

Making peripheral lines a central focus: a clinical evidence summary.

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Literature review

Short-term peripheral venous catheter-related bloodstream infections: A systematic review.

Mermel L. *Clin Infect Dis*. 2017;65(10):1757–1762. doi:10.1093/cid/cix56.2



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Accepted but unacceptable: Peripheral IV catheter failure.

Helm RE, Klausner JD, Klemperer JD, Flint LM, Huang E. *J Infus Nurs*. 2015;38(3):189–203. doi:10.1097/NAN.0000000000000100



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Prospective study

Reaching one peripheral intravenous catheter (PIVC) per patient visit with lean multimodal strategy: the PIV5Rights™ bundle.

Steere L, Ficara C, Davis M, Moureau N. *J Assoc Vasc Access*. 2019;24(3):31–43. doi:10.2309/j.java.2019.003.004.



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Retrospective study

Hospital-acquired *Staphylococcus aureus* primary bloodstream infection: a comparison of events that do or do not meet the central line-associated bloodstream infection definition.

Kovacs C, Fatica C, Butler R, et al. *Am J Infect Control*. 2016;44(11):1252–1255. doi:10.1016/j.ajic.2016.03.038.



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Prospective cohort

Mortality risk factors among non-ICU patients with nosocomial vascular catheter-related bloodstream infections: A prospective cohort study.

Saliba P, Hornero A, Cuervo G, et al. *J Hosp Infect*. 2018;99(1):48–54. doi:10.1016/j.jhin.2017.11.002.



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Observational cohort – 10 sites

Comparison of routine replacement with clinically indicated replacement of peripheral intravenous catheters.

Buetti N, Abbas M, Pittet D, et al. *JAMA Intern Med*. 2021;181(11):1471–1478. doi:10.1001/jamainternmed.2021.5345.



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Topics key

	PIVC complications
	PIVC infection rates
	Practice change
	PIVC failure modes
	Health economics
	BSI mortality rates
	<i>Staphylococcus aureus</i> BSI rates
	Non-ICU population
	Clinically indicated PIVCs
	Routine replacement PIVCs
	PIVC-BSI

Magnifying the view on PIVCs.

Peripheral intravenous catheters (PIVCs, PVCs and PIVs) are some of the most frequently used vascular access devices in health care settings, with 60%–90% of hospitalised patients requiring an IV during a stay.¹ However, while placing a PIVC is one of the most common invasive medical procedures performed worldwide,¹ it can lead to complications, patient anxiety and dissatisfaction, as well as nurse anxiety.

Many studies point to why PIVCs should be at the center – not the periphery – of initiatives to prevent catheter-related bloodstream infections (CRBSI), reduce clinical cost and improve patient outcomes.

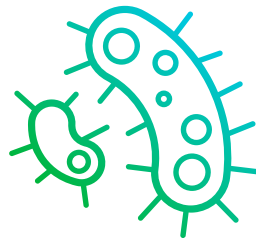
This clinical evidence summary demonstrates the importance of making PIVCs a central focus to reduce complications, while outlining methods that may help improve PIVC practice.

PIVCs are often considered a low-risk procedure; however:

A literature review found short-term PIVCs accounted for

22%

of hospital-acquired CRBSI.²



Well-trained professionals see high PIVC failure rates of

36% to 63%

(mean failure rate of 46%).¹



A non-ICU study found PIVCs accounted for

41%*

 of CRBSIs, with a mortality rate of

12.7%.

³

One observational study found **clinically indicated replacement of PIVCs was associated with higher rates of PIVC-BSI when compared to routine**

(individual research result (IRR), 7.20; 95% confidence interval (CI), 3.65–14.22; $p < .001$).⁴







*n=204

Short-term peripheral venous catheter-related bloodstream infections: a systematic review.

Mermel L. Short-term peripheral venous catheter-related bloodstream infections: a systematic review. *Clin Infect Dis*. 2017;65(10):1757–1762. doi:10.1093/cid/cix562.

