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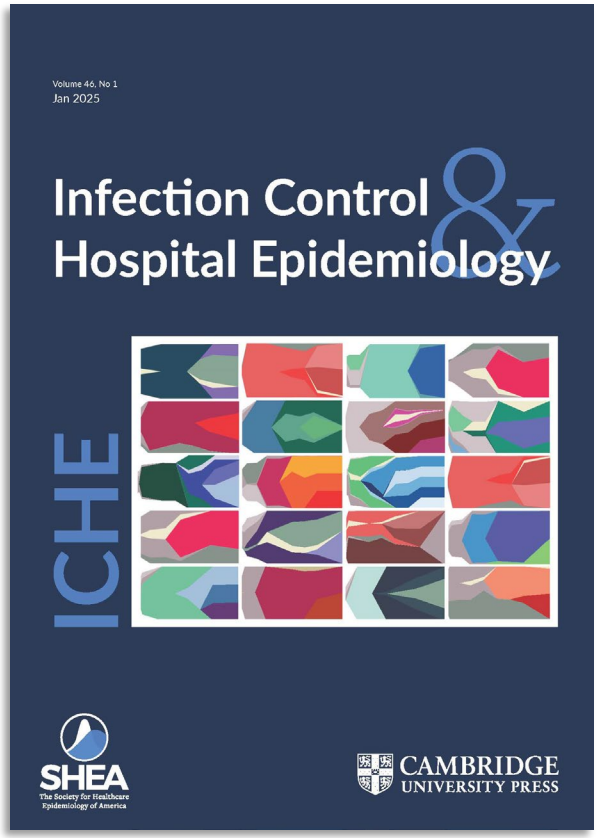

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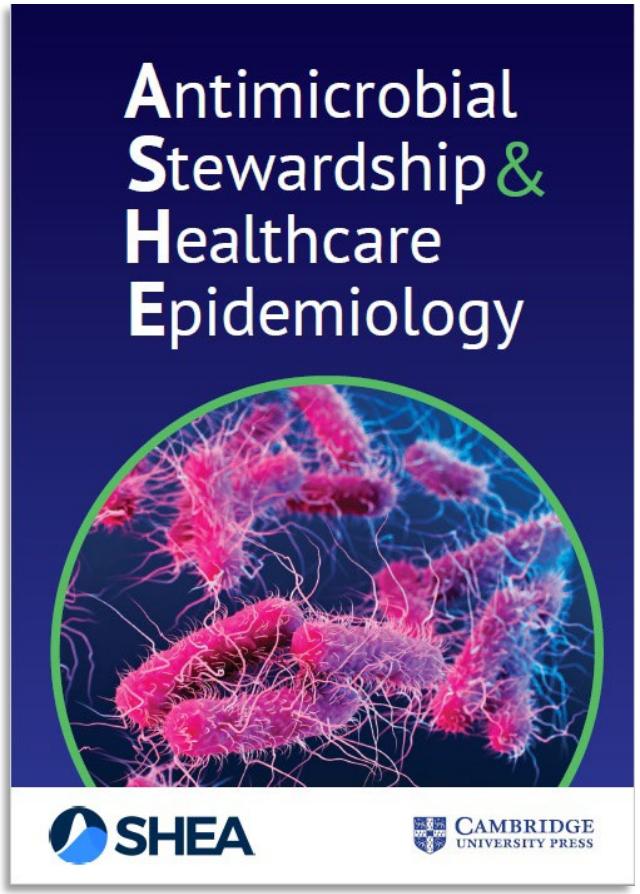

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Dr. Erica Shenoy
Mass General Brigham

Invited Panelist:

Lisa Maragakis, MD
Professor of Medicine & Epidemiology
Senior Director of Infection Prevention
Johns Hopkins Health System

Mass General Brigham

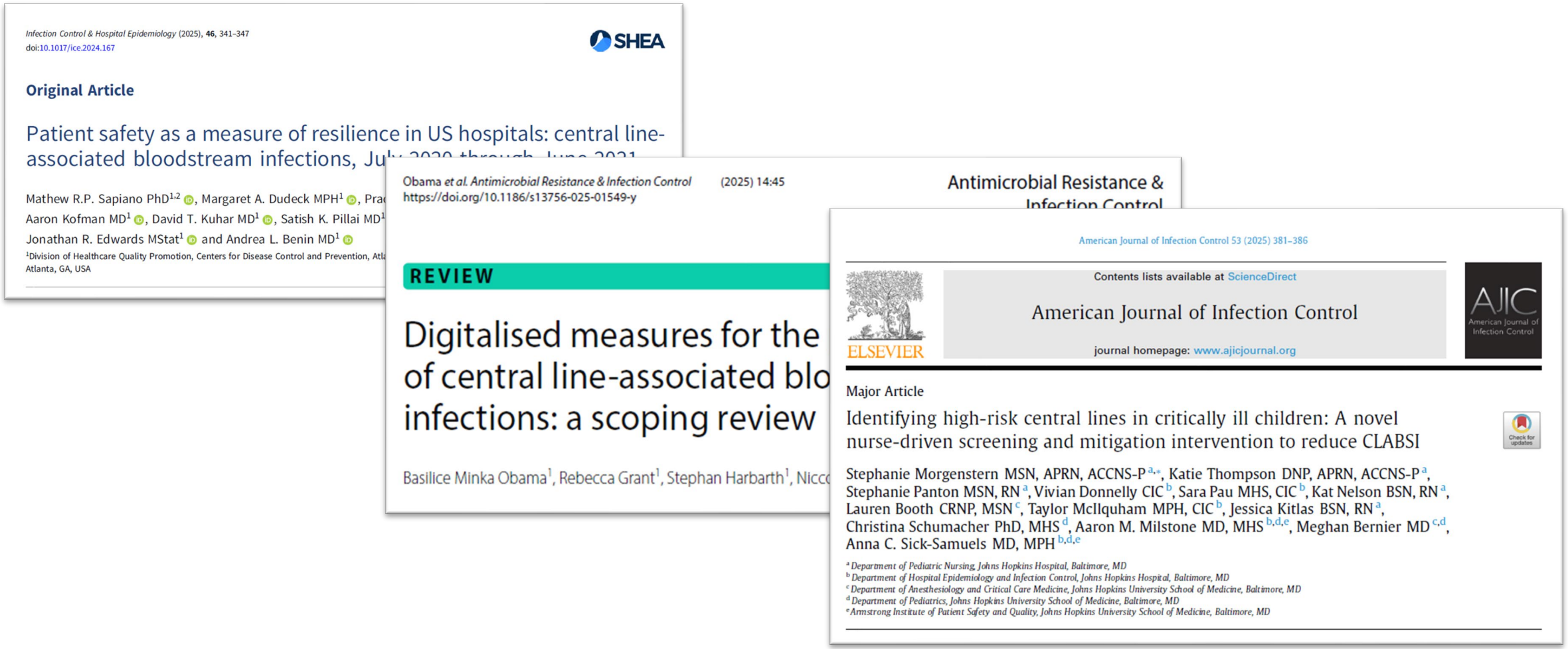
SHEA Town Hall

Clean Lines, Safe Lives: CLABSI Prevention Fundamentals

Erica S. Shenoy, MD, PhD
Chief of Infection Control, Mass General Brigham
Physician, Division of Infectious Diseases, Massachusetts General Hospital
Associate Professor, Harvard Medical School

September 2025

3 Interesting Takes



Infection Control & Hospital Epidemiology (2025), **46**, 341–347
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Original Article

Patient safety as a measure of resilience in US hospitals: central line-associated bloodstream infections, Ju

Mathew R.P. Sapiano PhD[1,2], Margaret A. Dudeck MPH[1], Prac
Aaron Kofman MD[1], David T. Kuhar MD[1], Satish K. Pillai MD[1]
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Obama *et al. Antimicrobial Resistance & Infection Control* (2025) 14:45
https://doi.org/10.1186/s13756-025-01549-y

Antimicrobial Resistance & Infection Control

REVIEW

Digitalised measures for the
of central line-associated blo
infections: a scoping review

