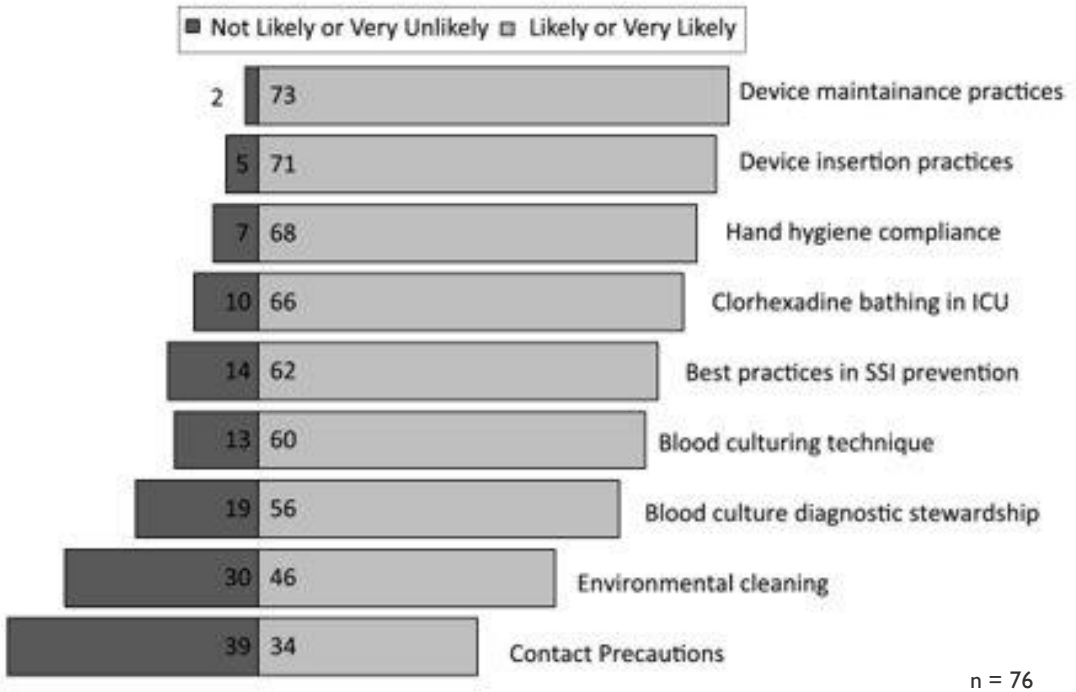
Culture Site	CLABSI (N=403), No. (%)	Non-CLABSI HOB (N=1,574), No. (%)	All HOB including CLABSI (N=1,977), No. (%)
None of the below	366 (90.8)	1,070 (68.0)	1,436 (72.6)
Urine only	19 (4.7)	200 (12.7)	219 (11.1)
Respiratory only	11 (2.7)	163 (10.4)	174 (8.8)
Skin/soft tissue only	5 (1.2)	93 (5.9)	98 (5.0)
Urine and respiratory	0	19 (1.2)	19 (1.0)
Skin/soft tissue and respiratory	0	15 (1.0)	15 (0.8)
Urine and skin/soft tissue	2 (0.5)	10 (0.6)	12 (0.6)
Urine, skin/soft tissue, and respiratory	0	4 (0.3)	4 (0.2)

Note. CLABSI, central-line–associated bloodstream infection; HOB, hospital-onset bacteremia; SSTI, skin and soft-tissue infection. Categories for positive culture sites are mutually exclusive.

Yu, K. C., Jung, M., & Ai, C. (2023). Characteristics, costs, and outcomes associated with central-line-associated bloodstream infection and hospital-onset bacteremia and fungemia in US hospitals. *Infect Control Hosp Epidemiol*, 1-7. https://doi.org/10.1017/ice.2023.132

BROADENING OUR FOCUS

Infection prevention improvement initiatives perceived as most likely to reduce HOB



n = 76

Dantes RB, et al. (2019). Hospital epidemiologists' and infection preventionists' opinions regarding hospital-onset bacteremia and fungemia as a potential healthcare-associated infection metric. Infection Control & Hospital Epidemiology, https://doi.org/10.1017/ice.2019.40

WE DON'T ALWAYS GET IT RIGHT

WHEN IT GOES WRONG

- Unnecessary antibiotics
- Additional lab tests
- Increased length of stay
- Acute kidney injury
- Increased healthcare costs
- C. difficile infection
- Antibiotic resistance
- Increased device days
- Increased healthcare-acquired conditions

CLOSTRIDIOIDES DIFFICILE

Clostridioides difficile infection (CDI) is the most common healthcare-associated infection. CDI can cause life-threatening diarrhea and most often occurs in people with recent exposure to antibiotics.

