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California Hospitals' Response to State and Federal Policies Related to Health Care–Associated Infections

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Abstract

In October 2008, the Centers for Medicare and Medicaid Services (CMS) denied payment for ten selected health care–associated infections (HAI). In January 2009, California enacted mandatory reporting of infection prevention processes and HAI rates. This longitudinal mixed-methods study examined the impact of federal and state policy changes on California hospitals. Data on structures, processes, and outcomes of care were collected pre- and post-policy changes. In-depth interviews with hospital personnel were performed after policy implementation. More than 200 hospitals participated with 25 personnel interviewed. We found significant increases in adoption of and adherence to evidence-based practices and decreased HAI rates ($p < .05$). Infection preventionists (IP) spent more time on surveillance and in their offices and less time on education and in other locations ($p < .05$). Qualitative data confirmed mandatory reporting had intended and unintended consequences and highlighted the importance of technology and organizational climate in preventing infections and the changing IPs' role. This is especially relevant because the California Department of Public Health has since mandated hospitals to report data on 29 different for surgical site infections and a lawsuit has been filed to delay the implementation of these requirements.

Keywords

state legislation; patient safety; nursing/health care workforce issues; health care quality; federal legislation

Health care–associated infections (HAIs), which have been identified as nursing sensitive outcomes, are a serious public health problem in the United States and globally (Kurtzman & Corrigan, 2007). In the United States, investigators at the Centers for Disease Control and Prevention (CDC) estimated that approximately 1.7 million patients acquire HAIs in hospitals each year, about 90,000 of these infected patients are estimated to die, and the annual hospital cost of these infections is more than US\$25 billion (Klevens et al., 2007; Scott, 2009). Four categories of infections account for approximately three quarters of HAIs in the acute care hospital setting: (a) surgical site infections (SSI); (b) central line–associated bloodstream infections (CLABSI); (c) ventilator-associated pneumonia (VAP); and (d)

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catheter-associated urinary tract infections (CAUTI). Despite the high morbidity, mortality, and costs associated with HAIs, a large proportion of HAIs are preventable (CDC, 2005; Pronovost et al., 2006). Because of the magnitude of this largely preventable problem and the increasing demand for health care information by the public and consumer groups, there have been a number of state and federal policies as well as private sector initiatives that have been recently implemented to provide incentives for hospitals to invest in infection-prevention efforts.

In 2005, as part of the Deficit Reduction Act P. L. 109-171 (section 5001 [c]), the Secretary of Health and Human Services was required to identify high-cost and high-volume preventable conditions that result in higher payments. Following this directive, the Centers for Medicare and Medicaid Services (CMS) promulgated regulations commencing October 1, 2008, which denied higher Medicare payment for 10 selected preventable conditions occurring during the hospital stay and were not present on admission. Given that by their very nature, many HAIs are considered preventable, it is not surprising that 3 of the 10 hospital-acquired conditions covered by the new CMS policy involved HAIs: (a) selected SSIs; (b) vascular catheter-associated infections; and, (c) CAUTI. While this policy theoretically could reduce payment to hospitals substantially (e.g., payment for a diagnosis-related group [DRG] 89 “pneumonia with complications” is more than US\$6,000 depending on location compared to, and DRG 90 “simple pneumonia”, which is about US\$3,700) because payment would only be reduced in instances in which the preventable complication was the only factor causing the patient to be classified under a more DRG expensive and this rarely would be the case, this policy was not likely to dramatically reduce overall payments (Rosenthal, 2007). Although the hospitals’ financial incentive to improve quality was not strong with this new rule, CMS gave a clear signal to hospitals that there was a shift toward pay for performance.

Other reputational incentives to reduce HAI are occurring at state levels. In 2003, Pennsylvania and Illinois were the first states to enact requirements mandating that hospitals report HAIs and as of June, 2009, all but 14 states had some form of mandated reporting (Association for Professionals in Infection Control and Epidemiology [APIC], 2011). These requirements are not uniform across the country. In California, the state in which this study was conducted, a series of bills passed aimed at decreasing HAI rates (Senate Bills 739, 1058, and 158). In January, 2007, the Hospital Infectious Disease Control Program was established by S.B. 739, and this bill also required the Department of Health to appoint a HAI Advisory Committee to oversee the program. Beginning in January, 2009, and with oversight of the HAI Advisory Committee, S.B. 1058 and 158 mandated that each hospital join the CDC’s National Healthcare Safety Network and report the following: central line insertion practices observed in intensive care locations, hospital-wide CLABSI rates as well as rates methicillin resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Enterococcus* (VRE), and clostridium difficile infections in all inpatient locations. Furthermore, these data were made public as of January 2011.

