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Evaluation of Manual and Automated Bloodstream Infection Surveillance in Outpatient Dialysis Centers

Nicola D. Thompson, PhD, MS[1], **Matthew Wise, PhD**[1], **Ruth Belflower, BSN**[1], **Meredith Kanago, MSPH**[2], **Marion A. Kainer, MD**[2], **Chris Lovell, RN, MSN**[3], and **Priti R. Patel, MPH**[1]

[1]Division of Healthcare Quality Promotion, Centers for Disease Control and Prevention, Atlanta, Georgia

[2]Tennessee Department of Health, Emerging Infections Program, Nashville, Tennessee

[3]Dialysis Clinic, Inc, Nashville, Tennessee.

Abstract

Outpatient hemodialysis bloodstream infection rates, now used for performance measurement and were significantly higher for manual compared with automated surveillance ($P < .001$), largely owing to the absence of blood culture data in the dialysis electronic health record. Improvement in data sharing between hospitals and outpatient dialysis centers is necessary.

Bloodstream infections (BSIs) are common in hemodialysis patients and cause substantial morbidity and mortality[1]; invasive methicillin-resistant *Staphylococcus aureus* (MRSA) incidence is more than 100 times higher than in the general population.[2] The Centers for Disease Control and Prevention (CDC) National Healthcare Safety Network (NHSN) provides methods and infrastructure for BSI surveillance in outpatient hemodialysis patients, which is used by the Centers for Medicare and Medicaid Services in the End-Stage Renal Disease Quality Incentive Program. Reliable and accurate surveillance data are necessary to inform facility prevention and quality improvement activities, reveal interfacility variations in healthcare quality for public reporting programs, and evaluate national progress toward US Department of Health and Human Services BSI reduction goals in end-stage renal disease facilities.

Surveillance has traditionally relied on manual data collection and entry by facility personnel; however, this approach can be time-consuming and costly and has the potential to direct staffing resources away from clinical duties. Development of streamlined reporting methods is critical for sustained reporting to NHSN.[3] To our knowledge, automated BSI surveillance based on electronic health record (EHR) data from the outpatient dialysis setting has not been evaluated. Our objective was to evaluate the performance of automated BSI surveillance compared with manual BSI surveillance.

Address correspondence to Nicola D. Thompson, PhD, MS, Division of Healthcare Quality Promotion, Centers for Disease Control and Prevention, 1600 Clifton Rd, MS A-16, Atlanta, GA 30333 (ndthompson@cdc.gov).

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METHODS

This evaluation was a collaborative project between Dialysis Clinic, Inc (DCI), a nonprofit dialysis corporation; the Tennessee Emerging Infections Program (EIP); and the CDC, performed from January 1 through June 30, 2012, at 13 outpatient dialysis centers in Tennessee. Data sharing was conducted among CDC, DCI, and Tennessee EIP to facilitate the surveillance evaluation.

NHSN Dialysis Event positive blood culture reporting definitions, a proxy BSI measure endorsed by the National Quality Forum and amenable to automated surveillance, were used.[4] A BSI case was defined as a blood sample obtained in a dialysis center patient while at the dialysis center or within 1 calendar day after hospital admission resulting in positive growth of any organism and with no positive blood culture in the previous 14 days. The number of hemodialysis outpatients with each vascular access type who received hemodialysis during the first 2 working days of the month was used as the denominator.

Automated BSI Case Identification

DCI uses an internally developed EHR system containing patient demographic and dialysis treatment information. An extract of data was made by DCI corporate staff and transferred electronically in a secure manner to CDC surveillance project staff. CDC staff developed a line listing of patients meeting the BSI case definition from January 1 through June 30, 2012, by processing the EHR data extract. Demographic information, clinical information, *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) codes, dialysis treatments, access type, and positive blood culture results were included.

Manual BSI Case Identification

A line listing of DCI patients with potential BSIs (defined in Figure 1) from January 1 through June 30, 2012, was created by CDC staff and provided to surveillance officers at the Tennessee EIP. EIP surveillance officers manually reviewed available medical and microbiology records of patients with a potential BSI. This included dialysis center records (paper charts and electronic records) and copies of patient records from care received at other healthcare facilities, forwarded at the request of dialysis staff to the dialysis centers for patient care, or at the request of EIP staff for this evaluation. For a patient meeting the BSI case definition, a standardized case report form was completed by a Tennessee EIP surveillance officer.

