



2014 - 2019

Surveillance Summary of Bloodstream Infections in Outpatient Hemodialysis Facilities — National Healthcare Safety Network

Introduction

In 2019, approximately 500,000 patients received hemodialysis at over 7,000 outpatient dialysis centers in the United States (1). Patients receiving outpatient hemodialysis are at high risk of infection because of repeated access of the bloodstream through vascular access sites necessary to perform the hemodialysis treatments, impaired immune systems, and frequent hospitalizations (1-3).

It has been well-established that different types of vascular access are associated with varying levels of infection risk (4,5). The most common vascular access types in order of increasing infection risk are arteriovenous fistulas (AVF), arteriovenous grafts (AVG), and central venous catheters (CVC).

Infections, including bloodstream infections (BSI), are a leading cause of death and hospitalizations among patients on outpatient hemodialysis (1). There are evidence-based strategies that have been proven to decrease BSIs with decreases sustained over time (6, 7). These are referred to as the [Core Interventions](#) for hemodialysis care.

The Centers for Disease Control and Prevention (CDC) has conducted surveillance for bloodstream infections (BSIs) and related events among patients receiving hemodialysis since 1999, most recently through the National Healthcare Safety Network (NHSN) (8,9). Data reported to NHSN, including BSI events and patient-months, have been used by the Centers for Medicare and Medicaid Services (CMS) as part of the [ESRD Quality Incentive Program \(QIP\)](#) since 2012 and as such, there is near universal reporting to NHSN from dialysis facilities across the nation. The text and figures that follow constitute a high-level summary of data reported to the NHSN reflecting several years of national progress toward reduction of BSIs in outpatient hemodialysis facilities.

Methods

Data Source

Outpatient hemodialysis facilities participating in NHSN are instructed to follow a standard protocol (10); as part of this protocol all outpatients who receive hemodialysis at the facility are monitored for three NHSN-defined dialysis events (positive blood culture; intravenous antimicrobial start; and pus, redness, or increased swelling at the vascular access site). The three types of dialysis events are reported using a standard data collection form. All types of vascular access that the patient has present at the time of the event are reported.

A positive blood culture is reportable if the blood specimen was collected in the outpatient setting or within one calendar day after hospital admission (i.e., on the day of or the day after admission to the hospital). There must be 21 or more days between positive blood cultures for each to be reported as

separate events. For each positive blood culture, the suspected source is indicated as (1) vascular access, (2) another site, (3) contamination, or (4) uncertain. All reportable positive blood cultures are defined as BSIs, regardless of suspected source. For each BSI, up to three pathogens isolated from blood may be reported along with antimicrobial susceptibilities of each pathogen.

Each month, using a standard form, facilities report the number of outpatients who received hemodialysis during the first 2 working days of the month stratified by patient vascular access type. If the patient has multiple vascular accesses, only his/her vascular access type with the highest risk of infection is counted using the following risk scale: CVC > other vascular access devices (e.g., catheter-graft hybrid) > AVG > AVF.

Each participating dialysis facility also completes an annual Practices Survey that includes data on facility characteristics and practices.

Standardized Infection Ratio

The standardized infection ratio (SIR) is a summary measure used to track healthcare-associated infections (HAI) at a national, state, or local level over time (11). The SIR adjusts for facility and/or patient-level factors that contribute to HAI risk within each facility. The SIR compares the actual number of HAIs reported to the number that would be predicted, given the standard population (i.e., NHSN 2014 baseline), adjusting for risk factors that are reported in NHSN. In other words, a SIR greater than 1.0 indicates that more HAIs were observed than predicted; conversely, a SIR less than 1.0 indicates fewer HAIs were observed than predicted.

Statistical Method

Dialysis BSI events were calculated using data reported by outpatient dialysis facilities to NHSN. Denominator data consist of the number of outpatients who received hemodialysis at the facility during the first two working days of each month. SIRs were calculated for BSIs based on 2014 baseline data (4, 11). The number of predicted BSIs was calculated by multiplying the 2014 national aggregate BSI pooled mean rates stratified by vascular access type times the facility's number of patient-months for each vascular access category. SIRs were calculated at the level of access type, then aggregated to total BSI SIRs by summing the observed and predicted events for each access type grouping. Mid-p exact tests were used to compare SIRs. The rate of dialysis BSI events was calculated per 100 patient-months and stratified by four vascular access type groups (e.g., Fistula, Graft, CVC, and other access types). Nontunneled and tunneled CVCs were collapsed into one category for analysis. Less than 1% of hemodialysis BSIs were assigned to the "other" vascular access group and were not included in access-stratified summaries. The frequency of the most common BSI pathogens in 2019 is also included. Since up to three pathogens can be reported per BSI, the total number of pathogens reported can be greater than the number of BSIs. Data were analyzed using SAS 9.4 (SAS Institute, Cary, NC).