223,900
infections per year

12,800
deaths per year

$1,000,000,000
in excess medical costs per year

CDC. Antibiotic Resistance Threats in the United States, 2019. Atlanta, GA: U.S. Department of Health and Human Services, CDC; 2019.

ANTIBIOTIC RESISTANCE

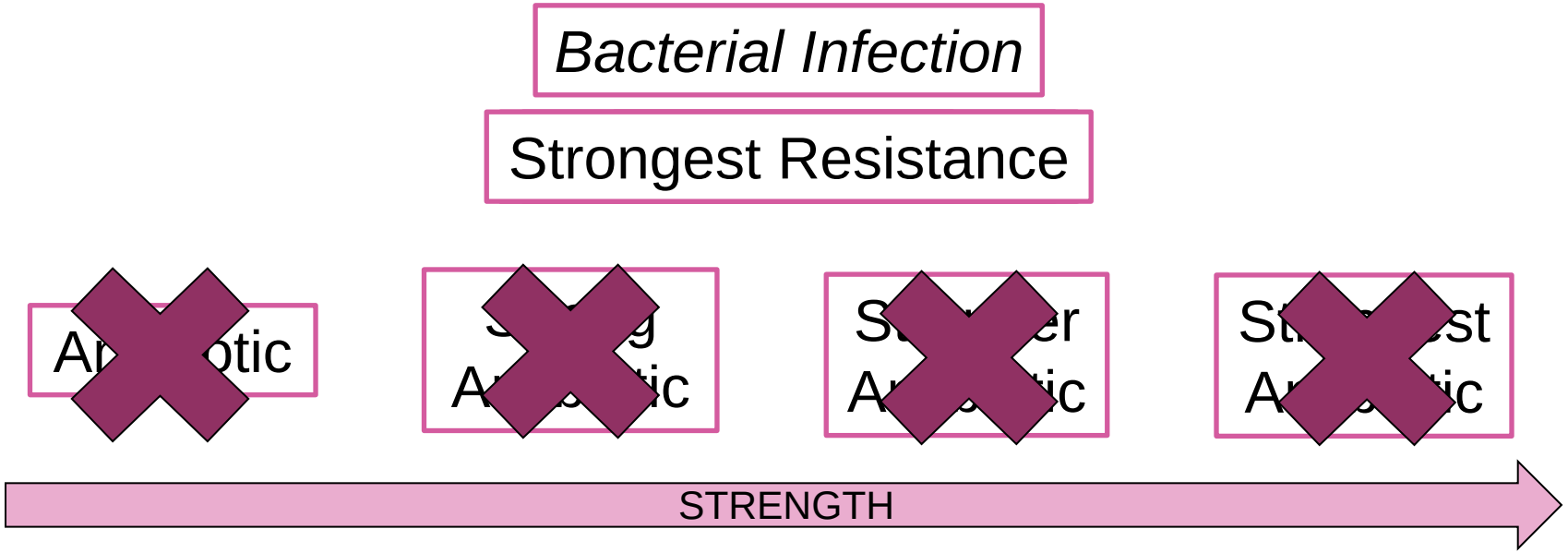
Antibiotic resistance occurs when bacteria no longer respond to the drugs designed to kill them. Anytime antibiotics are used, they can cause antibiotic resistance

2,868,700
infections per year

35,900
deaths per year

CDC. Antibiotic Resistance Threats in the United States, 2019. Atlanta, GA: U.S. Department of Health and Human Services, CDC; 2019.

