Dialysis Surveillance Report: National Healthcare Safety Network (NHSN)—Data Summary for 2006

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ABSTRACT

Thirty-two outpatient hemodialysis providers in the United States voluntarily reported 3699 adverse events to the Centers for Disease Control and Prevention (CDC) National Healthcare Safety Network (NHSN) during 2006. These providers were previously enrolled in the Dialysis Surveillance Network. The pooled mean rates of hospitalization among patients with arteriovenous fistulas, grafts, permanent and temporary central venous catheters were 7.7, 9.2, 15.7, and 34.7 per 100 patient-months, respectively. For bloodstream infection the pooled mean rates were 0.5, 0.9, 4.2, and 27.1 per 100 patient-months in these groups. Among the 599 isolates reported, 461 (77%) represented access-associated blood stream infections in patients with central lines, and 138 (23%) were in patients with fistulas or grafts. The microorganisms most frequently identified were common skin contaminants (e.g., coagulase-negative staphylococci). In 2007, enrollment in NHSN opened to all providers of outpatient hemodialysis. Specific information is available at http://www.cdc.gov/ncidod/dhqp/nhsn_FAQenrollment.html.

Background

In the United States, 309, 269 people were treated for end-stage renal disease (ESRD) by hemodialysis during 2004 (1). This number of cases was a record high and almost twice the number treated just 10 years earlier (1). Infections are the second most common cause of death among ESRD patients, and they account for nearly 14% of deaths (1). Their risk of infection occurs as a result of immunosuppression and is exacerbated by the need to routinely access their bloodstream for treatment. Antimicrobial resistance is of particular concern because hemodialysis patients are often hospitalized, where they can be exposed to antibiotic-resistant pathogens. In addition, they are often treated with long courses of antimicrobials (2).

The National Kidney Foundation's Kidney Disease Outcome Quality Initiative (DOQI) guidelines recommend monitoring vascular infections to identify outbreaks and observe trends (3). CDC guidelines to prevent intravascular catheter-related infections recommend surveillance of catheter insertion, maintenance and infection rates (4). Local (i.e., center-specific) surveillance of infections can help identify areas where improvements in infection control might be necessary. Additionally, local surveillance data can be used to evaluate the effectiveness of prevention interventions. If providers are to prevent antimicrobial resistance, monitoring antimicrobial use and antimicrobial resistance of organisms associated with infections in dialysis patients is critical (5).

Methods

CDC's National Healthcare Safety Network (NHSN) is the successor system to the Dialysis Surveillance Network (DSN; 6), the National Nosocomial Infections Surveillance System (NNIS; 7), and the National Surveillance System for Healthcare Workers. During 2005, outpatient hemodialysis providers already in the Dialysis Surveillance Network transitioned into the NHSN. Dialysis surveillance activities are part of the NHSN Patient Safety Component, Device-Associated Module. The detailed protocol and case report forms are available at http://www.cdc.gov/ncidod/dhqp/nhsn_members.html. Participants include free-standing and hospital-based centers that provide outpatient, chronic hemodialysis.

At each participating dialysis center, staff members monitor patients for any of three specific events that trigger a report: (1) an overnight hospital stay, (2) an outpatient start of an intravenous (IV) antimicrobial, or (3) a positive blood culture. More than one specific event

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may be recorded on the same patient's report. After 20 days, the occurrence of an outpatient start of an IV antimicrobial or a positive blood culture in a patient is considered a new case; a new hospitalization can be reported at any time. The case report form captures basic clinical data for each patient and event, including the type of vascular access and use of vancomycin. Information used to estimate the denominator (patient-months) is obtained during the first two working days of the month. During those 2 days, the number of patients with each type of vascular access is recorded (fistula, graft, temporary and permanent central line, and port). Rates expressed in patient-months can be interpreted as the average percentage of patients having the event each month (8).