Summary of 2014–2019 BSI Data

Facility Characteristics

- More than 7000 outpatient dialysis facilities reported data to NHSN in 2019; 92% reported for all 12 months (Table 1). This represented an increase of 1133 reporting facilities since 2014, when 5996 reported annual survey data.

- In 2019, the majority of reporting facilities had for-profit ownership (87%), were part of a dialysis chain (93%), and/or were freestanding clinics (93%). This is consistent with facility reports from 2014–2019 (data not shown).
- During 2014–2019, the medians remained stable for the number of stations in reporting facilities (17 for all years), number of patients treated during a single week (range 62–64), and percentage of facilities reporting all 12 months (range 92–96%).

Table 1. National Healthcare Safety Network (NHSN) Reporting Facilities Characteristics — Dialysis Annual Survey 2019

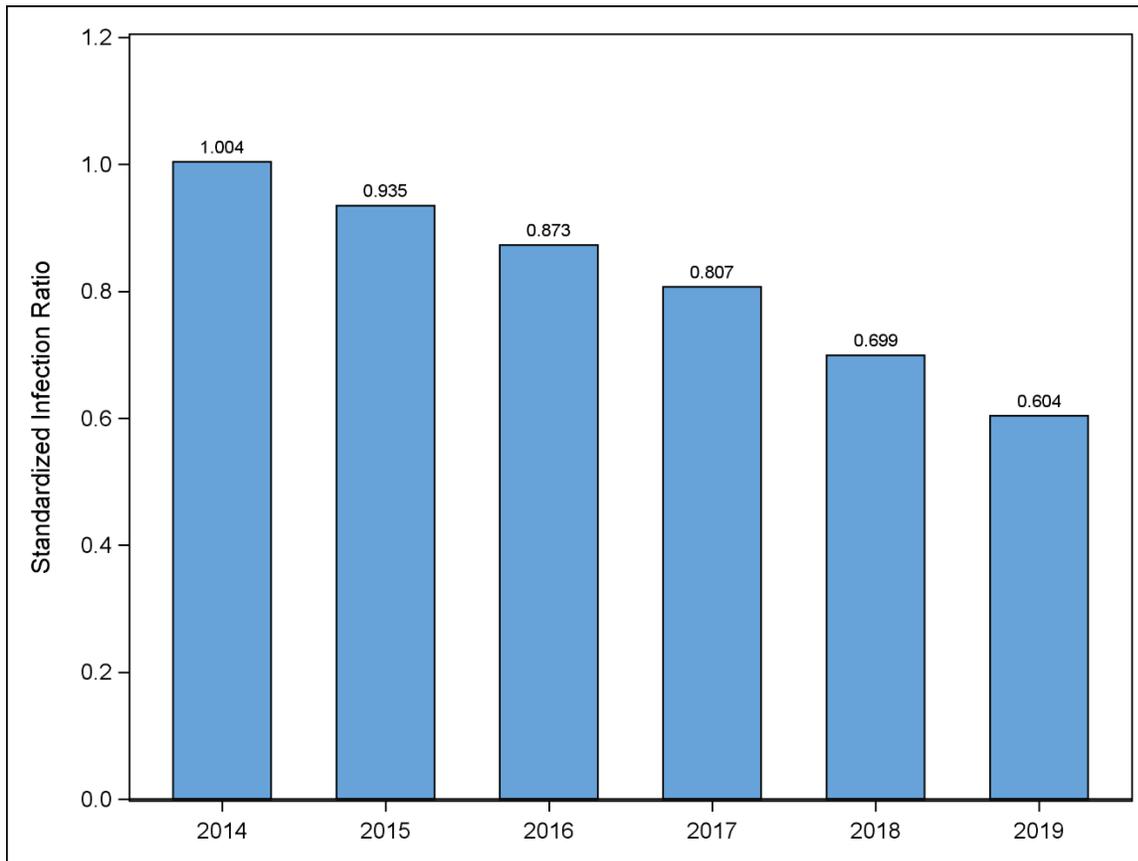
Number of facilities with NHSN annual survey data	7129
For-profit ownership, n (%)	6235 (87%)
Part of a dialysis chain, n (%)	6599 (93%)
Freestanding clinic (not hospital owned), n (%)	6616 (93%)
Number of stations, median (Interquartile range)	17 (12, 24)
Number of patients treated in one week*, median (Interquartile range)	62 (36, 95)
Number of facilities reporting all 12 months, n (%)	6801 (92%)