An example of a private sector initiative aimed at decreasing HAIs is the California Healthcare-Associated Infection Prevention Initiative (CHAIP) funded by the Blue Shield of California Foundation (BSCF). In California, 49 hospitals voluntarily joined the CHAIP quality improvement collaborative. The collaborative was staffed by infection prevention leaders from the APIC and other nationally recognized organizations like the Institute for Healthcare Improvement (IHI) and the California Institute for Health Systems Performance. CHAIP began during the late fall of 2008 and continued throughout 2009 with webinars, face-to-face meetings, and sharing of best practices. In addition, CHAIP hospitals could apply for funding to help purchase an automated surveillance system with the idea that more effective prevention programs could be put in place; about a third (17/49) of the hospitals

opted to participate in this portion of CHAIFI. As part of a larger evaluation effort of the overall CHAIFI project, the purpose of this analysis is to examine the impact of the 2008–2009 federal and state policies changes on the processes and outcomes of care in California hospitals.

Method

A longitudinal mixed-methods study was conducted using both quantitative and qualitative methods. Two web-based surveys were conducted to obtain empirical data. Survey 1 was conducted prior to implementation of CMS and state mandatory reporting laws, and Survey 2 was conducted several months after implementation. Hospital site visits with in-depth open-ended interviews of various hospital personnel involved with infection prevention were conducted to obtain qualitative data. Figure 1 illustrates the research data collection timeline in relation to federal and state policy changes as well as CHAIFI. Approval of all study procedures was obtained from the Columbia University Medical Center's institutional review board.

All nonspecialty acute care facilities in California with an adult intensive care unit (ICU) were eligible to participate in the surveys. In total, 331 hospitals were eligible to participate. Survey participants were recruited by staff at APIC and Columbia University School of Nursing using a modified Dillman technique (Dillman & Smyth, 2007). One staff member from each hospital's infection prevention and control department was asked to complete a web-based survey, preferably the department director or coordinator. Emails were sent directly to hospital infection prevention and control department contacts and announcements were also included in APIC e-newsletters, whereas contacts without email addresses were sent mailed letters describing this study. As an incentive to participate, weekly lotteries were offered to participants who completed the survey.

The surveys were modified from a previously developed and psychometrically tested instrument (Furuya et al., 2011; Stone, Dick, et al., 2009). Test-retest reliability of the survey instrument has been reported with a mean kappa of .88 for each item, $SD \pm 0.024$. Criterion-referenced validity has been assessed by comparing the institutional policies and data to survey responses; no discrepancies were found. For this study, minor modifications of the survey were made and content validity was established by a panel of experts.

In the survey, respondents were queried about hospital demographics, infection prevention and control department structural characteristics, infection prevention and control department work processes, policies in place regarding specific HAI-related evidence-based processes of care, adherence to these policies at the bedside and outcomes (i.e., CLABSI, VAP, and CAUTI rates) in the largest medical or medical/surgical ICU in their hospital. Hospital demographic variables included type of setting (i.e., urban, suburban/medium town, or rural), number of beds, ICU types (medical, mixed medical/surgical, cardiothoracic, neonatal, pediatric, and other) and teaching status (yes/no). Infection prevention and control department characteristics included staffing and organization and support for the department. Staffing was defined as the number of full-time equivalent (FTE) infection preventionists (IPs) and the number of physician hospital epidemiologists per 100 beds. Organization and support for the infection control department was assessed using a modified version of the Patient Safety Climate in Healthcare Organizations (PSCHO) Instrument (Singer et al., 2007). The instrument had three sub-scales: Institutional Organization and Support (six items, $\alpha = .71$), Senior Management Engagement (five items, $\alpha = .89$), and Leadership on Patient Safety (five items, $\alpha = .92$). Each response was indicated on a 5-point Likert-type scale; higher scores represented a more positive climate.

The work processes of the infection control and prevention department were measured in several ways. Based on the average hours per week each IP devoted to the program, the respondent was asked to estimate the average percentage of time per week spent on the following activities during the past 6 months: (a) routine surveillance of infections; (b) teaching infection prevention and control policies and procedures; (c) activities related to outbreaks; (d) daily isolation issues; (e) policy development and meetings; and (f) other (e.g., product evaluation, employee health, and emergency preparedness). This categorization of activities was based on the practice analysis published by the IPs specialty certifying body (Feltovich & Fabrey, 2010). We also asked about the proportion of time IPs spent in specific locations (department/offices, inpatient units, outpatient units, long-term facilities, and other). The presence of automated surveillance technology in the department was assessed; and if present, the use of the following functions: data mining with system integrated with clinical, laboratory and/or pharmacy; automatic alerts; built-in templates to create reports and data summaries; and integration of infection data with HAI definitions and/or reporting requirements (Grota, Stone, Jordan, Pogorzelska, & Larson, 2010). Last, respondents were asked to indicate their perception of the impact of mandatory reporting on their time, influence, and resources.