Dialysis staff members enter this information monthly using NHSN's reporting tool, accessible through CDC's Secure Data Network. Center-specific data are immediately available on-line. Data aggregated from all centers are analyzed at CDC. Patient and center information is protected at CDC by provisions of federal Public Health Service law (9).

Definitions

Each center determined whether a central line used for vascular access was considered temporary or permanent. A port vascular access was a fully implantable access device (e.g., Lifesite). We defined a hospitalization as any report where a patient stayed overnight in a hospital, regardless of cause. An antimicrobial start was any initiation of a new antimicrobial agent not in use for the previous 21 days, and delivered IV. Vancomycin starts were a subset of antimicrobial starts for which vancomycin was the agent used. We defined a local access infection as the presence of pus, redness, or swelling of the vascular access site without access-associated bloodstream infection. An access-associated bloodstream infection was defined as a patient with a microorganism identified in a blood culture where the source of infection was the vascular access site. A bloodstream infection was a report of a positive blood culture, regardless of the source of the infection, and included access-associated bloodstream infections. A vascular access infection was a patient with either a local access infection or an access-associated bloodstream infection.

In this report, we summarize data submitted by hemodialysis centers to the NHSN during 2006.

Results

Thirty-two centers providing outpatient hemodialysis reported data to the NHSN in 2006. These centers submitted data on 28,047 patient-months: 12,140 (43%) were among patients with fistulas, 8806 (31%) with permanent central lines, 6907 (25%) with grafts, 118 (0.4%) with temporary central lines, and 76 (0.3%) with ports. During 2006, dialysis centers reported 3699 adverse events. The number of events reported among patients with ports was not adequate to calculate rates or rate distributions. The number of events reported among patients with temporary central lines was not adequate to provide distribution of rates. Event rates varied by vascular access type (Table 1). The most frequent event was hospitalization (2985 reports). The pooled mean rate of hospitalization ranged from 7.7 per 100 patient-months among patients with fistulas to 34.7 per 100 patient-months among patients with temporary central lines. Percentiles describing the variability of rates across participating dialysis centers are also shown in Table 1. Half of the centers had a rate of hospitalization ≥ 7.9 per 100 patient-months among patients with fistulas.

The pooled mean rate among the 977 reports of antimicrobial starts ranged from 1.8 to 25.4 per 100 patient-months. In 73% of these events, vancomycin was used; the pooled mean rate of vancomycin starts ranged from 1.2 to 16.1 per 100 patient-months. The pooled mean rate of bloodstream infection ranged from 0.5 to 27.1 per 100 patient-months. The pooled mean rate of a vascular access infection (either a local access infection or an access-associated bloodstream infection) ranged from 0.4 to 22.9 per 100 patient-months.

Among the 532 positive blood cultures, 599 isolates were reported. Of these, 461 (77%) represented access-associated bloodstream infections in patients with central lines, and 138 (23%) were in patients with fistulas or grafts (Table 2). Among isolates from patients with either a central line, fistula, or graft, the microorganisms most frequently identified were common skin contaminants (e.g., coagulase-negative staphylococci). Overall, 181 isolates from positive blood cultures were tested for antimicrobial susceptibility and results reported to NHSN (Table 3). The most frequently reported organism was *S. aureus* of which 42% were resistant to methicillin (MRSA). Of the enterococci tested and reported, 26% were resistant to vancomycin.

Discussion

In 2006, rates of adverse events were higher among dialysis patients with central lines than among those with fistulas or grafts (8,10,11). The rate of hospitalization among patients with temporary central lines was 34.7 per 100 patient-months, about four times the rate among those with fistulas or graphs (7.7–9.2 patients per 100 patient-months). Likewise, the rate of bloodstream infection was substantially higher among patients with temporary central lines (27.1 per 100 patient-months) than among patients with fistulas or grafts (< 1 per 100 patient-months). Through the Fistula First Campaign, the Centers for Medicare and Medicaid Services (CMS), ESRD Networks, the renal community, and the Institute for Healthcare Improvement (IHI) are working with many other partners, including CDC, to improve the likelihood that patients receive the most optimal form of vascular access; generally an arteriovenous fistula. Complications related to vascular access are also avoided through appropriate access monitoring and intervention (12). However, even with optimal vascular access, careful attention to infection control is necessary to help prevent infections (13).