Topics

-  PIVC complications
-  PIVC infection rates
-  Practice change
-  *Staphylococcus aureus* BSI rates

Design

Literature review of papers from Jan. 1980 to Jan. 2017 on peripheral venous catheter-related bloodstream infections (PIVCR-BSI).

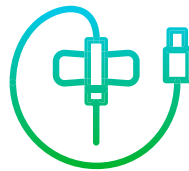
Method

Articles selected systematically following the PRISMA guidelines. *S. aureus* bacteremia, PIVC, and bacteremia were key search terms. The studies encompassed 85,063 peripheral venous catheters (PIVCs).

Findings



PIVCR-BSI average incidence rate of 0.18%: range 0% to 2.2%.



Short-term PIVCs accounted for 22% of hospital-acquired CRBSI.



***S. aureus* was found to be the most common pathogen. *S. aureus* has been associated with a higher patient morbidity and mortality.**



PIVCs with dwell times >3 days have been associated with a significantly increased risk of local site infection, phlebitis and PIVCR-BSIs.
Ex. PIVCR-BSI incidence was 324 times more catheter dwell times of less than three days vs. more than three days.

Up to

360,000
PIVCR-BSIs in
the U.S. per year

200 million adults with PIVCs and a PIVCR-BSI rate of 0.18%.

“Clinicians should have a high index of suspicion for the PIVC as a source of BSI.”


New PIVC recommendations:


- ▶ Assessing the PIVC insertion site for evidence of infection, phlebitis, and exudate is critical to reducing patient risk of PIVCR-BSI complications
- ▶ Remove non-essential PIVCs, especially PIVCs with evidence of local site infection or phlebitis
- ▶ Replace PIVCs placed under emergent conditions

Accepted but unacceptable: peripheral IV catheter failure.

Helm RE, Klausner JD, Klemperer JD, Flint LM, Huang E. Accepted but unacceptable: peripheral IV catheter failure. *J Infus Nurs.* 2015;38(3):189–203. doi:10.1097/NAN.0000000000000100

Topics

 PIVC failure modes

 PIVC infection rates

Design

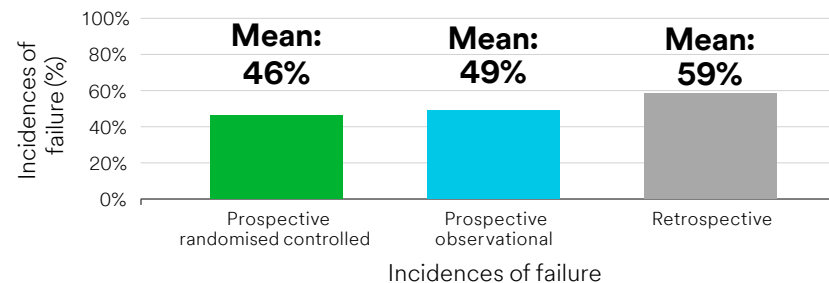
Literature review of 162 papers from 1990–2014.

Method

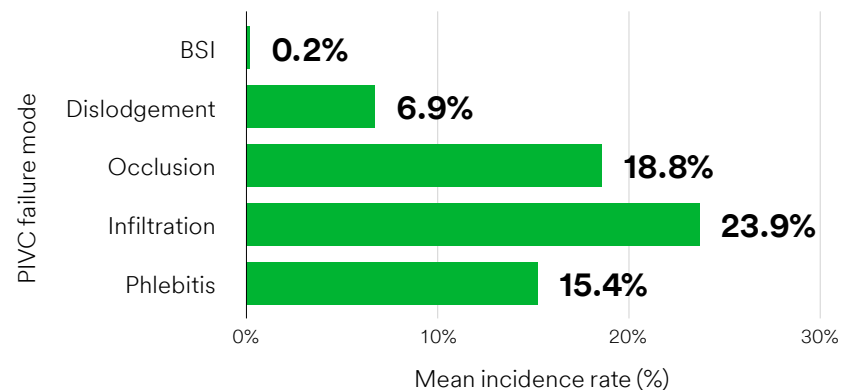
Studies were prospective randomised control trials (RCTs) and prospective observational studies with endpoints encompassing PIVC failure modes.