* Reported number of patients treated during the first week of February

Hemodialysis BSI SIRs

- Outpatient dialysis facilities made progress in preventing BSIs nationally. Between 2014 and 2019 the pooled BSI SIRs decreased by 40% (p<0.0001, 95% CI [39%, 41%]) (Figure 1).
- This decrease reflects collaborative efforts among outpatient dialysis providers, federal agencies, and professional societies including the [Making Dialysis Safer for Patients Coalition](#) that was launched in 2016, [American Society of Nephrology Nephrologists Transforming Dialysis Safety Initiative](#), and [Centers for Medicare & Medicaid Services ESRD Networks](#).

Figure 1. Dialysis Bloodstream Infection Standard Infection Ratio by Year, National Healthcare Safety Network, 2014–2019

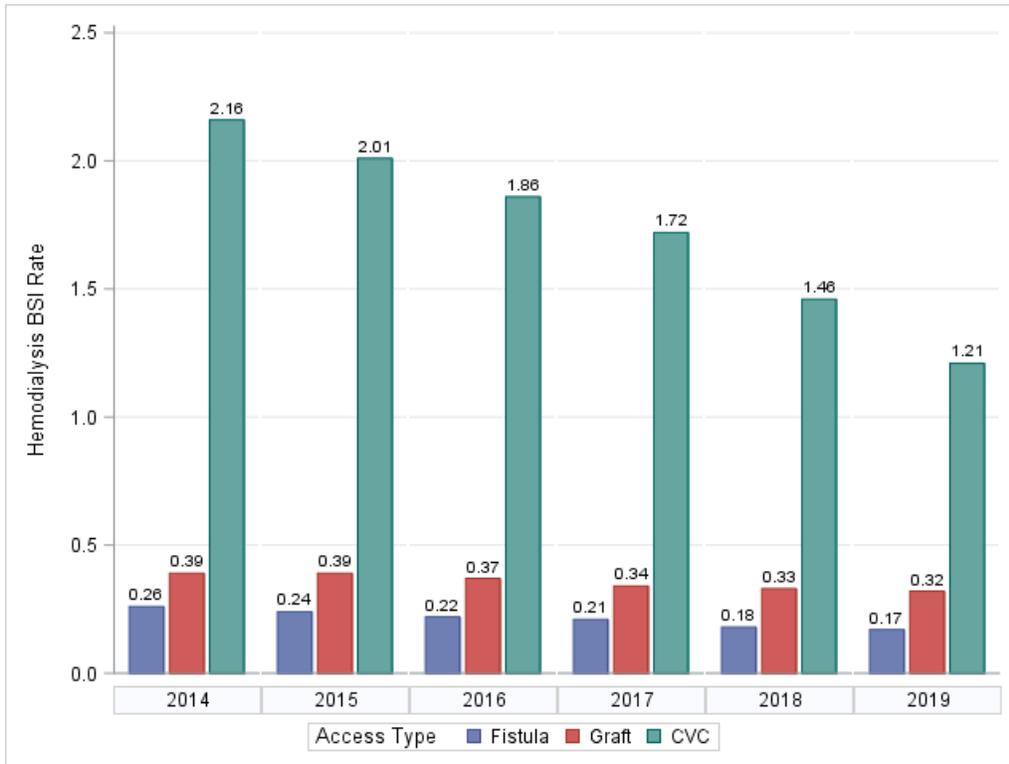


Text Version of Chart: Bar chart of standardized infection ratios for dialysis bloodstream infections. From left to right, 2014 SIR = 1.004, 2015 SIR = 0.935, 2016 SIR = 0.873, 2017 SIR = 0.807, 2018 SIR = 0.699, and 2019 SIR = 0.604.