TABLE 1. Pooled means and key percentiles of the distribution of rates of dialysis surveillance events by type of vascular access, device-associated module, patient safety component, National Healthcare Safety Network, 2006

Type of access	Event[a]	Pooled mean	Percentile				
			10%	25%	50% (median)	75%	90%
Hospitalization							
Fistula	932	7.7	0.1	2.9	7.9	10.4	11.3
Graft	632	9.2	0	3.6	9.8	13.2	15.1
Perm. central line	1380	15.7	0.3	9.5	15.8	21.2	25.2
Temp. central line	41	34.7	—	—	—	—	—
Antibiotic starts							
Fistula	218	1.8	0	0.3	1.4	2.8	3.9
Graft	163	2.4	0	0.6	1.8	3.7	5.5
Perm. central line	566	6.4	0	2.2	4.8	10.5	12.8
Temp. central line	30	25.4	—	—	—	—	—
Vancomycin							
Fistula	148	1.2	0	0	1.2	2	2.7
Graft	113	1.6	0	0.3	1.2	2.2	4
Perm. central line	436	5.0	0	1.8	3.1	7.8	9.5
Temp. central line	19	16.1	—	—	—	—	—
Bloodstream infection							
Fistula	63	0.5	0	0	0.3	0.7	1.1
Graft	63	0.9	0	0	0.6	1.6	2.2
Perm. central line	374	4.2	0	1.6	3.4	6	9.4
Temp. central line	32	27.1	—	—	—	—	—
Local access infection							
Fistula	27	0.2	0	0	0	0.2	1
Graft	31	0.4	0	0	0	0.5	1.1
Perm. central line	148	1.7	0	0	0.5	1.8	3.9
Temp. central line	6	5.1	—	—	—	—	—
Access-associated bloodstream infection							
Fistula	26	0.2	0	0	0	0.3	0.5
Graft	31	0.4	0	0	0.2	0.8	1.5
Perm. central line	272	3.1	0	0.6	2.4	4.5	6.3
Temp. central line	21	17.8	—	—	—	—	—
Vascular-access infection							
Fistula	53	0.4	0	0	0.3	0.7	1.3
Graft	62	0.9	0	0	0.7	1.3	2.1
Perm. central line	420	4.8	0	2	3.6	6	10.7
Temp. central line	27	22.9	—	—	—	—	—

Perm, permanent; temp, temporary.

The number of events reported among patients with temporary central lines was not adequate to provide distribution of rates.

[a] $\frac{\text{Number of events}}{\text{Number of patient-months}}$ 100.

Consistent with previous reports (8,10) we found that among bloodstream infections in patients with central lines, the most frequently reported organisms were common skin contaminants. However, among patients with fistulas or grafts, the frequency of common skin contaminants was somewhat higher in 2006 than during 1999–2005 (10). We cannot determine whether any of the common skin contaminants were true pathogens or specimen contamination (14,15). Antimicrobial treatment based on a report reflecting contamination can lead to antimicrobial resistance (see http://www.cdc.gov/drugresistance/healthcare/patients.htm#dialysis).

Monitoring organisms associated with infections and their resistance patterns is necessary for prevention of resistance (5). Methicillin-resistant *Staphylococcus aureus* is a major problem among patients on hemodialysis; the rate of invasive MRSA infections in dialysis patients was an estimated 45 per 1000 in 2005 in the United States (16). Among dialysis centers participating in NHSN, 42% of all *S. aureus* isolates from positive blood cultures were MRSA. To prevent infections with MRSA and other resistant organisms in outpatient dialysis centers a comprehensive approach that includes prevention of infections, judicious antimicrobial use, and prevention of transmission is needed (17).