Results

Peripheral IV catheter failure rate, assorted studies, 1990–2014



The five modes of peripheral IV catheter failure (prospective RCTs 1990–2014).



Incidence rate is a measure of the probability of occurrence of a given event within a population for a specified period of time.

Well-trained professionals see high PIVC failure rates of **36% to 63%** (mean failure rate of 46%).

These rates are “unacceptable to patients, caregivers, and the health care system.”




“Meaningful change will require that the concept of the peripheral IV catheter as an expendable and replaceable tool be discarded.”

A 2019 paper acknowledged that PIVC failure had been much less accepted since 2015, but had yet not seen significant improvement.⁵

Reaching one peripheral intravenous catheter (PIVC) per patient visit with lean multimodal strategy: the PIV5Rights™ bundle.

Steere L, Ficara C, Davis M, Moureau N. Reaching one peripheral intravenous catheter (PIVC) per patient visit with lean multimodal strategy: the PIV5Rights™ bundle. *J Assoc Vasc Access.* 2019;24(3):31–43. doi:10.2309/j.java.2019.003.004.

Topics

-  Health economics
-  PIVC complications
-  Practice change

Design

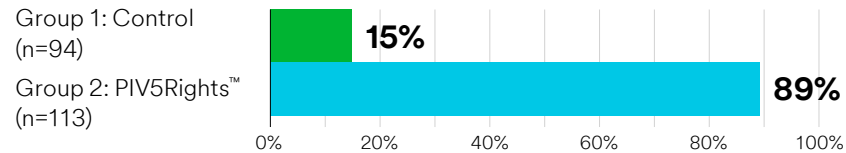
Prospective comparator single-center clinical superiority study to determine the impact of bundled practices.

Method

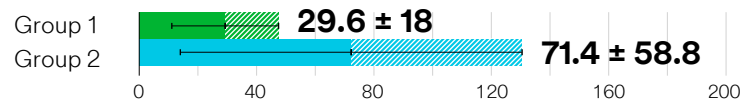
The study was conducted in a 47 bed medical unit from Nov. 2016 through Feb. 2018. It includes 114 adults who met criteria with 207 catheters. The best practice intervention study covered **P**–Proficiency, **I**–Insertion, **V**–Vein and Catheter, **5**–Supplies and Technology, **R**–Review and Assessment (PIV5Rights™).

Results

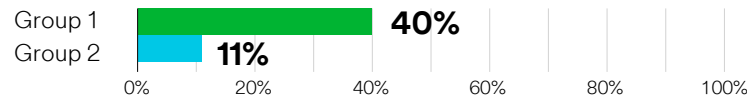
Success rate (therapy completed)



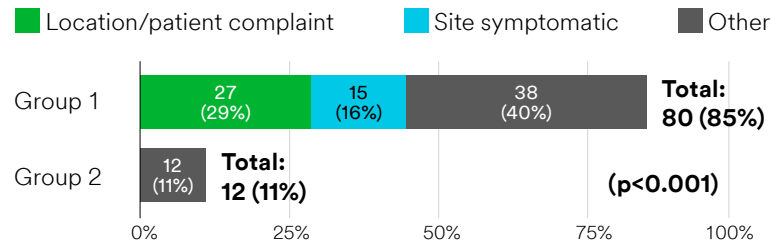
Dwell time, hours (mean ± SD, p<0.001)



Complication rate (% , p<0.001)



Catheter failure/causes of removal (% of Incidences)



Evidence-based PIVC bundle shown to be successful in **reducing catheters per patient stay (from 4.4 to 1.1).**

89%
of catheters achieved end of therapy.

Realised average savings of
\$3,376 per bed.




Beneficial practices included:

- ▶ Ultrasound guidance
- ▶ Forearm insertion
- ▶ Antimicrobial securement dressing, longer PIVC catheter (more than 1.75 in. long), IV start kit, anti-reflux needleless connector (NC)
- ▶ Disinfecting caps and wipes, flushing, assessment for dressing change

Hospital-acquired *Staphylococcus aureus* primary bloodstream infection: a comparison of events that do or do not meet the central line-associated bloodstream infection definition.