Basilice Minka Obama[1], Rebecca Grant[1], Stephan Harbarth[1], Nicc

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AJIC American Journal of Infection Control

Major Article

Identifying high-risk central lines in critically ill children: A novel nurse-driven screening and mitigation intervention to reduce CLABSI

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Resilient Systems are Safer Systems: CLABSI

Impact of Healthcare System Stressors on HAI (1)

- Analysis of hospital-level CLABSI and COVID-19 data and measures of facility strain
  - Critical staff shortages
  - Hospital inpatient COVID-19 occupancy
  - Sustained high inpatient COVID-19 occupancy rate
  - Community COVID-19 incidence rate
- All 4 metrics significantly associated with increased risk of CLABSI
- Additional analyses conducted to assess impact of modifying metrics on CLABSIs

Table 3. Fitted model parameters with CLABSI rate for each level of the variables included in the model

Variable	Level	CLABSI rate per 10,000 central line days (N CLABSI/N central line days	Parameter estimate (95% confidence interval)	*P* value
Hospital type	1. General, Veterans Administration, military, oncology, orthopedic, women's	9.2 (18,056/19,586,236)	0.32 (−0.34, 0.98)	0.3419
	2. Children's	9.8 (671/685,782)	0.53 (−0.14, 1.20)	0.1212
	3. Surgical	6.0 (36/59,797)	Referent	
Medical school affiliation	1. Major	9.6 (12,802/13,277,052)	0.17 (0.11, 0.22)	<.0001
	2. Graduate	8.5 (2,120/2,505,755)	0.02 (−0.06, 0.10)	0.5796
	3. None/undergrad	8.4 (3,841/4,549,008)	Referent	
Number of inpatient beds	1. Less than 60	6.6 (208/316,411)	Referent	
	2. 60–139	8.6 (1,342/1,562,475)	0.17 (−0.01, 0.36)	0.0651
	3. 140–268	8.9 (3,768/4,232,136)	0.20 (0.02, 0.38)	0.0264
	4. 269 or more	9.5 (13,445/14,220,793)	0.26 (0.09, 0.44)	0.0032
Location type	Adult critical care, oncology critical care[a]	13.8 (7,442/5,378,330)	1.34 (1.15, 1.54)	<.0001
	Pediatric critical care[b]	10.6 (2,631/2,479,490)	1.04 (0.84, 1.24)	<.0001
	Adult burn critical care	16.1 (107/66,630)	1.47 (1.11, 1.83)	<.0001
	Adult trauma critical care	6.9 (14/20,320)	0.58 (−0.22, 1.38)	0.1524
	Specialty care areas[c]	8.2 (100/121,240)	0.80 (0.50, 1.09)	<.0001
	Step-down units	7.7 (1,122/1,448,473)	0.76 (0.55, 0.97)	<.0001
	Select adult wards[d]	6.1 (4,531/7,379,232)	0.55 (0.35, 0.75)	<.0001
	Oncology wards[e]	7.8 (1,664/2,141,554)	0.76 (0.56, 0.96)	<.0001
	Oncology stem cell transplant wards[f]	11.2 (480/429,981)	1.14 (0.92, 1.37)	<.0001
	All other adult wards	10.3 (552/535,540)	1.06 (0.83, 1.29)	<.0001
	All other pediatric wards and nurseries	2.6 (120/931,938)	Referent	
Hospital inpatient COVID-19 occupancy rate	1. Less than 2.5%	7.5 (2,902/3,854,649)	Referent	
	2. 2.5%–9.9%	8.6 (8,270/9,645,482)	0.07 (0.02, 0.12)	0.0105
	3. 10%–19.9%	10.4 (4,760/4,589,909)	0.15 (0.07, 0.23)	0.0001
	4. 20% or more	12.6 (2,831/2,241,775)	0.29 (0.20, 0.38)	<.0001
Critical staff shortages	1. 0%–10% days with staff shortages	8.7 (13,548/15,492,330)	Referent	
	2. More than 10% days with staff shortages	10.8 (5,215/4,839,485)	0.12 (0.08, 0.17)	<.0001
Community COVID-19 incidence rate	1. Less than 5 per 100K in HRR	7.6 (1,948/2,562,897)	Referent	
	2. 5–19.9 per 100K in HRR	8.0 (5,507/6,846,095)	0.00 (−0.06, 0.06)	0.9719
	3. 20 or more per 100K in HRR	10.4 (11,308/10,922,823)	0.10 (0.03, 0.16)	0.0033
Sustained high inpatient COVID-19 occupancy rate	1. No sustained COVID Burden	8.0 (8,498/10,604,274)	Referent	
	2. 5%–19.9% for 30 or more days	10.2 (2,998/2,950,788)	0.05 (−0.01, 0.11)	0.0833
	3. 5%–19.9% for 90 or more days	10.5 (6,715/6,367,232)	0.08 (0.02, 0.13)	0.0064
	4. 20% or more for 30 or more days	13.7 (315/230,745)	0.14 (0.01, 0.28)	0.0391
	5. 20% or more for 90 or more days	13.3 (237/178,776)	0.12 (−0.04, 0.29)	0.1503

Note: CLABSI, central line–associated bloodstream infections; HRR, Hospital Referral Region.
[a]Includes the following critical care units: medical, medical/surgical, surgical, medical cardiac, surgical cardiothoracic, neurologic, neurosurgical, prenatal, respiratory, medical oncology, medical/surgical oncology, pediatric oncology, and surgical oncology.
[b]Includes the following critical care units: pediatric burn, pediatric cardiothoracic, pediatric medical/surgical, pediatric medical, pediatric neurosurgical, pediatric surgical, and pediatric trauma.
[c]Includes inpatient dialysis and adult and pediatric solid organ transplant.
[d]Includes medical, medical/surgical, neurology, neurosurgical, surgical, and telemetry wards.
[e]Includes general hematology/oncology, pediatric general hematology/oncology, leukemia, leukemia/lymphoma, lymphoma, and solid tumor wards.
[f]Includes adult and pediatric hematopoietic stem cell transplant wards.

Sapiano MRP, Dudeck MA, Patel PR, Binder AM, Kofman A, Kuhar DT, Pillai SK, Stuckey MJ, Edwards JR, Benin AL. Patient safety as a measure of resilience in US hospitals: central line-associated bloodstream infections, July 2020 through June 2021. Infect Control Hosp Epidemiol. 2025 Feb 14:1-7. doi: 10.1017/ice.2024.167. Epub ahead of print. PMID: 39948082.

Impact of Healthcare System Stressors on HAI (2)

Table 4. CLABSIs predicted from the mode under 5 scenarios

Scenario	Predicted CLABSIs	Percent change, %
Total observed CLABSIs (July 2020 to June 2021)	18,757	
Total CLABSIs predicted from full model	18,767	
1. Moderate COVID-19: highest hospital and community rates never reached, and no sustained hospital burden	17,388	−7.3
2. No staff shortages	18,161	−3.2
3. No sustained hospital burden	18,051	−3.8
4. No staff shortages or sustained hospital burden	17,475	−6.9
5. Low COVID-19: hospital and community rates low, no staff shortages or sustained hospital burden	14,925	−20.5

Note. CLABSIs, central line-associated bloodstream infections.

Sapiano MRP, Dudeck MA, Patel PR, Binder AM, Kofman A, Kuhar DT, Pillai SK, Stuckey MJ, Edwards JR, Benin AL. Patient safety as a measure of resilience in US hospitals: central line-associated bloodstream infections, July 2020 through June 2021. Infect Control Hosp Epidemiol. 2025 Feb 14:1-7. doi: 10.1017/ice.2024.167. Epub ahead of print. PMID: 39948082.

