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ORIGINAL ARTICLE

Discord among Performance Measures for Central Line–Associated Bloodstream Infection

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BACKGROUND. Central line–associated bloodstream infection (CLABSI) is a national target for mandatory reporting and a Centers for Medicare and Medicaid Services target for value-based purchasing. Differences in chart review versus claims-based metrics used by national agencies and groups raise concerns about the validity of these measures.

OBJECTIVE. Evaluate consistency and reasons for discordance among chart review and claims-based CLABSI events.

METHODS. We conducted 2 multicenter retrospective cohort studies within 6 academic institutions. A total of 150 consecutive patients were identified with CLABSI on the basis of National Healthcare Safety Network (NHSN) criteria (NHSN cohort), and an additional 150 consecutive patients were identified with CLABSI on the basis of claims codes (claims cohort). All events had full-text medical record reviews and were identified as concordant or discordant with the other metric.

RESULTS. In the NHSN cohort, there were 152 CLABSIs among 150 patients, and 73.0% of these cases were discordant with claims data. Common reasons for the lack of associated claims codes included coding omission and lack of physician documentation of bacteremia cause. In the claims cohort, there were 150 CLABSIs among 150 patients, and 65.3% of these cases were discordant with NHSN criteria. Common reasons for the lack of NHSN reporting were identification of non-CLABSI with bacteremia meeting Centers for Disease Control and Prevention (CDC) criteria for an alternative infection source.

CONCLUSION. Substantial discordance between NHSN and claims-based CLABSI indicators persists. Compared with standardized CDC chart review criteria, claims data often had both coding omissions and misclassification of non-CLABSI infections as CLABSI. Additionally, claims did not identify any additional CLABSIs for CDC reporting. NHSN criteria are a more consistent interhospital standard for CLABSI reporting.

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Because healthcare-associated infection (HAI) is one of the top 10 causes of death in the United States, there are national directives to eliminate HAIs.[1] Studies have consistently demonstrated that surveillance of HAI promotes reduction through feedback and benchmarking.[2-5] Central line–associated bloodstream infection (CLABSI) has been a major focus of state and national mandated reporting and is a target for performance incentives through value-based purchasing by the Centers for Medicare and Medicaid Services (CMS). However, differences exist in the CLABSI metrics used to monitor performance, and these differences have caused confusion in benchmarking and raised concerns about the validity of disparate measures.

The most widely used definition for CLABSI has been set forth by the Centers for Disease Control and Prevention (CDC) National Healthcare Safety Network (NHSN).[6] Subsets of NHSN-reported cases are used for CLABSI performance metrics set forth by Leapfrog, Consumer Reports, and many states for public reporting.[7-9] States with legislative mandates for CLABSI reporting have almost uniformly

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adopted this surveillance system, which requires trained infection preventionists (IPs) to review medical records for specific surveillance criteria.[10-13] In 2008, CMS announced regulations in which to deny payments for claims codes that indicated a hospital-associated CLABSI had occurred during the hospital stay.[14] Claims codes have also been used for the national Patient Safety Indicators set forth by the Agency for Healthcare Research and Quality (AHRQ) and University HealthSystem Consortium (UHC).[15-17] The use of different systems and their definitions, each with advantages and disadvantages, has complicated the landscape of benchmarking and public reporting for CLABSI.

Concerns with the validity of claims-based detection of CLABSI have been previously reported, and studies have found poor concordance (55%), sensitivity (9%), and positive predictive values (15%) when comparing claims codes for CLABSI and validation by chart review.[12,18,19] One study found that 92% of CLABSI identified by hospital billing records were misclassified.[20] More recent evaluations have not been performed since the institution of CMS reporting mandates and do not pay requirements. It is possible that the national attention focused on this issue in recent years, the maturation of NHSN reporting and CMS disincentives, and the institution of the "present at hospital admission" diagnosis may have improved the congruence of NHSN and administrative data.[14] Even if this is not the case, a more in-depth understanding of the frequency of and reasons behind discordance would prove invaluable as we continue to strive for better benchmarking.[21] In this study, we assessed the frequency of and reasons for discordance for CLABSI events on the basis of reporting measures several years after NHSN and claims CLABSI metrics were established for interhospital comparisons.