ANTIBIOTIC RESISTANCE



HEALTHCARE ACQUIRED CONDITIONS

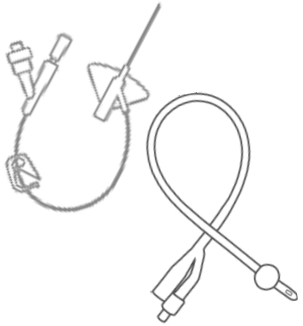
Each additional night in a hospital…

Hauck K, Zhao X. How dangerous is a day in hospital? A model of adverse events and length of stay for medical inpatients. Med Care. 2011 Dec;49(12):1068-75. doi: 10.1097/MLR.0b013e31822efb09. PMID: 21945976.

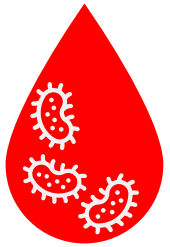
SETTING OUR SIGHTS ON SUCCESS

SIGHTS ON SUCCESS

Diagnostic Stewardship

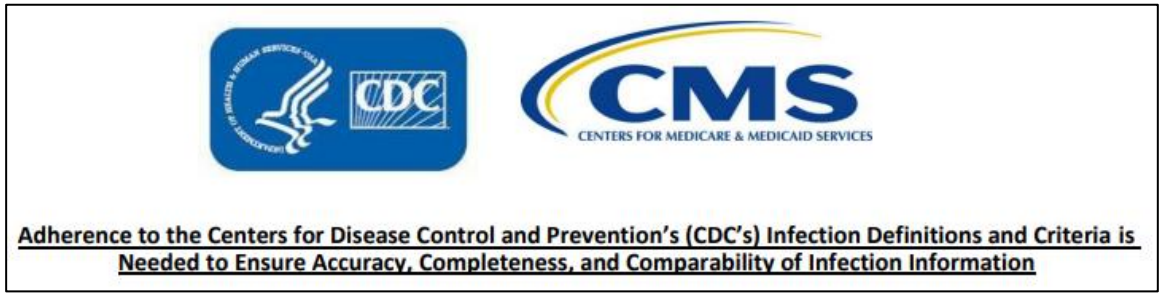


Device Stewardship



Blood culture contamination

SIGHTS ON SUCCESS: DIAGNOSTIC STEWARDSHIP



"Discouraging the ordering of diagnostic tests in the presence of clinical symptoms…"

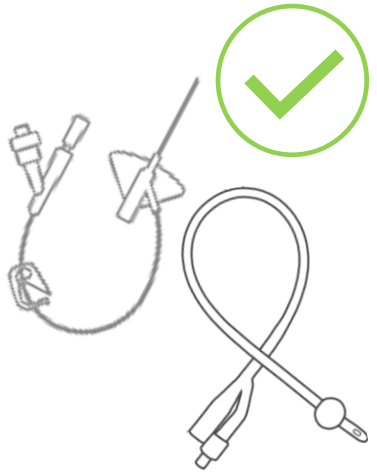
"Ordering diagnostic tests in absence of clinical symptoms…"

https://www.cdc.gov/nhsn/pdfs/cms/nhsn-reporting-signed.pdf

SIGHTS ON SUCCESS: DIAGNOSTIC STEWARDSHIP

SIGHTS ON SUCCESS: DEVICE STEWARDSHIP

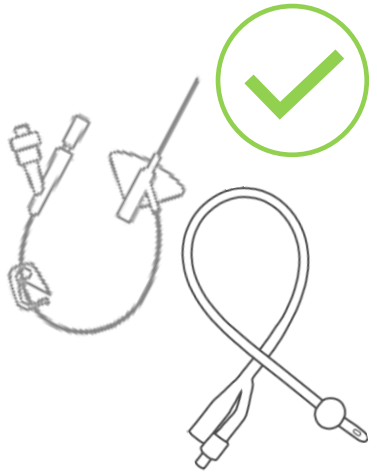
- Insertion
- Care/Maintenance
- Clinical Indication



SIGHTS ON SUCCESS: DEVICE STEWARDSHIP

Insertion

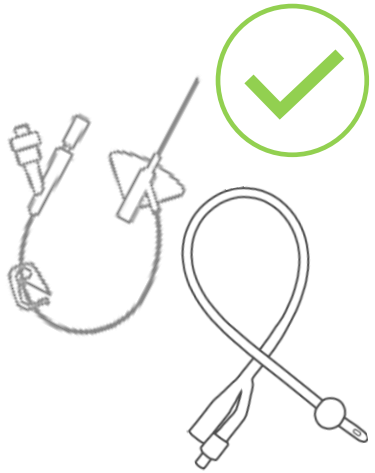
- Right device
- Right time
- By the right clinician