Kovacs C, Fatica C, Butler R, Gordon SM, Fraser TG. Hospital-acquired *Staphylococcus aureus* primary bloodstream infection: a comparison of events that do or do not meet the central line-associated bloodstream infection definition. *Am J Infect Control*. 2016;44(11):1252–1255. doi:10.1016/j.ajic.2016.03.038.

Topics

-  BSI mortality rates
-  PIVC infection rates
-  *Staphylococcus aureus* BSI rates

Design

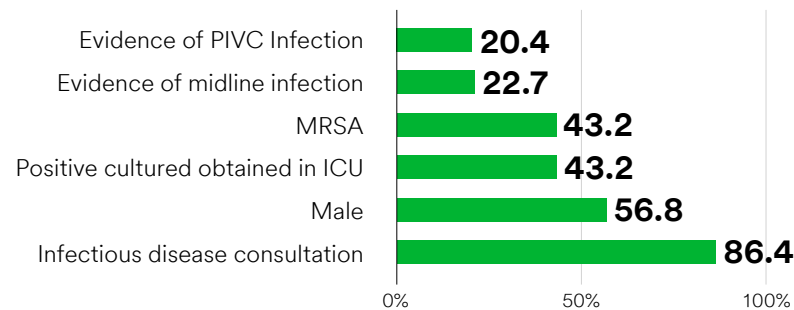
Retrospective study categorising patients with *S. aureus* hospital-acquired bloodstream infection (SA-HABSI) as central line-associated bloodstream infections (CLABSI) or non-CLABSI and comparing outcomes.

Method

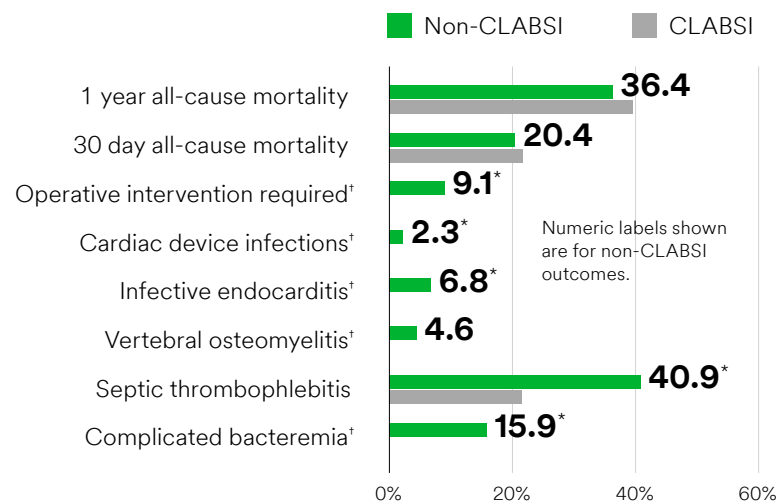
Study covered a four-year period in which 122 episodes in consecutive hospitalised patients had SA-HABSI. Cases were categorised based on National Healthcare Safety Network (NHSN) definition of CLABSI. Patients without central lines were categorised as non-CLABSI.

Results

Characteristics of primary SA-HABSI (%) in non-CLABSI patients



Comparison of CLABSI versus non-CLABSI outcomes (%)



[†]Outcome of 0% CLABSI value.

*Denotes significance at the 0.05 level.

36% of SA-HABSI were in patients without central lines.

“Infected PIVCs and midlines are the etiology of most non-CLABSI *Staphylococcus aureus* bacteremias.”





Complicated SA-HABSI are **much higher** in the non-CLABSI (15.9% vs 0%, $p < 0.001$) group, and the mortality rates are not significantly different between the groups.

“Our study demonstrates that **there is no risk free line** and that vigilance is required with any vascular access placement.”

Mortality risk factors among non-ICU patients with nosocomial vascular catheter-related bloodstream infections: a prospective cohort study.