Dialysis BSI Rates by Access Type

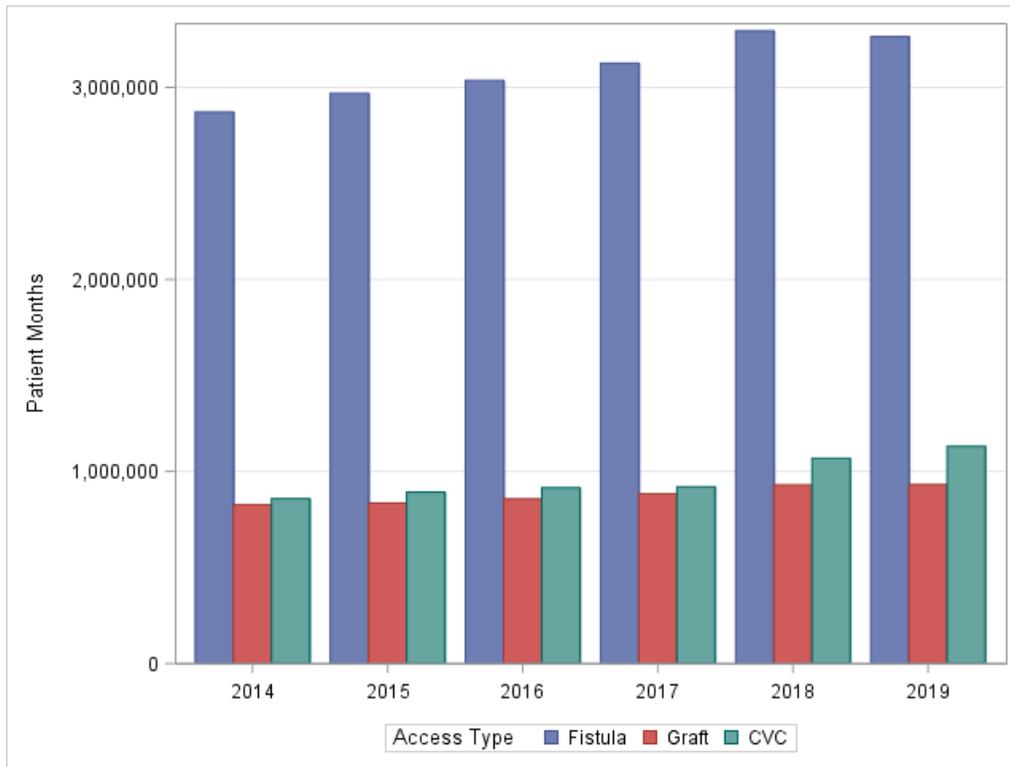
- The rate decreased for every vascular access type, however, the rate remained highest in patients with CVCs similar to previously published data (4,5) (Figure 2).
- From 2014 to 2019, 63% (98,502/156,805) of BSIs occurred in patients with CVCs while CVCs represented only 20% (5,784,411/29,610,941) of reported patient-months (Figure 3).
- We have made significant progress in preventing BSIs in patients with CVCs since 2014. However, BSIs still occur at a higher rate in patients with CVCs indicating there continue to be areas for improvement. For example, additional efforts are needed to decrease the number of patients initiating hemodialysis with CVCs. The percentage of patients initiating hemodialysis with CVCs has remained stable between 2009 (82.4%) and 2019 (81.8%) (1).

Figure 2. Annual Hemodialysis Bloodstream Infections Crude Rates by Access Types for Three Most Common Hemodialysis Access Types, per 100 Patient-Months, National Healthcare Safety Network, 2014–2019



Text Version of Chart: Bar chart of crude rates for dialysis bloodstream infections by access type reductions. From left to right, 2014 rates fistula = 0.26, graft = 0.39, CVC = 2.16, 2015 rates fistula = 0.24, graft = 0.39, CVC = 2.01, 2016 rates fistula = 0.22, graft = 0.37, CVC = 1.86, 2017 rates fistula = 0.21, graft = 0.34, CVC = 1.72, 2018 rates fistula = 0.18, graft = 0.33, CVC = 1.46, and 2019 rates fistula = 0.17, graft = 0.32, CVC = 1.21.