SIGHTS ON SUCCESS: DEVICE STEWARDSHIP

Care/Maintenance

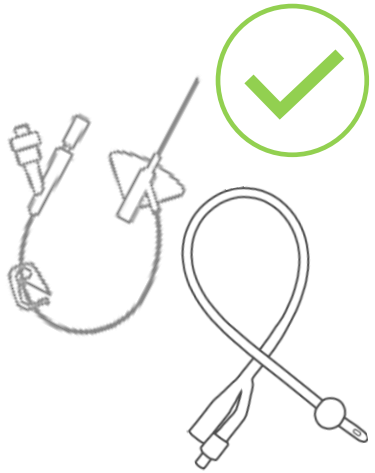
- Appropriate bundles
- Consider all devices



SIGHTS ON SUCCESS: DEVICE STEWARDSHIP

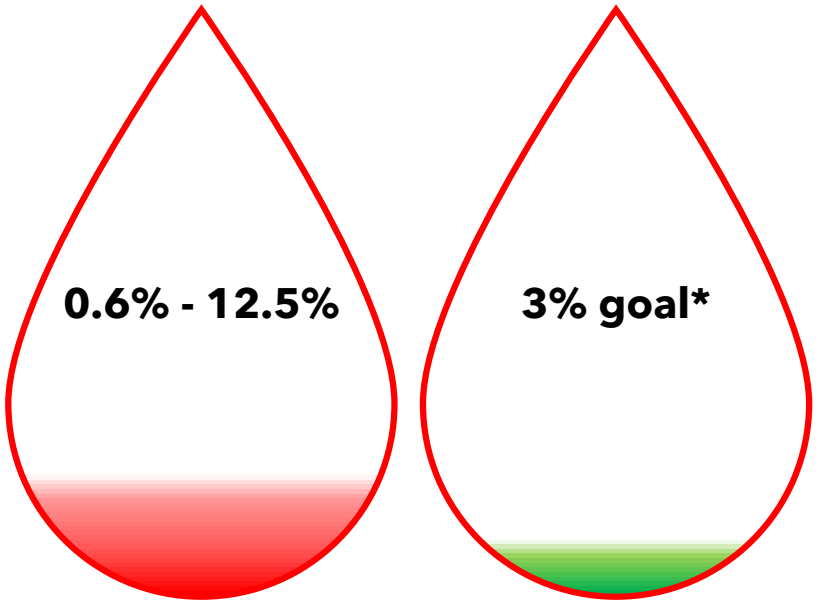
Clinical indication

- Is it needed?
- Is it functional?
- Any signs/symptoms?



SIGHTS ON SUCCESS: BLOOD CULTURE CONTAMINATION

Contamination rate



$$X = \frac{Contaminated\ blood\ cultures}{Total\ blood\ cultures}$$

30,000,000 annual blood cultures

X 3% blood culture contamination goal*

900,000 contaminated blood cultures per year

Doern GV, Carroll KC, Diekema DJ, Garey KW, Rupp ME, Weinstein MP, Sexton DJ. Practical Guidance for Clinical Microbiology Laboratories: A Comprehensive Update on the Problem of Blood Culture Contamination and a Discussion of Methods for Addressing the Problem. Clin Microbiol Rev. 2019 Oct 30;33(1):e00009-19. doi: 10.1128/CMR.00009-19. PMID: 31666280; PMCID: PMC6822992.

SIGHTS ON SUCCESS: BLOOD CULTURE CONTAMINATION

Studies show cost increases due to blood culture contamination

$6,463 per contamination event

79% due to prolonged stay and increased antibiotic therapy

Doern GV, Carroll KC, Diekema DJ, Garey KW, Rupp ME, Weinstein MP, Sexton DJ. Practical Guidance for Clinical Microbiology Laboratories: A Comprehensive Update on the Problem of Blood Culture Contamination and a Discussion of Methods for Addressing the Problem. Clin Microbiol Rev. 2019 Oct 30;33(1):e00009-19. doi: 10.1128/CMR.00009-19. PMID: 31666280; PMCID: PMC6822992.