Saliba P, Hornero A, Cuervo G, *et al.* Mortality risk factors among non-ICU patients with nosocomial vascular catheter-related bloodstream infections: a prospective cohort study. *J Hosp Infect.* 2018;99(1):48–54. doi:10.1016/j.jhin.2017.11.002.

Topics

-  BSI mortality rates
-  Non-ICU population
-  PIVC infection rates
-  *Staphylococcus aureus* BSI rates

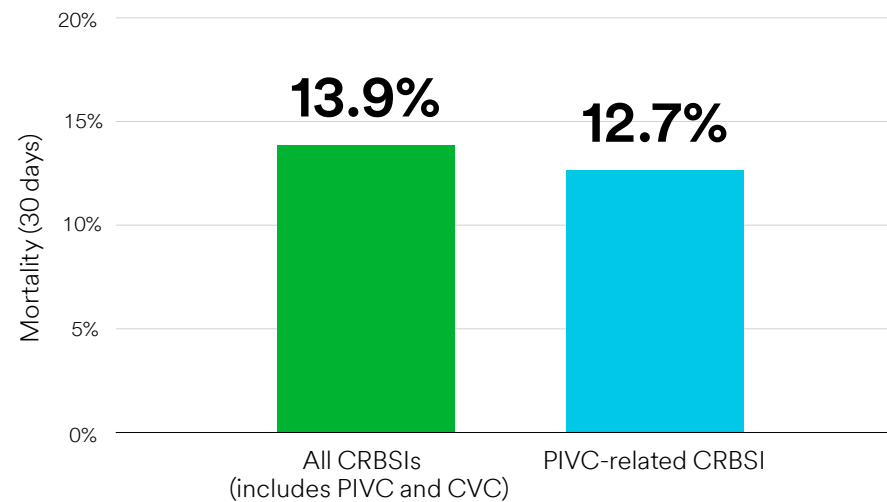
Design

Prospective cohort study of non-ICU patients with nosocomial CRBSIs between Jan. 2004 and Dec. 2014 to identify mortality risk factors.

Method

Statistical analysis of non-ICU patients with nosocomial CRBSIs identified 546 cases of CRBSI.

Results




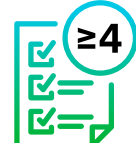



PIVCs accounted for **41%*** of CRBSIs, with a mortality rate of **12.7%**.
*n=204

Did not find increased mortality with central catheters compared to peripheral catheters.

“Nosocomial CRBSIs outside ICUs are associated with **high mortality risk.**”

CRBSI rate: **0.23/1,000 patient days.**

Factors associated with statistically significant increased mortality for nosocomial CRBSIs:




- 
Age ≥ 65 years
- 
Charlson score ≥ 4
- 
Admission to medical wards
- 
S. aureus infection
- 
Candida infection

Note: ‘Charlson Score’ is a scale for measuring comorbidities.

Comparison of routine replacement with clinically indicated replacement of peripheral intravenous catheters.

Buetti N, Abbas M, Pittet D, et al. Comparison of routine replacement with clinically indicated replacement of peripheral intravenous catheters. *JAMA Intern Med.* 2021;181(11):1471–1478. doi:10.1001/jamainternmed.2021.5345.

Topics

-  Clinically indicated PIVCs
-  Routine replacement PIVCs
-  PIVC-BSI

Design

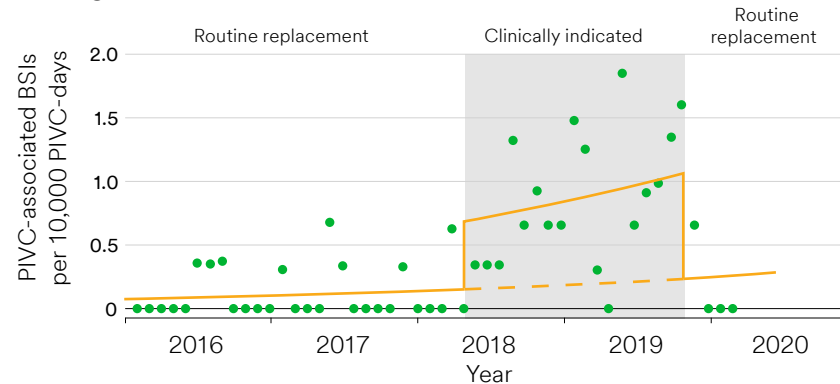
Single center, 10-site, observational cohort study (2008 beds).