METHODS

We conducted 2 multicenter retrospective cohort studies of hospital-associated CLABSI identified within the University of California (UC) Health System. This system includes the following tertiary care, multispecialty academic institutions with the approximate number of licensed beds given in parentheses: Ronald Reagan UC Los Angeles (UCLA) Medical Center and Santa Monica UCLA Medical Center and Orthopedic Hospital (950 licensed beds combined), UC San Francisco Medical Center (700 beds), UC Davis Medical Center (600 beds), UC San Diego Medical Center (550 beds), and UC Irvine Medical Center (420 beds). This study was approved by the institutional review board of the UC Regents.

Across their hospital populations, each of the sites identified 25 consecutive adult patients with a hospital-associated CLABSI event on the basis of CDC NHSN criteria (NHSN cohort) and 25 consecutive adult patients with hospital-associated CLABSI events on the basis of CMS claims codes (*International Classification of Diseases, 9th Revision* [*ICD-9*], code 999.31 not present at admission; claims cohort) from 2011 or a recent year (2009–2010) in which no internal cross-referencing was occurring between the 2 CLABSI measures.

All patients had full text medical record reviews performed for the hospitalization during which the CLABSI was found. Medical records were reviewed by highly experienced IPs, hospital epidemiologists, and physicians to collect descriptive data for each patient (demographic characteristics, comorbidities, and hospitalization dates) and central line data (type and dwell time at time of CLABSI). For each CLABSI in the NHSN cohort, it was determined whether a CMS claims code criteria for hospital-associated CLABSI was present. For each claims cohort CLABSI event, it was determined whether the NHSN criteria for hospital-associated CLABSI were met. Each event was thus categorized as concordant or discordant with the other CLABSI quality measure. Patients with more than 1 CLABSI identified for that admission had each event evaluated and described.

Reasons for discordance between NHSN and claims criteria were recorded and described. For events in the NHSN cohort that did not have an accompanying claims code, the categories for discordance included the following: (1) CLABSI, but line infection present at hospital admission (not hospital-associated infection); (2) positive blood culture results attributed to contamination; (3) positive blood culture results attributed to another source (secondary bloodstream infection); (4) missed coding opportunity; and (5) other. For events in the claims cohort that did not meet NHSN CLABSI criteria, the categories for discordance included the following: (1) CLABSI, but line infection present at hospital admission (not hospital-associated infection); (2) does not meet NHSN criteria and is likely attributable to contaminant; (3) positive blood culture result attributable to secondary infection; 4) no positive blood culture result and cellulitis at line site; (5) no positive blood culture result and no evidence of infection; and (6) other. In addition to describing patient CLABSI characteristics, we describe overall hospital patient population characteristics using the California hospitalization data from 2010.[22]

Analysis

For CLABSI events in each cohort, we described both patient and central line characteristics by the percentage of events with each evaluated characteristic. We also compared patient characteristics between the NHSN cohort and the claims cohort using contingency χ^2 tests. Characteristics based on median values were compared using the Wilcoxon Mann-Whitney test. Reasons for discordance were tabulated for each cohort.

RESULTS

Total patient characteristics for all 6 participating UC hospitals are found in Table 1. Description of patients present in the NHSN cohort and claims cohort are found in Table 2. For descriptive purposes, the combined base population of these 6 academic medical centers is described. There were 116,696 hospitalizations across the 6 academic medical cen-

TABLE 1. Characteristics of the Total General Inpatient Population of the 6 Participating University of California Medical Centers, 2010