SIGHTS ON SUCCESS: BLOOD CULTURE CONTAMINATION

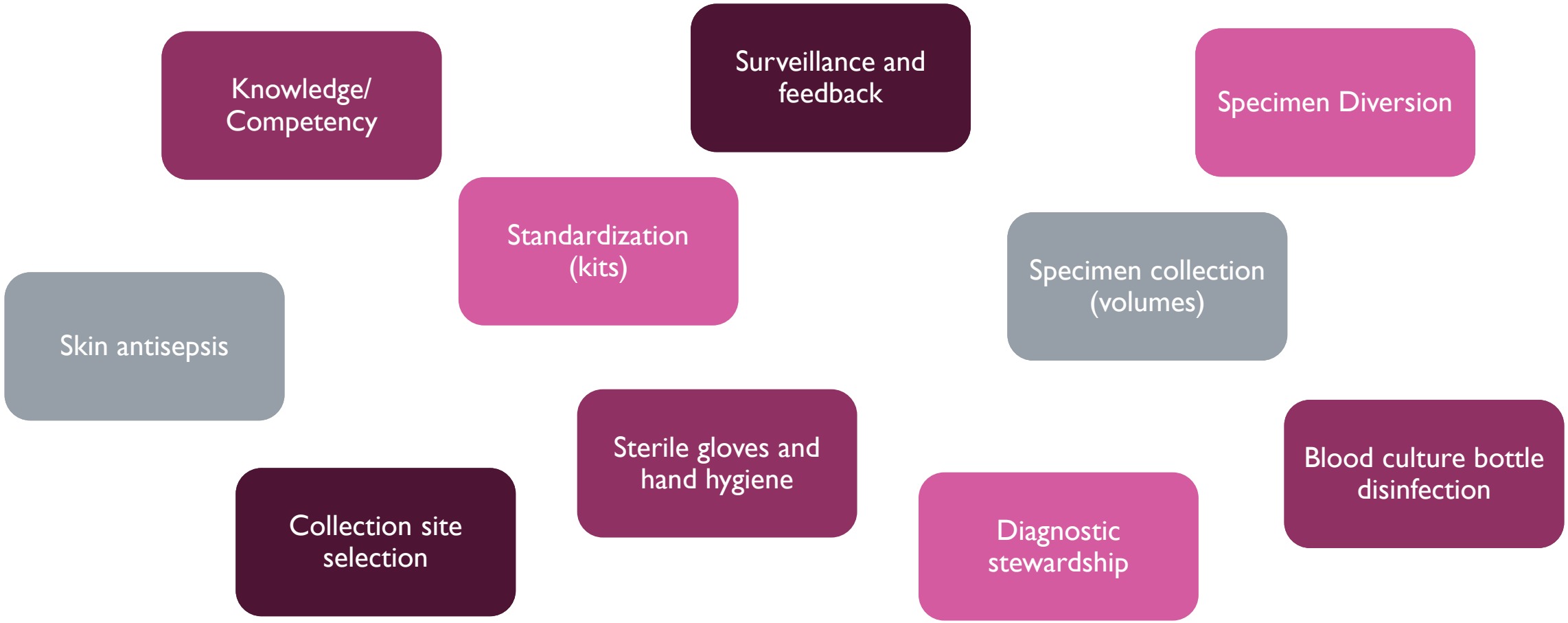
$6,463 per contamination event

900,000 contaminated blood cultures per year

$5,816,700,000

Doern GV, Carroll KC, Diekema DJ, Garey KW, Rupp ME, Weinstein MP, Sexton DJ. Practical Guidance for Clinical Microbiology Laboratories: A Comprehensive Update on the Problem of Blood Culture Contamination and a Discussion of Methods for Addressing the Problem. Clin Microbiol Rev. 2019 Oct 30;33(1):e00009-19. doi: 10.1128/CMR.00009-19. PMID: 31666280; PMCID: PMC6822992.

SIGHTS ON SUCCESS: BLOOD CULTURE CONTAMINATION



IN SUMMARY

THANK YOU!

DJ SHANNON, MPH, CIC, VA-BC, FAPIC