Figure 3. Annual Number of Reported Patient-Months by Hemodialysis Access Types, National Healthcare Safety Network, 2014–2019



Text Version of Chart: Bar chart of total hemodialysis patient-months reported to NHSN by year. Plot shows a bar for fistula access that starts just below 3 million patient-months in 2014, increasing to just above 3 million in 2019. The bars for graft and CVC access that are both under 1 million patient-months until 2018 when CVC patient-months increase to above 1 million while graft access stays just below 1 million patient-months each year.

Dialysis BSI Pathogen Distribution

- In 2019, *Staphylococcus aureus* remained the most common individual pathogen associated with BSIs (33%) in outpatient hemodialysis facilities. Compared to NHSN data published in 2014 there has been little change in pathogen distribution (4), with coagulase-negative *Staphylococcus* species (21.3%), *Enterococcus faecalis* (5.2%), *Escherichia coli* (5.1%), *Klebsiella* species (4.2%) and *Enterobacter cloacae* (3.3%) being the next most commonly reported pathogens.

Conclusions

- Despite significant success at preventing BSIs in outpatient dialysis facilities through implementation of strategies such as the [Core Interventions](#), there is need 1) to continue to ensure that these interventions are applied equitably across all dialysis facilities, 2) to continue

to expand BSI prevention through identification of additional strategies, and 3) for continued efforts to decrease CVC use and increase the number of patients with AVFs and AVGs for vascular access.

References

1. United States Renal Data System. 2021 *USRDS Annual Data Report: Epidemiology of kidney disease in the United States*. National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD, 2021.
2. Kato S, Chmielewski M, Honda H, Pecoits-Filho R, Matsuo S, Yuzawa Y, Tranaeus A, Stenvinkel P, Lindholm B. Aspects of immune dysfunction in end-stage renal disease. *Clin J Am Soc Nephrol*. 2008 Sep;3(5):1526-33.
3. Tennankore KK, Nadeau-Fredette AC, Matheson K, Chan CT, Trinh E, Perl J. Home versus In-Center Dialysis and Day of the Week Hospitalization: A Cohort Study. *Kidney360*. 2022 Jan; 3(1):103-112.
4. Nguyen DB, Shugart A, Lines C, Shah AB, Edwards J, Pollock D, Sievert D, Patel PR. National Healthcare Safety Network (NHSN) Dialysis Event Surveillance Report for 2014. *Clin J Am Soc Nephrol*. 2017 Jul 7;12(7):1139-1146.
5. Ravani P, Palmer SC, Oliver MJ, Quinn RR, MacRae JM, Tai DJ, Pannu NI, Thomas C, Hemmelgarn BR, Craig JC, Manns B, Tonelli M, Strippoli GF, James MT. Associations between hemodialysis access type and clinical outcomes: a systematic review. *J Am Soc Nephrol*. 2013 Feb;24(3):465-73.
6. Yi SH, Kallen AJ, Hess S, Bren VR, Lincoln ME, Downham G, Kelley K, Booth SL, Weirich H, Shugart A, Lines C, Melville A, Jernigan JA, Kleinbaum DG, Patel PR. Sustained Infection Reduction in Outpatient Hemodialysis Centers Participating in a Collaborative Bloodstream Infection Prevention Effort. *Infect Control Hosp Epidemiol*. 2016 Jul;37(7):863-6.
7. Patel PR, Yi SH, Booth S, Bren V, Downham G, Hess S, Kelley K, Lincoln M, Morrissette K, Lindberg C, Jernigan JA, Kallen AJ. Bloodstream infection rates in outpatient hemodialysis facilities participating in a collaborative prevention effort: a quality improvement report. *Am J Kidney Dis*. 2013 Aug;62(2):322-30.
8. Tokars JI. Description of a new surveillance system for bloodstream and vascular access infections in outpatient hemodialysis centers. *Semin Dial*. 2000 Mar-Apr;13(2):97-100.
9. National Healthcare Safety Network, Dialysis Event. Centers for Disease Control and Prevention. <https://www.cdc.gov/nhsn/dialysis/event/index.html>. Accessed January 9, 2023.
10. National Healthcare Safety Network, Dialysis Event Surveillance Protocol. Centers for Disease Control and Prevention. <https://www.cdc.gov/nhsn/pdfs/pscmanual/8pscaldialysiseventcurrent.pdf>. Accessed January 9, 2023.
11. The NHSN Standardized Infection Ratio (SIR). Centers for Disease Control and Prevention. <https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf>. Accessed January 9, 2023.