Impact of Healthcare System Stressors on HAI (3)

- Stressors such as reduced staffing and higher occupancy with patients with COVID-19 negatively affected patient safety, specifically as measured by CLABSIs
- Staffing shortages and sustained stress from caring for high loads of patients with COVID-19 over prolonged periods each contributed to more than a 3% increase in CLABSIs
- Facilities reporting **staffing shortages** for more than 10% of days contributed close to 600 more CLABSIs than expected

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Commentary

Resilience: the need to address it from frontline, to organizational, and national levels

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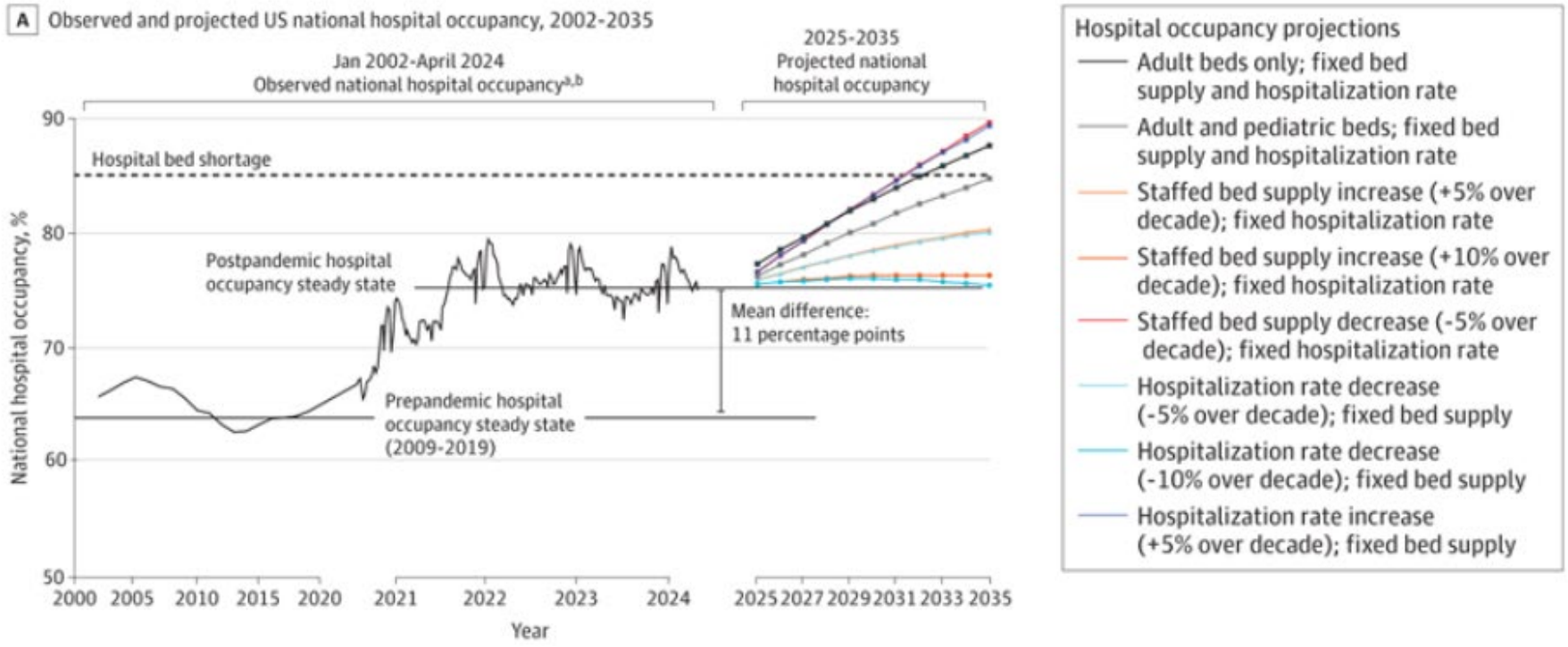
The coronavirus disease 2019 (COVID-19) pandemic has led to major disruptions in healthcare. It brought large waves of critically ill patients, cared for in an already stressed healthcare environment. Addressing the high transmission risk of the disease, its severity, and its complex management, clinically and operationally, had a substantial impact on the healthcare workforce and their function. Many experienced personnel exited the workforce, often replaced by new potentially less skilled members. In addition, alterations in processes, supply chain shortages, and measures to mitigate transmission risk or build capacity disrupted established systems for patient care delivery resulting in diminished interactions between healthcare workers and patients.[1,2] Since the early pandemic period, healthcare resilience, defined as the ability to adjust and sustain operations under expected and unexpected conditions,[3] has been an important element to assess readiness and response to major challenges to healthcare systems. Resilience can be considered at three levels, the individual, the hospital or organizational, and state or national levels. Sapiano *et al.*[4] addressed US hospitals resilience using central line associated bloodstream infections (CLABSI) as a surrogate. They evaluated the impact of four stressors, critical staff shortages, hospital inpatient COVID-19 occupancy rate, its sustained high inpatient occupancy rate, and its community burden in the early pandemic on CLABSI outcomes, a surrogate for patient safety. The authors found a higher CLABSI rate for larger hospitals, a disproportionately higher rate for patients cared for in critical

The study indirectly addresses resilience of US hospitals, using one healthcare-associated infection- CLABSI, and brings an element that we have hardly seen prior to the pandemic, the instability of workforce and consequently more risk for safety events, particularly infectious complications. More studies are needed to evaluate the measures that may correlate with safety outcomes in hospital settings. The increase in CLABSI events may be predominantly attributable to the COVID-19-infected patients admitted to the hospital, with a sizable proportion of them requiring intensive care and support, and prolonged length of stay. In one study of a large system, hospital-onset bloodstream infections were more than three times higher for COVID-19-infected compared to non-infected patients.[6] The CLABSI risk may be increased based on the characteristics of COVID-19-infected patients, with their higher acuity requiring complex care (eg the frequency of central line access and manipulation, and the use of immunosuppressive agents). Potential additional outcomes to evaluate include other publicly reported healthcare-associated infections such as catheter-associated urinary tract infections (CAUTI), hospital-onset (HO) methicillin-resistant *Staphylococcus aureus* bacteremia, and HO *Clostridioides difficile* infection. It is noteworthy that we have not seen increases in CAUTI for a large system with the early waves of the pandemic,[7] underscoring the importance of evaluating multiple measures to assess hospital resilience. In addition, noninfectious measures such as risk-adjusted mortality may be important to study as global measures to assess

Sapiano MRP, Dudeck MA, Patel PR, Binder AM, Kofman A, Kuhar DT, Pillai SK, Stuckey MJ, Edwards JR, Benin AL. Patient safety as a measure of resilience in US hospitals: central line-associated bloodstream infections, July 2020 through June 2021. Infect Control Hosp Epidemiol. 2025 Feb 14:1-7. doi: 10.1017/ice.2024.167. Epub ahead of print. PMID: 39948082; Fakih MG. Resilience: the need to address it from frontline, to organizational, and national levels. Infect Control Hosp Epidemiol. 2025 Jan 2:1-2. doi: 10.1017/ice.2024.225. Epub ahead of print. PMID: 39743852.

Post-Pandemic, Hospital Occupancy is 11% Higher…due to 16% Decrease in Staffed Beds

Figure 1. Observed and Projected US National Hospital Occupancy, and Observed US Staffed Hospital Beds and Mean Daily Census



Leuchter RK, Delarmente BA, Vangala S, Tsugawa Y, Sarkisian CA. Health Care Staffing Shortages and Potential National Hospital Bed Shortage. JAMA Netw Open. 2025 Feb 3;8(2):e2460645. doi: 10.1001/jamanetworkopen.2024.60645. PMID: 39969884; PMCID: PMC11840646.