Variable	No. of patients (range)	Percentage of patients (range)
Total admissions	116,696 (12,885–23,701)	100.00 (11.0–20.3)
Male sex	53,778 (5,254–11,065)	46.1 (4.5–9.5)
Age, years		
18–44	40,369 (3,516–8,363)	34.6 (3.0–7.1)
45–64	41,861 (3,366–9,196)	35.9 (2.9–7.9)
65–84	27,730 (3,133–5,894)	23.8 (2.7–5.1)
≥85	1,455 (81–492)	1.2 (0.1–0.4)
Race		
White	82,175 (9,712–18,574)	70.4 (8.3–12.9)
Black	401 (29–133)	0.3 (0.02–0.1)
Asian	10,806 (1,000–3,300)	9.3 (0.9–2.8)
Other	23,314 (1,657–6,948)	20.0 (1.4–6.0)
Comorbidity		
Diabetes	21,885 (2,292–4,993)	18.8 (2.0–4.3)
Renal disease	13,837 (1,417–2,957)	11.9 (1.2–2.5)
Liver disease	4,952 (396–1,133)	4.2 (0.3–1.0)
Cancer	16,459 (1,586–4,709)	14.1 (1.4–4.0)
AIDS	1,141 (65–494)	1.0 (0.06–0.4)
Surgical procedure[a]	44,452 (3,639–11,031)	38.1 (3.1–9.4)
Length of stay, days		
1–2	23,723 (2,405–5,810)	20.3 (2.1–5.0)
3–4	40,523 (4,506–8,418)	34.7 (3.9–7.0)
5–7	27,080 (3,255–5,808)	23.2 (2.8–5.0)
≥8	25,370 (2,439–5,606)	21.7 (2.1–4.8)
Insurer		
Commercial	39,304 (3,630–9,578)	33.7 (3.1–8.2)
Medicare	41,049 (4,351–8,617)	35.2 (3.7–7.4))
Medicaid	23,048 (1,407–5,636)	19.8 (1.2–4.8)
Other	13,295 (761–4,313)	11.4 (0.7–3.7)
Preadmission location		
Home	104,022 (12,078–20,935)	89.1 (10.3–17.9)
Other acute care hospital	6,304 (312–1,583)	5.0 (0.3–1.3)
Skilled nursing facility	1,544 (56–467)	1.3 (0.1–0.4)
Discharge disposition		
Home	83,871 (7,806–17,297)	71.9 (6.7–15.5)
Transfer to acute care hospital	1,925 (192–497)	1.6 (0.2–0.4)
Skilled nursing facility	8,093 (842–1,947)	6.9 (0.7–1.5)
Home health	664 (44–174)	0.6 (0.03–0.1)
Died	2,562 (302–537)	2.2 (0.3–0.5)

[a] Surgery during the current hospitalization.

ters in 2010. Of these, 18.8% of patients (21,885 of 116,696) were diabetic, 11.9% (13,837 of 116,696) had renal disease, and 38.1% (44,452 of 116,696) had surgery during the current hospitalization. In addition, 19.8% (23,048 of 116,696) were Medicaid patients. The median length of stay for all hospitalized patients was 4 days, compared with 39 and 29 days for the NHSN cohort and claims cohort, respectively. Compared with values for the NHSN cohort and claims cohort (Table 2), all hospitalized patients had lower values for diabetes (18.8%) and cancer (14.1%).

In the NHSN cohort, there were 150 patients with 152 CLABSIs, with 2 patients having 2 CLABSIs each (Table 2). Compared with the claims cohort, the NHSN cohort had a significantly higher proportion of hemodialysis patients with CLABSI as well as a trend toward more patients with diabetes and more patients with immunocompromise or cancer. Additionally, median length of stay and median day of culture were significantly longer for CLABSI events in the NHSN cohort than for those in the claims cohort.

In the NHSN cohort, 31 CLABSI events occurred in patients who had multiple concurrent lines (Table 3). CLABSI events were most commonly seen among peripherally inserted central catheter (PICC) lines (64.9%), which were also reported by participating hospitals to be the catheter most

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TABLE 2. Comparison of Characteristics of Patients with Central Line–Associated Bloodstream Infection (CLABSI) Events Identified by National Health and Safety Network (NHSN) and Claims Data