The numbers of BSIs (numerator) and patient-months (denominator) during the evaluation were pooled, and total and access-specific BSI incidence rates per 100 patient-months for manual and automated surveillance were calculated. The BSI rate difference between manual and automated surveillance was calculated for each center. BSI cases were investigated to identify potential reasons for discordance among surveillance methods. BSI rates were compared using Poisson regression; $P < .05$ was considered statistically significant. Data analysis was performed using SAS, version 9.3 (SAS Institute), and OpenEpi.

RESULTS

Comparison of BSI Case Identification and BSI Rates

From January 1 through June 30, 2012, a total of 1,063 patients received at least 1 hemodialysis treatment at the 13 outpatient dialysis centers. During this time, 1,317 potential BSIs were identified (range, 183–253/month) and underwent medical record review by Tennessee EIP surveillance officers. Through manual surveillance, 68 BSIs meeting the case definition were identified (range, 6–17/month) in 56 patients. Most BSIs were caused by *S. aureus* (36 [53%]), of which 19 were MRSA. In comparison, 24 BSI cases (range, 0–7/month) in 24 patients were identified through automated surveillance; 13 (54%) were caused by *S. aureus*, of which 6 were MRSA. Pooled mean BSI rates, overall and by specific access type, were significantly lower for the automated compared with manual surveillance (Table 1). The BSI rate from manual surveillance was higher than from automated surveillance at 12 of the 13 centers, with an overall BSI rate difference (the manual BSI rate minus the automated BSI rate) of 1.02 per 100 patient-months (95% CI, 0.60–1.49) and ranging from 0.00 to 1.80 per 100 patient-months by center.

Investigation of Discordance

The 24 BSI cases identified by automated surveillance were also identified by manual surveillance; all 24 were blood cultures drawn at the dialysis center. For the 44 discordant BSI cases, 2 were identified in the dialysis EHR, but the specimen source code was incorrectly recorded as either “exit site” or “other.” The remaining 42 BSI cases were all blood cultures drawn on the day of or day after hospital admission. The information necessary to apply the BSI case definition (specimen source, collection date, and positive culture results) was not found in the dialysis EHR. For 31 (70%) of the 44 discordant BSI cases, review of the EHR identified documentation of an ICD-9-CM code suggesting an infection; for 12 of these, the ICD-9-CM code suggested a BSI. For 13 discordant BSI cases, there were no ICD-9-CM codes suggesting an infection.

In summary, automated surveillance for BSI performed using EHR data from outpatient dialysis centers resulted in under-ascertainment of BSI cases, largely due to the exclusion of information on blood culture drawn on day 1 or 2 of hospitalization. Of note, for several of the missing BSI cases, the EHR had documentation of ICD-9-CM codes suggesting a BSI, indicating some clinical information from the hospitalization had been obtained by the patient’s dialysis center. For patient safety, quality improvement, and public reporting purposes, it is necessary to improve efforts to systematically identify blood cultures drawn within the first 2 days of hospitalization for hemodialysis outpatients. Additional work is needed to establish successful and sustainable processes to ensure more complete capture of BSIs.

Dialysis providers are often challenged by incomplete transfer of pertinent clinical data from their patients’ hospitalizations, and this is a recognized barrier to safe care transitions.[5,6] Efforts to explore and identify best practices for efficient and effective communication of pertinent patient information during care transitions are necessary. This will require collaboration between the many stakeholders, including both dialysis centers and hospitals.

Even though this evaluation was performed in a small number of centers from a single provider, in a comparison of MRSA BSI cases reported to 2 CDC surveillance systems[7] it was found that up to 60% of MRSA BSI were not reported to NHSN by outpatient dialysis centers during 2013, suggesting our findings are likely not unique to the participating centers. Maintaining accurate BSI surveillance data in this vulnerable patient population is of national public health importance. Before adoption of automated case-finding methods, robust evaluation and validation of the data obtained should be undertaken to avoid incomplete reporting of dialysis event data to the NHSN.