Digital Tools to Support CLABSI Prevention

CLABSI Prevention: Digital Approaches and Tools (1)

- Scoping review of literature on digitized interventions to prevent CLABSIs published between 2014-2024
- Of 263 publications, 6 were ultimately included
  - All used by RNs in tertiary care hospitals
  - 5/6 in ICUs and pediatric populations
  - Part of bundles
- Types of interventions
  - Dashboards
  - Mobile apps
  - Automated notifications
  - E-learning
- Quasi-experimental, associated with CLABSI reduction however limited by study design, high risk for bias

Table 1 Study characteristics

Study (first author, year)	Study period; baseline duration (B); intervention duration (I)	Settings	Study population	Digitalised CLABSI prevention intervention
Engel et al., 2023	2018–2021, B = 24 months, I = 14 months	3 hospitals: 1 university hospital and 2 community hospitals (34 units, 983 beds)	HCWs in adult and paediatric acute care wards	An e-learning module on CHG bathing (background on the evidence and short video) was available for HCW. An electronic reminder in the EHR for daily CHG bathing created a worklist task for nurses and nursing assistants.
Hugo et al., 2022	2017–2021 ; B = 12 months ; I = 27 months	1 quaternary care, pediatric academic hospital (7 in-patient units, 364 beds)	Nurses in pae-diatric ICU and non-ICU wards	A digital application (Rounds+®) assisted nurses during CVC maintenance rounds by documenting key bundle elements, including line access, dressing changes/port needle insertions, and cap changes. A dedicated nurse recorded observations in the app and marked any protocol deviations as "done with cor-rection" when the deviation was addressed in real-time.
Chemp-arathy et al., 2021	2015–2019 B= 30 months; I = 15 months	1 pediatric academic hospital (395 beds)	HCWs (physician and nurses) in paediatric ICU and non-ICU wards	An automated hospital-wide CLABSI bundle adherence system was imple-mented via a dashboard. The dashboard was integrated into the EHR and pro-vided visual representations of bundle-adherence rates across units and bundle elements. Adherence calculations were based on data entered by nursing staff into the EHR during bundle checks.
Orwol et al., 2018	2014–2015 ; B = 12 months ; I = 12 months	1 pediatric academic hospital	Nurses working in paediatric ICU and non-ICU wards	The application (CLABSI App®) served as a self-assessment tool for CVC care. It integrated just-in-time microlearning with in-line explanations of institutional CLABSI prevention bundle elements, on-demand video demonstrations, and visualization of self-reported compliance. Users could compare their perfor-mance to unit-wide aggregates, and the app supported customized teams and competitions across shifts and units.
Pageler et al., 2014	2009–2012 ; B = 23 months; I = 4 months	1 PICU (24 beds) in an academic pediatric hospital	HCWs in PICU	An electronic dashboard was integrated into the EHR with a specific interface for each patient to highlight critical clinical data and ensure compliance with evidence-based best practices for CVC insertion and maintenance. The page displayed actionable items, color-coded visual indicators for compliance, and an integrated checklist combining elements of pediatric-specific CVC insertion and maintenance bundles for CLABSI prevention. The checklist was dynamically linked to nursing and physician documentation, displaying only relevant com-ponents and providing educational links to support clinician decision-making. In addition, an electronic multipatient dashboard was displayed in the PICU.
Bae et al., 2022	2018–2021 ; B = 16 months ; I = 14 months	1 single tertiary care hospital	HCWs in adult ICU	An automatic notification of CVC-days in the electronic healthcare system was introduced. It displayed the CVC indwelling days in the prescription section of the electronic healthcare system. Medical staff evaluated the need for a CVC every day. Until the assessment of CVC maintenance was completed, the automatic notification of catheter days continued.

Abbreviations: B: baseline; CLABSI: central line associated bloodstream infections; CHG: chlorexidine gluconate; CVC: central venous catheters; EHR: electronic health record; HCW: healthcare workers; I: intervention; ICU: Intensive care unit; PICU: paediatric intensive care unit

Obama BM, Grant R, Harbarth S, Buetti N, Catho G. Digitalised measures for the prevention of central line-associated bloodstream infections: a scoping review. Antimicrob Resist Infect Control. 2025 May 12;14(1):45. doi: 10.1186/s13756-025-01549-y. PMID: 40355970; PMCID: PMC12067738.

CLABSI Prevention: Digital Approaches and Tools (2)

- Most reported an increase in bundle adherence although one reported a decrease in intervention period
- Reported associated reduction in CLABSI rates of 21%-73%
- Three of the studies assessed satisfaction/perception of healthcare personnel involved
  - Mixed reviews

Table 2 Impact on CLABSI rates, process outcomes and user satisfaction with the digitalised intervention

First author, year	Impact on CLABSI rate	Process outcomes	Satisfaction/perception
Engel et al.,2023	22.8% decrease on CLABSI rate (from 0.70 to 0.54 CLABSI per 1000 central line days, $p=0.15$)	CHG bathing documentation compliance increase from 77–94.1% from baseline to the intervention period	Over 60 nurses: 85% of satisfaction with the e-learning module; 62% with the EHR worklist task; 85% found the initiative valuable and 78% sustainable
Hugo et al., 2022	42% decrease on CLABSI SIR* (from 0.96 (at the highest point in pre-intervention) to 0.53 (at the last time point post-intervention) CLABSI per 1000 central line days, no statistical test performed to compare the two periods).	Initial decreased compliance to the maintenance bundle from 86.9 to 40.8% in the 1st month then return to baseline rate progressively during the intervention period. Doubling in numbers of rounds performed during the intervention period.	-Reluctance of the nurses in the beginning (qualitative analysis) -Increase in workload in the beginning for the influencers (qualitative analysis)
Chemparathy et al.,2021	21% decrease on CLABSI rate (from 0.82 to 0.6 CLABSI per 1000 central line days, $p=0.001$) (statistical method used for comparison not specified)	Average all-element bundle adherence increased from 25–44% from baseline to intervention period. Highest in NICU (64%), PICU and cardiovascular ICU	NICU, haematology oncology and stem cell transplant units tend to use less frequently because they prefer their own bundle rounds system (real-time follow up and coaching instead of automated process)
Orwoll et al., 2018	48% decrease in CLABSI rate in the intervention group during the study period compared to baseline (from 3.36 to 1.72 CLABSI per 1000 central line days ($p=0.03$) versus an increase in the control group (from 0.79 to 1.65 CLABSI per 1000 central line days ($p=0.09$)).	-Each bundle prevention element had high (> 95%) reported compliance except for patient bathing at 85% (575/673). - Comparing preceding year to study period, intervention group compliance by individual core element ranged from 97.3–100%, with 3 elements scoring slightly lower during the study period than during the preceding year -Overall compliance rates were slightly lower in the intervention group (94%) than the control group (98%)	Not assessed
Pageler et al., 2014	73% decrease on CLABSI rate (from 2.6 to 0.7 CLABSI per 1000 central line days, $p=0.029$)	-Increased compliance for line daily review and documentation of line necessity, frequency of dressing, cap and port needles changes. -Decreased compliance with insertion bundle documentation	Not assessed
Bae et al., 2022	61% decrease on CLABSI rate (from 3.1 to 1.2 per 1000 CVC days, $p=0.047$)	Reduction of catheter days from 956 vs. 819 ($p>0.001$) and short-term CVC per patient from 7.53 vs. 6.74 ($p<0.001$)	Not assessed

CLABSI central line associated bloodstream infections; CVC: central venous catheters; SIR: Standardized infection ratio; CHG: chlorhexidine gluconate; ICU: intensive care unit; NICU neonatal intensive care unit;

*SIR: actual number over the expected number of CLABSI

Obama BM, Grant R, Harbarth S, Buetti N, Catho G. Digitalised measures for the prevention of central line-associated bloodstream infections: a scoping review. Antimicrob Resist Infect Control. 2025 May 12;14(1):45. doi: 10.1186/s13756-025-01549-y. PMID: 40355970; PMCID: PMC12067738.