Variable	No. (%) of cases		P
	NHSN criteria	Claims data	
Unique patients	150	150	
Reported cases	152	150	
Patient characteristics			
Male sex	78 (51.3)	87 (58.0)	.24
Age, years			
18–44	41 (27.6)	38 (25.3)	.65
45–64	62 (40.8)	68 (45.3)	.43
65–84	39 (25.7)	37 (24.7)	.84
≥85	9 (5.9)	7 (4.7)	.63
Comorbidity			
Diabetes	44 (28.9)	31 (20.7)	.10
Hemodialysis	35 (23.0)	19 (12.7)	.02
Cancer/immunocompromise	76 (50.0)	60 (40.0)	.08
Active chemotherapy	40 (26.3)	20 (13.3)	.005
Neutropenia	35 (23.0)	18 (12.0)	.01
Bone marrow transplant	15 (10.0)	12 (8.0)	.60
Solid-organ transplant	7 (4.6)	6 (4.0)	.80
Hospital length of stay, median days (IQR)	39 (24–63)	29 (16–46)	<.001
Attributable unit for CLABSI			
ICU	60 (39.5)	57 (38.0)	.79
Non-ICU	56 (36.8)	50 (33.3)	.52
Specialty unit[a]	36 (23.7)	20 (13.3)	.02
Other[b]	0 (0.0)	23 (15.4)	<.001

NOTE. ICU, intensive care unit; IQR, interquartile range.

[a] Based upon NHSN categories; specialty units include oncology and transplant units.

[b] CLABSI event could not be confirmed by chart review, and therefore an attributable unit could not be assigned.

commonly used. Of the 152 CLABSI events in the NHSN cohort, 73.0% (111 of 152) did not have a corresponding CMS claims code for CLABSI (Table 4). The largest reasons for discordance were error in coding a documented hospital-associated line (36.2%) and poor documentation (23.7%), usually stating that the CLABSI was simply bacteremia, often without a designated source. There were 11 CLABSI events (7.2%) that were not categorized, often reflecting a lack of clear consensus between different teams (such as between an infectious disease team and primary care renal team) or there being no reason discernible to reviewers. Within the subset of 31 cases with multiple concurrent lines, 27 (87.1%) did not have a corresponding claims code. For these patients, NHSN-defined CLABSI events that did not have a corresponding claims code were increased ($P < .05$) compared with events among patients in the same cohort with a single line at the time of their CLABSI event.

In the claims cohort, there were 150 patients with 150 CLABSIs. Of the CLABSI events, 16 involved patients with multiple lines (Table 3). Similar to findings for the NHSN cohort, PICC lines were the type most commonly associated with CLABSI events. There was 65.3% discordance (98 of 150 cases; Table 4) between claims codes for CLABSI and NHSN criteria. The most common reasons for discordance were bacteremia attributable to a secondary source (22%), which was most often pneumonia or intra-abdominal abscess, or bacteremia due to contamination (14.7%). Reasons categorized under "other" had no evidence of infection present; instead, the events were attributable to symptoms such as febrility, septicemia, or a patient's response after line removal. When excluding CLABSI events that were present at hospital admission for the claims cohort, 9.3% of events (14 of 150) were still discordant as a result of meeting NHSN criteria for being present at hospital admission.

DISCUSSION

CLABSI events have become nationally important as an indicator of hospital performance, such that numerous agencies and patient advocacy groups have selected various metrics for reporting them. The use of detailed CDC-based chart review evaluation by state departments of public health, Leapfrog, and Consumers Reports is juxtaposed against the claims-based metrics used by CMS, AHRQ, and UHC.[7,9,15,17] We report substantial continued discordance (>65.3%) that remarkably exceeds the discordance expected on the basis of

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TABLE 3. Characteristics of Central Line–Associated Bloodstream Infection (CLABSI) by Type of Identification

Variable	No. (%) of CLABSIs		P
	NHSN cohort (n = 152)	Claims cohort (n = 150)	
Type of line			.43
PICC	98 (64.9)	78 (51.7)	
Central venous catheter	27 (17.9)	36 (23.8)	
Hemodialysis catheter	25 (16.6)	9 (6.0)	
Portacath	15 (9.9)	17 (11.3)	
Tunneled catheter	38 (25.2)	39 (25.8)	
Line body location			.81
Antecubital	48 (31.8)	47 (31.1)	
Internal jugular	30 (19.9)	35 (23.2)	
Subclavian	29 (19.2)	32 (21.2)	
Femoral	15 (9.9)	8 (5.3)	
Hospital day of culture, median days (IQR)[a]	18 (10–35)	9 (4–17)	.002
Line dwell time at time of culture, median days (IQR)[a]	10 (6–20)	7 (4–13)	.03
Cases with multiple lines, median no. of cases (IQR)	31 (20.5)	16 (10.7)	.02
Length of hospital stay	40 (24–73)	34 (17–50)	.92
Hospital day of blood culture[a]	19 (10–30)	9 (6–17)	.29
Line dwell time at time of culture[a]	8 (5–15)	4 (3–8)	.99