Method

- ▶ Routine Replacement (every 96 hours): Jan. 1, 2016 – Mar. 31, 2018
- ▶ Clinically Indicated Replacement: Apr. 1, 2018 – Oct. 15, 2018
- ▶ Return to Routine Replacement: Oct. 16, 2018 – Oct. 16, 2019
- ▶ Overall n=412,631 PIVCs, 164,331 total patients
- ▶ n=241,432 baseline PIVCs (11 PIVC-BSI)
- ▶ n=130,779 intervention PIVCs (46 PIVC-BSI, 40,420 reversion PIVCs)
- ▶ Average PIVC dwell time increased during intervention period

Results

Monthly incidence of peripheral venous catheter (PIVC)-associated bloodstream infections (BSIs) during the three study periods



PIVC dwell time	Baseline	Intervention	Reversion
> 4 days	26,372 (10.9%)	26,656 (20.4%)	5170 (12.8%)
> 7 days	5745 (2.4%)	10,656 (8.1%)	947 (2.3%)

Insertion site	Baseline	Intervention	Reversion	p-value
Forearm	130,877 (54.2)	50,584 (38.7)	15,276 (37.8)	<.001
Arm	6930 (2.9)	2105 (1.6)	675 (1.7)	
Elbow	12,247 (5.1)	21,508 (16.4)	7530 (18.6)	
Hand	69,615 (28.8)	30,930 (23.7)	9141 (22.6)	
Other	6018 (2.5)	2636 (2.0)	771 (1.9)	
Wrist	15,745 (6.5)	23,016 (17.6)	7027 (17.4)	
Operator				
Out-of-hospital	18,909 (7.8)	10,573 (8.1)	2786 (6.9)	<.001
In-hospital	222,523 (92.2)	120,206 (91.9)	37,634 (93.1)	
PIVC-BSI	11 (<0.1)	46 (<0.1)	4 (<0.1)	<.001

Clinically indicated replacement:
0.9 BSI per 10,000 cd.

Routine replacement:
0.13 per 10,000 cd.

Routine group:
15 microbes identified
(60% coag-negative *Staph*).

Intervention group:
46 microbes identified
(21.7% *S. aureus*).

Clinically indicated replacement associated with **higher rates of PIVC-BSI** when compared to routine (IRR, 7.20; 95% CI, 3.65-14.22; p<.001).

PIVC-BSI: Defined per European Centre for Disease Prevention and Control.

References

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- 1 Helm RE, Klausner JD, Klemperer JD, Flint LM, Huang E. Accepted but unacceptable: peripheral IV catheter failure. *J Infus Nurs.* 2015;38(3):189–203. doi:10.1097/NAN.0000000000000100.

 - 2 Mermel L. Short-term peripheral venous catheter-related bloodstream infections: a systematic review. *Clin Infect Dis.* 2017;65(10):1757–1762. doi:10.1093/cid/cix562.

 - 3 Saliba P, Hornero A, Cuervo G, *et al.* Mortality risk factors among non-ICU patients with nosocomial vascular catheter-related bloodstream infections: a prospective cohort study. *J Hosp Infect.* 2018;99(1):48–54. doi:10.1016/j.jhin.2017.11.002.

 4. Buetti N, Abbas M, Pittet D, *et al.* Comparison of routine replacement with clinically indicated replacement of peripheral intravenous catheters. *JAMA Intern Med.* 2021;181(11):1471–1478. doi:10.1001/jamainternmed.2021.5345.

 5. Helm RE. Accepted but unacceptable: peripheral IV catheter failure: 2019 Follow-up. *J Infus Nurs.* 2019;42(3):149–150. doi:10.1097/NAN.0000000000000324.
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