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention

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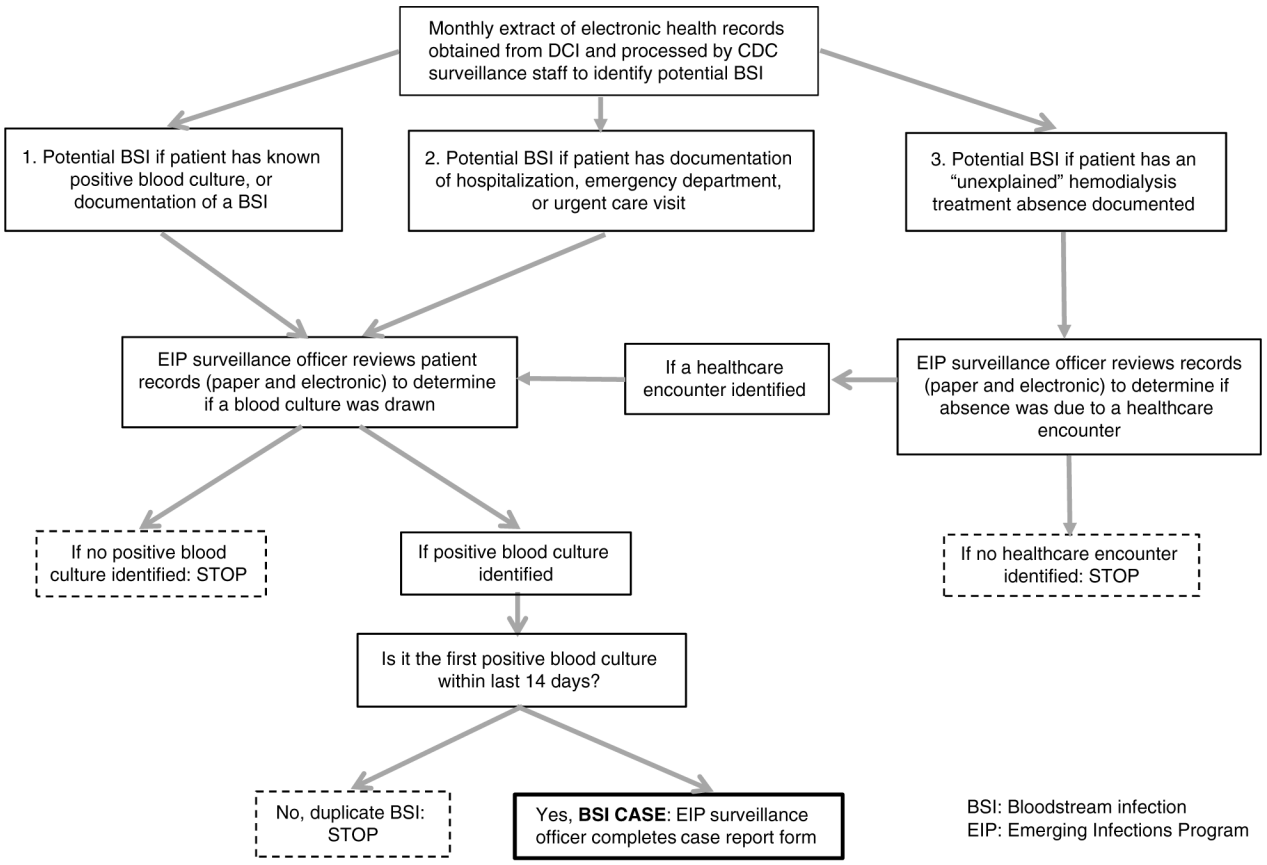

FIGURE 1.

Overview of the manual surveillance process for the identification of bloodstream infections in hemodialysis outpatients. CDC, Centers for Disease Control and Prevention; DCI, Dialysis Clinics, Inc.

TABLE 1.

Overall and Access-Specific Pooled Mean Bloodstream Infection (BSI) Rates per 100 Patient-Months From Manual and Automated Surveillance at 13 Outpatient Dialysis Centers, January 1–June 30, 2012

Variable	Manual surveillance (95% CI)	Automated surveillance (95% CI)	*P* value[a]
Overall pooled mean BSI rate	1.62 (1.27–2.04)	0.57 (0.38–0.84)	<.001
Fistula BSI rate	0.65 (0.37–1.06)	0.23 (0.08–0.51)	<.001
Graft BSI rate	1.15 (0.66–1.89)	0.27 (0.07–0.73)	<.001
Catheter BSI rate	4.44 (3.22–5.99)	1.78 (1.05–2.81)	<.001

[a]Poisson *P* value of comparison of BSI rate per 100 patient-months.

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