CLABSI Prevention: Digital Approaches and Tools (3)

- Different types of interventions
- We need better studies

Table 3 Digitalised interventions for CLABSI prevention

Type of Digitalised Intervention	Examples Related to Central Vascular Catheters	Target
Digitalised checklist (in a mobile application or EHR)	- Indication for catheter insertion - Checklist for catheter insertion - Daily assessment for catheter necessity	Improve compliance with good clinical practices
Automatic reminders in EHR	- Alerts on catheter days - Reminders for dressing changes	Increase compliance with preventive measures and timely catheter removal
Decision-making algorithm	- Guidance on appropriate CVC indication - Algorithm-based recommendations for catheter type selection - Optimised order-sets to guide blood cultures ordering - Alerts for inappropriate catheter use based on patient status	Support clinical decision-making
E-learning modules	- Training on CVC insertion techniques - Simulation-based learning for CVC complications management - Case-based learning on CLABSI prevention - Refresher courses on maintenance bundles	Enhance knowledge of good clinical practices
Dashboard and real-time analytics	- Patient-specific summary of needs and objectives related to CVC with automated reminders - Inter-unit comparison of CLABSI rates and compliance with preventive bundles	Improve monitoring of compliance and early identification of risks
Gamification	- Team-based competition on best compliance with preventive measures - Reward system for adherence to best practices - Interactive quizzes with leaderboards on catheter safety	Motivate healthcare teams through engagement

Obama BM, Grant R, Harbarth S, Buetti N, Catho G. Digitalised measures for the prevention of central line-associated bloodstream infections: a scoping review. Antimicrob Resist Infect Control. 2025 May 12;14(1):45. doi: 10.1186/s13756-025-01549-y. PMID: 40355970; PMCID: PMC12067738.

Drilling Down on CLABSI Risk Factors

A Nurse Driven Protocol to Identify Pediatric Patients at High Risk for CLABSI (1)

- Development of pediatric ICU specific risk screening tool to identify patients at higher risk of developing a CLABSI and focus specific mitigation strategies based on risks identified
- September 2020 – December 2022; all patients admitted to PICU who had a CVC
- Retrospective review of 2 years of CLABSI to identified risk factors, combined with literature, to develop a single tool including modifiable and intrinsic risk factors, with associated mitigation strategies

Risk Factor	Qualifier	Response/Risk Mitigation
CONSISTENT OR RISK FOR COMPROMISED DRESSING OR SUTURE INTEGRITY [1]	▪ Altered skin integrity at CVL site ▪ Diaphoretic patient ▪ Location increases difficulty of achieving occlusive dressing (i.e., IJ) ▪ Frequent stooling with femoral line ▪ Non-intact sutures ▪ Line movement (in and out of insertion site)	▪ Report to primary team promptly ▪ Consult VAT, CNS or CLABSI RNs for difficult dressing troubleshooting ▪ Frequent dressing site assessments (at least hourly) ▪ Discuss options for line removal or relocation with primary team ▪ Implement difficult dressing strategies such as Mastisol, Aquaguard, StatSeal.
BEHAVIORAL CONCERNS [1]	▪ Removes/contaminated dressing and/or CVL directly ▪ Refuses CHG/linen changes or other CLABSI prevention bundle items	▪ Report to primary team promptly ▪ Consult child life to assist with age-appropriate education ▪ Involve and educate families in preventative care
INCONSISTENT CLABSI BUNDLE ADHERENCE IN PAST 7 DAYS [1]	▪ Regardless of reason (i.e., patient instability) ▪ >2 misses of any kind (CHG or linen) in last week, or CHG miss in last 3 days	▪ Discuss HAC tool on rounds daily ▪ Discuss with Charge or Base nurse to identify ways to improve compliance
LINE LOCATION NEAR SOURCE OF CONTAMINANT [1]	▪ Near tracheostomy or tubing ▪ Line or tubing near perineal/diaper area	▪ Cover line/tubing during suctioning, nebulizer treatments, diaper changes
FREQUENT ACCESS [1]	▪ > 80 times into CVL consistently over 3 days	▪ Report to primary team promptly ▪ Convert medications IV to PO/enteral ▪ Consider alternative lab draw options, i.e., arterial line or capillary ▪ Increase or add infusions to decrease frequency of intermittent medication needs, i.e., sedation
5 OR MORE ACCESS POINTS [1]	▪ Including PIV, art lines, CVL lumens, and ECMO cannula	▪ Report to primary team and discuss options for reduced access points
DURATION OF LINE [1]	▪ Regardless of antibiotic coating ▪ Non-tunneled CVL > 7 days old AND expected use for > 14 days total ▪ UVC/UAC > 5 days old with expected use for > 7 days total ▪ PICC > 45 days [2]	▪ Discuss line necessity or possibility for replacement with primary team ▪ Reduce other risk factors where possible (i.e., Reduce line entries by converting medications from IV to PO) ▪ *Routine* replacement/rewire of PICC and Tunneled catheters is not recommended for CLABSI prevention. (CDC) ▪ PICC lines are flagged at approximately 6 weeks to prompt thoughtful conversation about ongoing central venous access needs. If PICC use is expected to exceed 8 weeks the provider team will consult an HEIC physician to discuss.
PERCUTANEOUS DIALYSIS CATHETER [2]	▪ Regardless of in use or not.	▪ If on hypothermia blanket, change disposable blanket components daily with linen changes ▪ Consider anticoagulation of CRRT circuit if frequent clotting issues are present. Frequent clotting/pump functionality issues = more line accesses. ▪ Remove promptly when no longer in use (Refer to Appendix B "percutaneous dialysis catheter removal decision guide" below)
FEMORAL LINE [1]	▪ Placed for acute resuscitation AND expected use for > 7 days	▪ Begin planning for new line location or removal as soon as possible
TPA EVENT/ SUSPECTED OR CONFIRMED CLOT BURDEN [2]	▪ Any TPA or patency event in the last week ▪ Known thrombin/fibrin at catheter site	▪ Replacement/removal of a line with suspected/confirmed clot burden and/or consistent patency concerns should be prioritized.
EXTENDED LENGTH OF STAY [1]	▪ > 30 Days current hospitalization (ICU or floors)	▪ Alert clinical team
RECENT EMERGENT/URGENT PROCEDURE [1]	▪ Procedure within prior 48 hours and CVL present at that time (i.e., intubation, chest tube placement)	▪ Discuss with primary team options for line removal or relocation ▪ Patient requires optimal line maintenance and attention to other risk factors. Address any barriers to CLABSI prevention promptly with primary team.
RECENT TRAVEL/3RD PARTY MANIPULATION OF CVL [3]	▪ Including anesthesia, dialysis, IR/radiology, etc.	
PRIOR LINE REPAIR [1]	▪ Of currently present CVL	
CHG CONTRAINDICATIONS [1]	▪ < 36 weeks gestation ▪ CHG allergy	
HISTORY OF CLABSI [1]	▪ Within current admission ▪ Within last 30 days ▪ Of the current CVL within prior 90 days	

Fig. 1. High-risk central line screening tool. This high-risk central line screening tool was developed through review of literature and local institutional trends by multidisciplinary CLABSI prevention team. The top white rows are considered modifiable risk factors and the gray rows are nonmodifiable patient factors. The tool is used weekly to screen patients with central venous access devices for factors that increase the risk for central line–associated bloodstream infections. The tool has had 3 iterations denoted by superscripts next to the respective risk factors with the most recent modifications in November 2023. [1]In the original Version 1. [2]Risk factor added in Version 2. [3]Risk factor added in Version 3. CHG, chlorhexidine gluconate; CLABSI, central line-associated bloodstream infection; CNS, clinical nurse specialist; CVL, central venous line; ECMO, extracorporeal membrane oxygenation; HAC, hospital-acquired condition; HEIC, hospital epidemiology and infection control; ICU, intensive care unit; IJ, internal jugular; IR, interventional radiology; IV, intravenous; PICC, peripherally inserted central catheter; PIV, peripheral intravenous vein catheter; PO, per os or by mouth; TPA, tissue plasminogen activator; UAC, umbilical arterial catheter; UVC, umbilical venous catheter; VAT, vascular access team.

Morgenstern S, Thompson K, Panton S, Donnelly V, Pau S, Nelson K, Booth L, McIlquham T, Kitlas J, Schumacher C, Milstone AM, Bernier M, Sick-Samuels AC. Identifying high-risk central lines in critically ill children: A novel nurse-driven screening and mitigation intervention to reduce CLABSI. Am J Infect Control. 2025 Mar;53(3):381-386. doi: 10.1016/j.ajic.2024.10.029. Epub 2024 Nov 4. PMID: 39505114; PMCID: PMC11874062.