Participation in NHSN is voluntary, and CDC restricted enrollment during 2006 to existing participants in NNIS or DSN. Therefore, results reported may not represent all U.S. centers providing outpatient hemodialysis. Currently, all U.S. outpatient hemodialysis centers interested in participating in NHSN are invited to enroll. Participating centers can be free-standing dialysis centers or centers affiliated with a hospital, but they should serve mostly ambulatory, chronic hemodialysis patients. To participate in NHSN, centers must meet certain technical requirements (i.e., Internet access, a valid e-mail address, and have the ability to download a digital certificate) and make a commitment to follow the data collection protocol, complete an annual practices survey, and report data for dialysis events and denominator data for at least 6 months in a given year. For

TABLE 2. Microorganisms isolated from blood cultures reported by U.S. participants in outpatient dialysis surveillance by type of vascular access, device-associated module, patient safety component, National Healthcare Safety Network, 2006

	Central line-associated bloodstream infection number (%)	Fistula or graft access-associated bloodstream infection number (%)
Staphylococcus aureus	91 (19.7)	39 (28.3)
Other gram-positive	46 (10.0)	22 (15.9)
Gram-negative rods	107 (23.2)	19 (13.8)
Common skin contaminants[a]	204 (44.3)	51 (37.0)
Fungi	8 (1.7)	4 (2.9)
Other	5 (1.1)	3 (2.2)
Total	461	138

[a]Common skin contaminants included: *Bacillus* sp., *Corynebacterium* sp., coagulase-negative *Staphylococcus*, Diphtheroids, *Propionibacterium acnes, Propionibacterium propionicum, Propionibacterium* sp. unspecified, *Staphylococcus epidermidis, Staphylococcus auricularis, Staphylococcus capitis* ssp. *capitis, Staphylococcus capitis* ssp. unspecified, *Staphylococcus haemolyticus, Staphylococcus hominis, Staphylococcus lugdunensis, Staphylococcus simulans, Staphylococcus warneri,* alpha-hemolytic *Streptococcus*, and *Streptococcus viridans*.

TABLE 3. Antimicrobial susceptibility among most frequently reported isolates[a] from blood cultures reported by U.S. participants in outpatient dialysis surveillance, device-associated module, patient safety component, National Healthcare Safety Network, 2006

	Number of isolates tested and reported	Number (%) resistant
Staphylococcus aureus resistant to methicillin	123	52 (42%)
Enterococcus spp. resistant to vancomycin	39	10 (26%)
Enterobacter spp. resistant to third generation cephalosporins	17	1 (6%)

[a]The number of coagulase-negative staphylococci resistant to methicillin was < 5 and omitted from the report.

enrollment information, please visit http://www.cdc.gov/ncidod/dhqp/nhsn_FAQenrollment.html.

Dialysis centers interested in conducting surveillance for adverse events often ask about the time and resource investment surveillance activities require. A hospital-based unit serving dialysis outpatients recently documented implementation of surveillance activities using the NHSN protocol (18). In their experience, the methods were easy to implement; maintenance of the activities required an estimated 2 hours of staff time per month. The facility observed that surveillance participation resulted in a decline in rates of bloodstream infections and antimicrobial use through ownership and engagement of staff (18).

The National Healthcare Safety Network provides tools for outpatient dialysis centers to analyze their own data so that they can monitor trends, evaluate needs for prevention, and measure the impact of their prevention efforts. Adjusting the number of events for patient risk factors, such as vascular access type, and the time period at risk is needed to compare rates across dialysis centers. The dialysis surveillance activities in the NHSN use patient-months as the adjustment for time at risk, but other methods are available and rates can be converted for comparability (19). For further information about surveillance and the prevention of dialysis-associated adverse events, please visit http://www.cdc.gov/ncidod/dhqp/dpac_dialysis_pc.html.

Disclaimer

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