Respondents were asked about the presence of a set of frequently recommended, evidence-based bundled policies related to decreasing CLABSI (four items), VAP (four items), and CAUTI (four items) in either a medical or medical/surgical ICU. In addition, we inquired about five evidence-based bundled policies relating to the prevention of SSI, which occur throughout the hospital. As having policies alone is insufficient to decrease infection rates, CLABSI, VAP, and CAUTI respondents were asked about the rate of adherence to the policies last time measured (all of the time: 95%–100%; usually: 75%–94%; sometimes: 25%–74%; rarely or never: <25%; and don't know or no monitoring). The CLABSI policies are the same processes that the California legislation mandated hospitals publicly report. To ease response burden and be consistent with a national survey we have conducted, we did not collect data on adherence to the SSI policies (Stone, Dick, et al., 2009).

The HAI outcomes measured were the ICU-specific incidence rates of CLABSI, VAP, and CAUTI recorded during the quarter prior to when the survey was administered. Because of the various different types of SSI that may manifest in many different settings both within and outside of the hospital as well as to ease response burden, we did not collect data on the SSI outcomes. Consistent with CDC NHSN definitions and reporting (Horan, Andrus & Dudeck, 2008), rates of infection for CLABSI, VAP, and CAUTI were calculated by dividing the number of infections by the number of device days, and multiplying the result by 1,000 and reported separately by ICU type.

Descriptive statistics were computed. Paired *t* tests and chi-square tests were used to compare difference between the two surveys. To examine the impact of the policies, we estimated changes over time in (a) the structure and processes of infection prevention and control departments, (b) the role of the IP, (c) the implementation and adherence to evidence-based infection prevention protocols at the bedside, and (d) HAI rates. Linear and logistic multivariate regressions with forward selection method were conducted to examine these changes overtime, controlling for hospital characteristics. All data were analyzed in SAS 9.2 software (<http://www.sas.com/>).

To obtain additional understanding of the processes related to infection prevention and control and to verify the results of our surveys, six CHAPI hospitals were visited and in-depth open-ended interviews were conducted in the summer of 2009. Hospitals were purposively sampled with the goal of reaching a broad range of different geographic regions and various sizes. Within each hospital, 3 to 6 participants with various roles related to the

provision of care in the ICU and the infection prevention and control department were interviewed to obtain a range of perspectives. These employees included IPs, hospital epidemiologists, top administrators, and nurse managers. All interviews were conducted by trained members of the research team, audiotaped, and transcribed. Transcripts were entered into NVivo 8[®] software to facilitate the coding process and content analysis was conducted.

Results

The hospital demographics and infection prevention and control department structural characteristics are displayed in Table 1. About 200 hospitals participated in both surveys ($n = 207$ and 203 , respectively; response rates = 59 and 61 , respectively). The only significant difference in hospital demographics was the types of ICUs; at Time 2, responding hospitals reported more cardiothoracic, neonatal, and other ICUs, p values all $< .05$). There were no differences in the structure of the infection prevention and control departments.

The changes in work processes of the infection prevention and control departments are summarized in Table 2; due to missing data, samples sizes vary in this table. At Time 2, it was reported that IPs spent more time on surveillance (37% vs. 41% , $p < .02$) and less time on education (11% vs. 9% , $p < .01$). In addition, it was reported that IPs spent more time in department offices (47.4% vs. 52.7% , $p = .03$) and less time in other locations (8.5% vs. 6.4% , $p = .02$). While the proportion of hospitals using automated surveillance technology did not significantly increase (23% of hospitals at Time 1 and 29% of hospitals at Time 2, $p = .17$), there were significant increased use of data mining (from 37% to 60% , $p = .02$) and automatic alert (from 58% to 87% , $p < .01$) functions.

Table 3 describes the presence and adherence to evidence-based protocols at Time 1 and Time 2. There was increased reporting of the presence the CLABSI and CUATI related evidence-based policies at Time 2, (6 of 8 p values $< .05$ and 1 policies demonstrating an important trend, $p = .07$). The presence of two other policies related to VAP (deep vein thrombosis prophylaxis and sedation vacation) and one policy related to SSI (glucose control) also increased significantly. There was increased clinician adherence to chlorhexidine use for line insertion (65% compared with 78% at Time 1 and Time 2, respectively, $p = .02$) and to barrier precautions (50% compared with 75% at Time 1 and Time 2, respectively, $p < .01$). Although there was no significant difference between Times 1 and 2, the lack of adherence to policies aimed at preventing CAUTI is notable. In addition, what is also notable is the relatively low presence of the CAUTI-related policies (Time 1 ranged from 41% to 72% , and Time 2 ranged from 75% to 88%).