A Nurse Driven Protocol to Identify Pediatric Patients at High Risk for CLABSI (2)

- Intervention
  - December 2020: Weekly rounds using the screening tool applied by CLABSI nurse champions; for patients identified as high or moderate risk, nurses emailed information to CLABSI prevention team and medical and nursing leadership
  - July 2021: Bedside CVC rounds moved to earlier in the week to occur concurrently with the CVC risk screening
- Outcomes assessed
  - CLABSI rate
  - Months between CLABSI
  - CVC utilization rate
  - Balancing measures (bundle adherence, CAUTI)

Table 1
Summary of frequency of central venous catheter screening risk classification and specific risk factors identified from December 2020-December 2022

Total screening events	1,583	
Risk category	N	%
High-risk (≥ 4 risk factors)	479	30.3
Moderate-risk/watcher (< 4 risk factors)	419	26.5
Low-risk	685	43.3
Risk factors identified	N	%
Extended length of stay ≥ 30 d	539	34.0
Line location near the source of contaminant	385	24.3
Consistent or risk for compromised dressing or suture integrity	384	24.3
Inconsistent CLABSI bundle adherence in the past 7 d	350	22.1
Five or more lumen access points	302	19.1
Duration of line	294	18.6
Frequent access/line entry	270	17.1
Suspected/confirmed clot burden	154	9.7
Femoral line	135	8.5
History of CLABSI	129	8.2
Recent emergent/urgent procedure	122	7.7
Behavioral concerns	106	6.7
Contraindication to CHG	35	2.2
Percutaneous dialysis catheter	33	2.1
Prior line repair	2	0.1

NOTE. All central venous catheters were reviewed once per week for these risk factors. Definitions of risk factors are qualified in the tool presented in Figure 1. Patients could have multiple risk factors.
CHG, chlorhexidine gluconate; *CLABSI*, central line-associated bloodstream infection.

Morgenstern S, Thompson K, Panton S, Donnelly V, Pau S, Nelson K, Booth L, McIlquham T, Kitlas J, Schumacher C, Milstone AM, Bernier M, Sick-Samuels AC. Identifying high-risk central lines in critically ill children: A novel nurse-driven screening and mitigation intervention to reduce CLABSI. Am J Infect Control. 2025 Mar;53(3):381-386. doi: 10.1016/j.ajic.2024.10.029. Epub 2024 Nov 4. PMID: 39505114; PMCID: PMC11874062.

A Nurse Driven Protocol to Identify Pediatric Patients at High Risk for CLABSI (3)

- Performance of Screening Tool (1583 screens)
  - 15 CLABSIs identified, 14 screened with the tool prior tc CLABSI
    - high-risk + moderate-risk: sensitivity 93%, specificity 50%; high-risk: 76% sensitivity, 70% specificity
  - 3 patients who had low risk screens went on to develop CLABSI within 1 week
    - Retrospective review identified additional risk factors that would have reclassified as high/moderate
    - Including these updated risk assessments increased sensitivity to 100%
- CLABSI rate- no significant change
- Months between CLABSI- increase in duration between CLABSI events

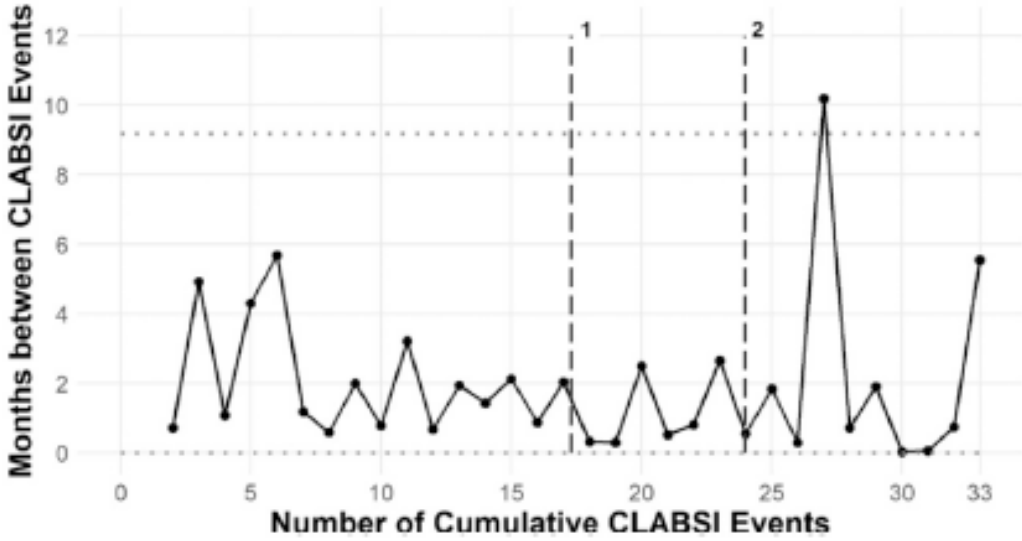


Fig. 2. G-chart showing time between CLABSI events, combined pediatric intensive care units, January 2020-December 2022. Notes: Black solid line shows the number of months between each CLABSI event, with upper and lower control limits shown by the dotted gray lines. Timing of intervention implementation (1: December 2020 introduction of screening; 2: July 2021 bedside rounding) is shown by the vertical dashed line. CLABSI, central line-associated bloodstream infection.

Morgenstern S, Thompson K, Panton S, Donnelly V, Pau S, Nelson K, Booth L, McIlquham T, Kitlas J, Schumacher C, Milstone AM, Bernier M, Sick-Samuels AC. Identifying high-risk central lines in critically ill children: A novel nurse-driven screening and mitigation intervention to reduce CLABSI. Am J Infect Control. 2025 Mar;53(3):381-386. doi: 10.1016/j.ajic.2024.10.029. Epub 2024 Nov 4. PMID: 39505114; PMCID: PMC11874062.

Going to IDWeek?

Looking ahead…to IDWeek 2025!

Adult ID | Epi & Infection Control | Global ID | Investigative ID | HIV-STD-TB | Pediatric ID | Trainee | Transplant

Session Type: Symposium

157 - Cavities, Appys and CLABSIs, Oh My! Perspectives From Our Surgery and Radiology Colleagues

Tuesday, October 21, 2025 1:45 PM - 3:00 PM US ET Location: B302-B304

1:45 PM - 2:10 PM US ET	From Bugs to Badness: Cavitary Lesions Through the Radiologist's Lens Speaker: Juan Olazagasti, MD (he/him/his) – University of Virginia Health System
2:10 PM - 2:35 PM US ET	From Scalpel to Script: The Evolution of Appendicitis Management From a Surgeon's Perspective Speaker: Giana Davidson, MD MPH (she/her/hers) – University of Washington
2:35 PM - 3:00 PM US ET	Leave That Line Alone! Innovative Approaches to Line Retention, Removal or Exchanges From the Surgical Lens Speaker: Craig A. McBride, PhD FRACS FACS (he/him/his) – Professor of Paediatric Surgery, University of Queensland, Australia