NOTE. IQR, interquartile range; PICC, peripherally inserted central catheter.
[a] Limited to those with blood culture; 21 events from the claims cohort did not have an associated bacteremia.

chance alone. This discordance between the chart-review and claims-based metrics raises concern about the reliability of these metrics, because they cause confusion for hospital administrators, hospital infection prevention programs, and the public when trying to make interinstitutional comparisons.[23] These comparisons become essential as national campaigns aim to reduce CLABSI and other HAIs to the lowest possible levels, thereby driving hospital policy and physician decision making. Despite the fact that discrepancies among chart-review and claims-based metrics have been known for well over a decade, and despite long-standing use of CLABSI reporting metrics, solutions are not forthcoming to enable the resolution of discordant measures. Among NHSN-confirmed CLABSIs, only a quarter met claims-based criteria, and among claims-based events, only a third met CDC criteria.

Common reasons for CLABSI discordance have not been previously reported. When compared with NHSN chart review criteria, claims were most commonly discordant because of coding omissions, despite physician documentation of hospital-associated line infections, or because of poor documentation in cases in which bacteremia is described without discussion of potential causes. Together these reasons accounted for more than 75% of all discrepancies in the cohort. Correction of coding omissions would account for half of all discordant cases. Nevertheless, it is possible that coding omissions were intentional, meaning that the patient's record had so many significant diagnoses for coding that CLABSI did not make the list of available coding opportunities. This is likely, because claims were more discordant with NHSN-defined CLABSI in those patients with multiple lines than in those with a single line.

In contrast, patients with claims codes for CLABSI often did not meet NHSN criteria for CLABSI because the bacteremia was attributed to either another infection or to a contaminant. This accounted for over half of all discrepancies in the cohort. Furthermore, nearly 10% of claims-based CLABSI events were incorrectly designated as hospital associated, despite the institution of the "present at hospital admission" flag. These reasons suggest that claims codes continue to lack substantial sensitivity and specificity for CLABSI because of coding omissions and inaccurate attributions of bacteremia.[18,20]

Although claims data may be interpreted as valuable in reflecting the clinical opinion of physicians, they are highly subjective and are affected by the documentation practices of physicians. With increasing nonpayment of CLABSI events by Medicare and Medicaid, there is increasing pressure for nonreporting. To ensure accurate reporting, a robust validation system must be in place to establish consistent reporting among all hospitals even with current disincentives. Although improved physician documentation is needed for any metric, interfacility comparisons should favor objective over subjective criteria to ensure consistency in reporting events.

Even with explicit criteria, current NHSN CLABSI definitions can permit variation in interrater reliability estimates.[24-26] In response, the CDC is enhancing the objective criteria for CLABSI through a series of modifications that take effect in

TABLE 4. Reasons for Discordance between National Health and Safety Network (NHSN) and Claims Data for Central Line–Associated Bloodstream Infection (CLABSI) Events

Variable	Data for CLABSI events
NHSN cohort	
Patients	150
CLABSI by NHSN criteria	152
Cases without *ICD-9* code for CLABSI	111 (73.0)
Reasons for lack of claims coding	
Coding omission	55 (36.2)
Poor documentation (bacteremia without specified cause)	36 (23.7)
Blood culture attributed to another infection	11 (7.2)
Blood culture attributed to contamination	5 (3.3)
Line infection present at admission	0 (0)
Other	11 (7.2)
Claims cohort[a]	
Unique patients	150
No. of CLABSI by claims criteria	150
Cases not reported to NHSN	98 (65.3)
Reasons for lack of NHSN reporting	
Blood culture attributed to another infection	33 (22.0)
Contaminant	22 (14.7)
CLABSI present at admission	14 (9.3)
Poor documentation[b]	13 (8.7)
No positive blood culture, cellulitis at line site	5 (3.3)
No positive blood culture, line tip positive	5 (3.3)
No positive blood culture, no symptoms	4 (2.7)
Omission (NHSN criteria met, not reported)	0 (0)
Other	17 (11.3)

NOTE. Data are no. (%) of cases, unless otherwise indicated. *ICD-9, International Classification of Diseases, 9th Revision.*

[a] CLABSI identified by *ICD-9* code 999.31 plus indicator that diagnosis was not present at admission.