Mass General Brigham

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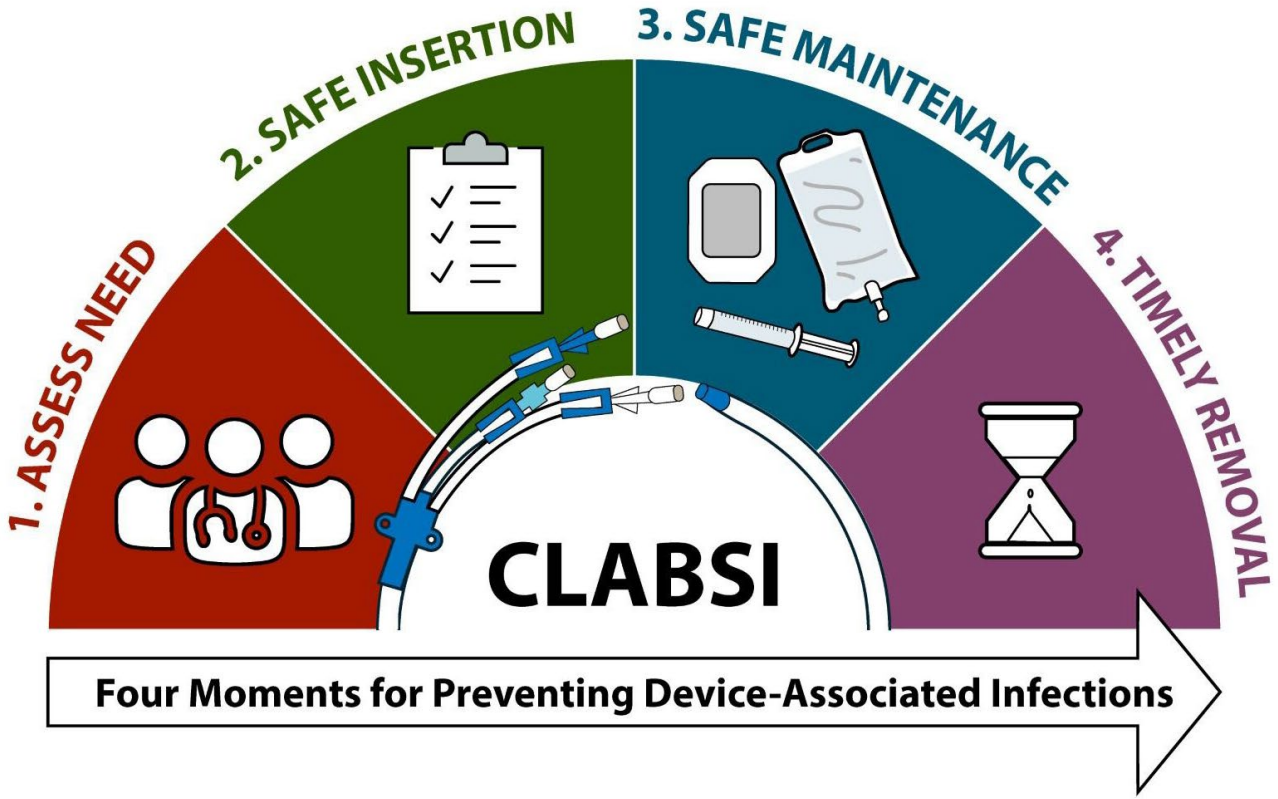
MEDICINE

CLABSI Prevention

Lisa L. Maragakis, MD, MPH

The Four Moments for Preventing CLABSI



CVC Insertion Bundle

SHEA/IDSA/API Compendium: 2022 Update on CLABSI

- Providing all necessary equipment in a kit or cart
- Using a checklist to ensure adherence to infection prevention practices
- Performing hand hygiene
- Picking the optimal site for placement with preference for the subclavian site followed by the internal jugular site and avoiding the femoral site
- Performing chlorhexidine-alcohol skin prep with appropriate application
- Using maximal sterile barrier precautions
- Using point-of-care ultrasound for catheter placement
- Covering the site with an occlusive chlorhexidine-containing dressing

Buetti N, Marschall J, Drees M, et al. Strategies to prevent central line-associated bloodstream infections in acute-care hospitals: 2022 Update. Infect Control Hosp Epidemiol. 2022 May;43(5):553-569. PMID: 35437133.

CVC Maintenance Bundle

SHEA/IDSA/API Compendium: 2022 Update on CLABSI

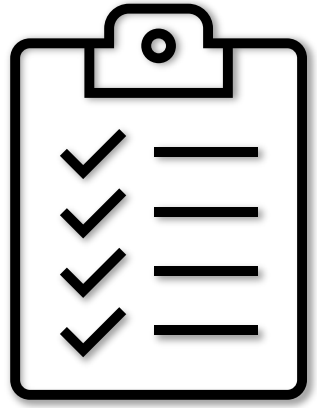
- Assess and dress the CVC with a CHG-containing dressing
- Clean hands and aseptic hub access
- Care of lines and connectors
- CHG skin antisepsis
- Daily re-evaluation of the necessity of CVCs
- CLABSI surveillance
- Maintain appropriate staffing levels

Buetti N, Marschall J, Drees M, et al. Strategies to prevent central line-associated bloodstream infections in acute-care hospitals: 2022 Update. Infect Control Hosp Epidemiol. 2022 May;43(5):553-569. PMID: 35437133.

Ensure CVC Insertion Supplies are Available

- Adherence to optimal care practices is improved when the availability of necessary equipment and supplies is ensured.
- Ensure:
  - All required supplies are available in the unit.
  - All required supplies are together in a standard location (such as a line cart, box, or automated supply dispensing machine).
  - A process is in place to replenish supplies and to respond to supply shortages or interruptions.

CVC Insertion Checklist



- Promotes standardization of evidence-based care.
- Improves communication.
- Ensures use of appropriate equipment and supplies.
- Minimizes errors and risk of complications.
- Supports reliable care and eliminates “shortcuts” and “workarounds”.
- Empowers staff to stop a procedure when there is a defect.

Hand Hygiene and Maintenance of a Sterile Site

- Hand hygiene with an alcohol-based solution or soap and water must be performed by the provider inserting the CVC, the assistant, and anyone who enters the room during the procedure during the
  - Before touching the patient to scout the site
  - Before donning sterile gloves
  - Upon leaving the patient's room

Ensure your team is aware of how to perform proper hand hygiene. You can refer to the two videos below:

- **Hand-washing Steps Using the WHO Technique** (Johns Hopkins Medicine, YouTube)[11]
- **Hand Rubbing Steps Using the WHO Technique** (Johns Hopkins Medicine, YouTube)[12]

Johns Hopkins Medicine. Hand-washing Steps Using the WHO Technique [Video]. Youtube. March 26, 2019. https://www.youtube.com/watch?v=lisgnbMfKvI. Accessed July 18, 2025.
ohns Hopkins Medicine. Hand-Rubbing Steps Using the WHO Technique [Video]. Youtube. May 8, 2019. https://www.youtube.com/watch?v=B3eq5fLzAOo. Accessed July 18, 2025.

Optimal Site Selection

JOHNS HOPKINS MEDICINE

- The subclavian site is preferred due to the lowest CLABSI risk.
- The internal jugular is the next best site.
- Avoid the femoral site.
- Consider specific patient issues and anatomy when choosing a site.
  - Avoid placing CVCs in areas where the line might become contaminated.
  - Consider the optimal orientation of the line to support dressing adherence.
- Choosing the best site is both a technical intervention and an adaptive intervention.

Skin Preparation With Chlorhexidine-Alcohol

- **Always perform proper hand hygiene and don maximal barrier precautions prior to skin prep.**
- **Use at least a 2% chlorhexidine-alcohol solution, for all CVC insertions.**
  - Apply with a back-and-forth rubbing motion.
  - Subclavian or Internal jugular: Apply for at least 30 seconds.
  - Femoral: Apply for at least 2 minutes.
- **Chlorhexidine-alcohol must be allowed to dry fully.**
  - No waving, blowing, or wiping!
  - Subclavian or Internal jugular: Wait for at least 30 seconds.
  - Femoral: Wait for at least 2 minutes.
  - Longer prep and drying times are recommended for the femoral site because of the skin folds and increased risk of contamination intrinsic to the area.

Maximal Barrier Precautions

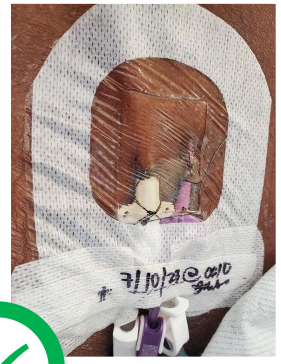
Patient	• Sterilely and completely draped from head to toe, *preferably with a fenestrated drape*	
Insertor/Operator and Assistant(s)	• Proper hand hygiene • Face mask and cap to cover hair • Sterile surgical gown with neck snaps/ties secured • Sterile gloves • Eye protection	
Anyone else in or at risk of entering the sterile field	• Same as the insertor/operator	
Observer and Runner	• Proper hand hygiene • Face mask and cap to cover hair • *If at risk of entering sterile field, use sterile gown and gloves*	

- **Maximal barrier precautions also apply to equipment used during the procedure.**
  - Ultrasound probe must be sterilely covered.
  - Ultrasound gel must be sterile.

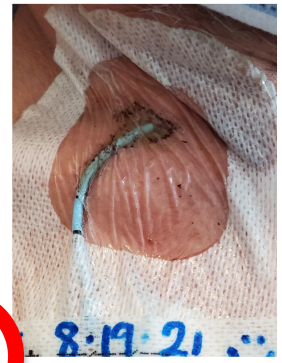
Assess And Dress: Standardize CVC Dressing Care

- Dress the insertion site with a chlorhexidine-containing dressing.
- Assess the CVC dressing status daily.
- Replace the dressing only on the recommended change date or when it becomes damp, non-occlusive, or soiled.
- Replace dressing on short-term CVC sites.
  - Every 2 days for gauze dressings.
  - Every 7 days for transparent dressings.
- Use standard dressing kits containing all required supplies.
- Utilize aseptic technique and a CHG with alcohol-based skin preparation.
- Document the date and time on each CVC dressing.
- Contain the CVC exit site completely within the dressing.

Clean, Dry, and Occlusive CVC Dressings



- The CVC dressing is the barrier to prevent pathogens from entering the bloodstream around the CVC.
- It is important to maintain a dressing that is clean and dry.
  - No fluid or blood accumulation under the dressing
- It is equally important to ensure that the entire perimeter of the dressing is fully occlusive.
  - No torn or lifted edges
  - No overlap with other dressings or devices



Disinfect The Hub, Connectors, and Injection Ports

- Perform hand hygiene before and after central line access.
- Disinfect the catheter hub, needleless connector, or injection port before accessing the CVC.
- Before each access, “Scrub the hub” using mechanical friction and 70% alcohol or alcohol-based CHG preparation for no less than 5 seconds.
- Monitor personnel adherence to disinfection and care of hubs, connectors, and ports.

Click to access a YouTube video on “Scrub the Hub”, provided by Johns Hopkins Medicine.

https://www.youtube.com/watch?v=x96cU3_Nkas

Minimize CVC Access

- Every CVC access increases the CLABSI risk.
- Reduce CVC access as much as possible.
- Identify opportunities to reduce access:
  - Scheduling medications
  - Converting intravenous medications to oral
  - Grouping labs requiring blood draws together

Replace Administration Sets

- Routine replacement of administration sets not used for blood, blood products, or lipids can be performed at intervals of up to 7 days.[29]
  - This is a change from previous guidance, which stated up to 96 hours.
- Change all administration set tubing and any add-ons at the same time, when possible, to minimize the number of times the CVC line is opened
- Change needleless connectors or injection ports at least as frequently as the administration set.
- Perform hand hygiene before handling the CVC and the administration set.
- Use aseptic technique to set up and change administration sets and add-on devices.
- Do not prime the new tubing over sinks, drains or trash cans.

Daily Chlorhexidine Gluconate (CHG) Skin Antisepsis

- Train personnel should in CHG application.
- Apply to all skin areas. Pay special attention to joints and skin folds.
  - Do not rinse off. Allow to air-dry.
- CVCs and other medical devices should also be cleaned with CHG.
- CHG should be applied over occlusive and semi-permeable dressings. It should not be applied over permeable (gauze) dressings.
- Tell patients and families about the importance of daily CHG antisepsis.
- Check skin and hair products for compatibility with CHG.
- CHG is recommended for superficial wounds and rashes, but not for large, deep, or packed wounds.
- CHG is safe for use on the face, but care must be taken to avoid contact with the eyes and ear canals.
- CHG is safe for use on the perineum.

Apply CHG to the body in the following order (one CHG wipe per body area; six in total):

① Face, neck & chest. **Avoid eyes and ear canals.**

② Both shoulders, arms and hands

③ Abdomen, ***then*** groin/perineum

④ Right leg and foot

⑤ Left leg and foot

⑥ Back of neck, back, ***then*** buttocks

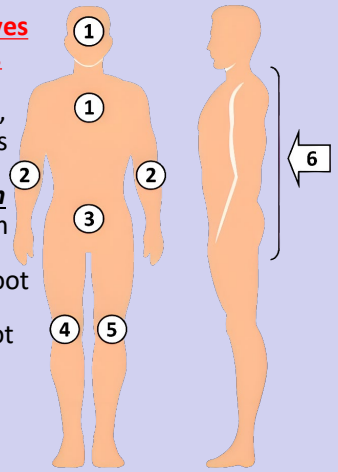


Image adapted from **Decolonization Toolkit: Instructional Handouts for Staff and Patients**. March 2022. Agency for Healthcare Research and Quality. https://www.ahrq.gov/hai/tools/abate/handouts.html.

Prompt CVC Removal

- During the daily discussion about the necessity for the CVC:
  - Discuss the plan for CVC removal.
  - Determine who will decide to remove the CVC.
  - Consider and provide non-CVC alternatives for venous access.
- Solicit and carefully consider the frontline personnel's input regarding CVC necessity and the level of CLABSI risk.
- Remove the CVC as soon as it is no longer necessary.
- Audit the CVC daily assessment and prompt removal process to identify opportunities for improvement.[42,43]
- Implement interventions to reduce unnecessary CVC use.

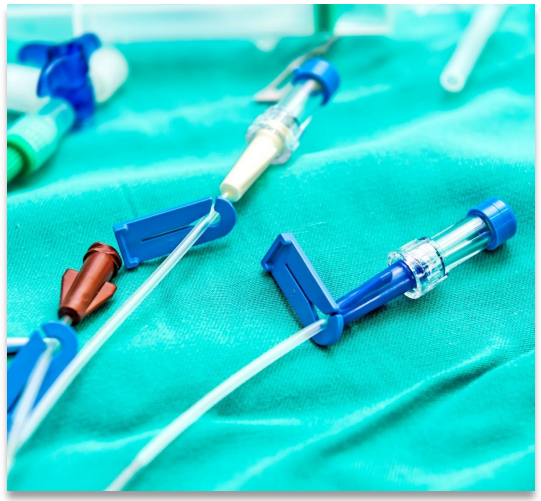
Perform CLABSI Surveillance

- Perform CLABSI surveillance in ICU and non-ICU settings.
- Share CLABSI outcome data widely to hospital and departmental leadership as well as to the frontline healthcare personnel.
- Maintain HCP awareness of the importance of adherence to CVC insertion and maintenance best practices for CLABSI prevention.
- Audit surveillance periodically to ensure consistent application of the surveillance definitions.

Ensure Appropriate Staffing

- Ensure an appropriate nurse-to-patient ratio.
- Observational studies show that these measures are associated with lower CLABSI risk in units caring for patients with CVCs.
- Limit the use of float nurses in ICUs.
- Encourage frequent staff competency assessment and training.

Additional Approaches to Prevent CLABSI



- **Additional approaches** are supported by current studies, but the potential benefits don't clearly outweigh the potential negatives.
- Perform a risk assessment to determine the potential costs and benefits before implementing these approaches.
- Additional approaches include:
  - Antiseptic or antimicrobial-coated catheters
  - Antimicrobial lock therapy for long-term CVCs
  - Weekly tissue plasminogen activator for hemodialysis CVCs
  - Infusion and vascular access teams
  - Antimicrobial ointments for hemodialysis CVC insertion sites
  - Antiseptic-containing hub or cap to cover connectors

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Barriers To CVC Maintenance

- Lack of knowledge—both initially and ongoing.
- Lack of buy-in and understanding of the "why."
- Time constraints, staffing issues.
- Lack of available supplies.
- Poor communication and teamwork.
- Absence of standardized processes to ensure evidence-based practices.
- Lack of auditing and feedback of adherence to recommended practices and outcomes to the frontline team.

Overcoming Barriers to CVC Maintenance

- Create standardized processes.
- Conduct regular CVC training sessions.
- Ensure that new personnel receive CVC orientation and training.
- Utilize checklists.
- Provide all necessary supplies, ideally in prepackaged dressing change kits.
- Incorporate prompts into existing EMR charting.
- Conduct CVC line rounds.
    - Assess each CVC.
    - Audit bundle compliance.
    - Problem solve, coach and provide feedback.