[b] CLABSI event documentation by physician or infection preventionist was incomplete or vague.

January 2013. There are 3 major clarifications: HAIs are defined as events that occurred more than 2 calendar days after hospital admission, a central line is required to be indwelling for at least 2 days, and a definition is established that will separate out bloodstream events likely attributable to gut translocation in patients with neutropenia or transplant-associated disease and classify them as unlikely to be CLABSI.[27] These changes are a welcome advancement in standardizing surveillance and interhospital comparisons for CLABSI rates.

The proposal by CMS to relinquish claims-based CLABSI metrics in favor of NHSN criteria for data submission and reporting requirements is a step in the right direction toward a unified metric.[28,29] However, CMS has also recently added the CLABSI diagnosis code to the existing vascular catheter–associated infection category for its hospital-acquired condition payment policy.[28] This and other claims-based metrics still persist and are in need of reconciliation. Additional reconciliation may be needed with the conversion from *ICD-9* to the *International Classification of Diseases, 10th Revision,* by October 2013. For CLABSI, there is a one-to-one correlation for the new code (T80.211), which may lead to straightforward transition, but this would not be expected to address the issues of discordance presented above.

There are limitations to this study. The abstracted data from 6 large academic centers may not be generalizable with respect to coding practices and patient case mix. Case mix may be particularly relevant when high severity of illness produces a large number of competing diagnoses for a fixed number of diagnoses codes. Thus, hospitals with less ill patients may find that coding omission is less common. In addition, despite the use of highly experienced IPs to assess the presence of NHSN criteria, substantial interrater reliability among IPs has been described.[23]

In conclusion, despite marked increases in public reporting of CLABSIs and the addition of the "present at hospital admission" diagnosis code in California, we found 65%–75% discordance between chart-review and claims-based metrics for CLABSI. Although use of claims-based metrics is decreasing, particularly with the recent proposal by CMS to adopt NHSN reporting metrics, other public reporting systems continue to

rely on claims for CLABSI rates. Such discordance will continue to cause confusion for the public and be problematic for hospital leadership in need of reliable benchmarks.[23,26]

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REFERENCES

1. Kennedy E, Enzi M, Dingell J. *Health-Care-Associated Infections in Hospitals: Number Associated with Medical Deveices Unknown, but Experts Report Provider Practices as a Significant Factor.* Washington, DC: US Government Accountability Office, 2008.
2. Centers for Disease Control and Prevention. Public health focus: surveillance, prevention, and control of nosocomial infections. *MMWR Morb Mortal Wkly Rep* 1992;41(42):783–787.
3. Roy MC, Perl TM. Basics of surgical-site infection surveillance. *Infect Control Hosp Epidemiol* 1997;18(9):659–668.
4. Misset B, Timsit JF, Dumay MF, et al. A continuous quality-improvement program reduces nosocomial infection rates in the ICU. *Intensive Care Medicine* 2004;30(3):395–400.
5. Edwards JR, Peterson KD, Mu Y, et al. National Healthcare Safety Network (NHSN) report: data summary for 2006 through 2008, issued December 2009. *Am J Infect Control* 2009;37(10): 783–805.
6. National Healthcare Safety Network. http://www.cdc.gov/nhsn/. Accessed June 16, 2012.
7. Leapfrog Group. Importance of public reporting in reducing ICU infections: Leapfrog responds to new CDC infection report. http://www.leapfroggroup.org/policy_leadership/leapfrog_news/4805797. Accessed June 28, 2012.
8. Association for Professionals in Infection Control and Epidemiology. Hospitals appear to be heeding mandates to reduce and report preventable infections, but long-term impact still to be determined. http://www.apic.org/For-Media/News-Releases/Article?id=7dce1641-e014–4f1e-a89f-f614e055864c. Accessed June 28, 2012.
9. Consumer Reports. How we rate hospitals. http://www.consumerreports.org/health/doctors-hospitals/how-we-rate-hospitals/the-basics/the-basics.htm. Accessed June 28, 2012.
10. Horan TC, Emori TG. Definitions of key terms used in the NNIS system. *Am J Infect Control* 1997;25(2):112–116.
11. Yokoe DS, Classen D. Improving patient safety through infection control: a new healthcare imperative. *Infect Control Hosp Epidemiol* 2008;29(Suppl 1):S3–S11.
12. Stone PW, Horan TC, Shih HC, Mooney-Kane C, Larson E. Comparisons of health care-associated infections identification using two mechanisms for public reporting. *Am J Infect Control* 2007;35(3):145–149.
13. Horan TC, Lee TB. Surveillance: into the next millennium. *Am J Infect Control* 1997;25(2):73–76.
14. Stone PW, Glied SA, McNair PD, et al. CMS changes in reimbursement for HAIs: setting a research agenda. *Medical Care* 2010;48(5):433–439.
15. Agency for Healthcare Research and Quality. http://www.ahrq.gov/. Accessed June 28, 2012.
16. McDonald KM, Romano PS, Geppert J, et al. *Measures of Patient Safety Based on Hospital Administrative Data: The Patient.* Rockville, MD: Agency for Healthcare Research and Quality, 2002.
17. University HealthSystem Consortium. https://www.uhc.edu/. Accessed June 28, 2012.
18. Stevenson KB, Khan Y, Dickman J, et al. Administrative coding data, compared with CDC/NHSN criteria, are poor indicators of health care-associated infections. *Am J Infect Control* 2008; 36(3):155–164.
19. Zrelak PA, Sadeghi B, Utter GH, et al. Positive predictive value of the Agency for Healthcare Research and Quality Patient Safety Indicator for central line-related bloodstream infection ("selected infections due to medical care"). *J Healthc Qual* 2011; 33(2):29–36.
20. Sherman ER, Heydon KH, St John KH, et al. Administrative data fail to accurately identify cases of healthcare-associated infection. *Infect Control Hosp Epidemiol* 2006;27(4):332–337.
21. Platt R. Toward better benchmarking. *Infect Control Hosp Epidemiol* 2005;26(5):433–434.
22. California Office of Statewide Health Planning and Development. http://www.oshpd.ca.gov/. Accessed June 16, 2012.
23. Lin MY, Hota B, Khan YM, et al. Quality of traditional surveillance for public reporting of nosocomial bloodstream infection rates. *JAMA* 2010;304(18):2035–2041.
24. Emori TG, Edwards JR, Culver DH, et al. Accuracy of reporting nosocomial infections in intensive-care-unit patients to the National Nosocomial Infections Surveillance System: a pilot study. *Infect Control Hosp Epidemiol* 1998;19(5):308–316.
25. McBryde ES, Brett J, Russo PL, Worth LJ, Bull AL, Richards MJ. Validation of statewide surveillance system data on central line–associated bloodstream infection in intensive care units in Australia. *Infect Control Hosp Epidemiol* 2009;30(11):1045–1049.
26. Rubin MA, Mayer J, Greene T, et al. An agent-based model for evaluating surveillance methods for catheter-related bloodstream infection. *AMIA Annu Symp Proc* 2008:631–635.
27. Thompson N. Patient safety component protocol changes for 2013: update on changes to CLABSI definitions. In: *Program and abstracts of the National Health and Safety Network Members Meeting at the Association for Professionals in Infection Control and Epidemiology 2012*; San Antonio, TX; June 3, 2012.
28. Department of Health and Human Services. Medicare Program; Hospital Inpatient Prospective Payment Systems for Acute Care Hospitals and the Long-Term Care Hospital Prospective Payment System and Fiscal Year 2013 Rates; Hospitals' Resident Caps for Graduate Medical Education Payment Purposes; Qual-

ity Reporting Requirements for Specific Providers and for Ambulatory Surgical Centers. 77 Federal Register 53257 (2012). Document number 2012-19079.

29. Cardo D, Dennehy PH, Halverson P, et al. Moving toward elimination of healthcare-associated infections: a call to action. *Infect Control Hosp Epidemiol* 2010;31(11):1101–1105.