Table 4 reports the ICU-specific HAI rates. In medical/surgical ICUs, there were decreased rates of CLABSI (2.3 median rate compared with 1.1 at Time 1 and Time 2, respectively, $p < .01$) and VAP (2.6 compared with 1.3 at Time 1 and Time 2, respectively, $p = .01$). There were no differences in the CAUTI rates.

In total, 23 interviews (with 25 personnel) typically lasting 1 hr were completed. Four major themes emerged from the qualitative data confirming mandatory reporting having both intended and unintended consequences as well as highlighted the importance of technology and organizational climate in the prevention of infections and reinforced the changes occurring in the IPs' role. Mandatory reporting subthemes included frustration with increased workload, frustration with current reporting requirements not addressing local HAI issues, variable HAI reporting requirements between state and federal policies, and positively an increased awareness and priority of infection prevention at the administrative level. Many of those interviewed discussed technology and commented on increased efficiency and more available time for other HAI-prevention activities. However, it was

noted that technology is not a panacea and for many, initiating technology was a frustrating process. The IP role had increased visibility and in addition to being educators, new roles as expert consultants were mentioned. Last, a positive organizational climate with shared accountability, teamwork, and effective communication structures were stressed.

Discussion

This is the first statewide study that has examined changes in infection prevention and control structures, processes, and outcomes pre- and postmandatory reporting requirements. Our results provide some evidence that the policy changes are working. There were, for example, significant increases in the presence of evidence-based practices related to CLABSI and CAUTI prevention, and both of these infections were targeted by different policy initiatives. Furthermore, it was only in the CLABSI processes (which were mandated for reporting by the state) that we found increased reports of clinician adherence. Hospitals also reported decreased CLABSI and VAP rates in medical surgical ICUs at Time 2 compared with Time 1.

Results of this study indicate that the role of the IP may be changing with more time spent on surveillance and in the office and less time on educational activities and in other settings. These findings were confirmed in the qualitative data and the trends are concerning in light of the fact use of automated technology functions increased, and such systems are designed to reduce time and enhance the efficiency of surveillance activities. However, as discovered in the qualitative data, information technology support is also needed with the increased technology, and the mandated reporting is felt to be increasing the workload of the IP. Although we did not examine the roles of other bedside clinicians, their responsibilities are also likely to be changing with the increased emphasis on performance measurement and public reporting.

Despite enthusiastic support for the public release of performance measures and extensive adoption of quality measurement and reporting, there has been little research examining the effect of these policy changes on the delivery of health care and even less research has assessed whether reporting actually improves the public's safety (McKibben, Fowler, Horan, & Brennan, 2006; Ross, Sheth, & Krumholz, 2010). In general, public reporting of institution-level performance indicators (sometimes called *report cards*) has been seen as a quality improvement tool. Clearly, the goal of both the CMS policy change and state reporting is to give incentives to hospitals to improve hospital practices and decrease HAIs. In a survey of senior hospital executives, it was reported that public reporting of hospital quality measures has helped to focus leadership and increase investments in quality-improvement activities (Laschober, Maxfield, Felt-Lisk, & Miranda, 2007). In New York, after coronary artery bypass graft (CABG) report cards became public, mortality rates from this surgery decreased and reporting was hailed as a success (Hannan, Kilburn, Racz, Shields, & Chassin, 1994). However, enthusiasm was curbed by simultaneous reports of surgeons turning away the sickest patients (Schneider & Epstein, 1996), which resulted in increased racial disparities in the provision of services (Werner & Asch, 2005; Werner, Asch, & Polsky, 2005). Others have found evidence that financial incentives led to better documentation, rather than improved quality (Petersen, Woodard, Urech, Daw, & Sookanan, 2006).

It is not yet clear what (if any) unintended consequences of public reporting of HAI may ensue. It is possible that hospitals may be less likely to admit patients at high-risk for HAI, such as those from long-term care settings. Other unintended consequences could increase resource use such as active culturing of low-risk patients on admission to identify colonized individuals or increased use of antibiotics in the absence of clinical indication. Last,

although validation efforts are underway, pressure to “look good” could motivate hospitals to underreport HAI rates (to both NHSN and in our survey) and also to overreport adherence to processes. The long-term effect of financial and reputational incentives related to HAI is unknown (Stone, 2009; Stone et al., 2010).

Legislative and regulatory policies related to HAI prevention continue to evolve. The Patient Protection and Affordable Care Act, Public Law 111-148, builds on past efforts to expand value-based purchasing and develop a “National Quality Strategy” while it reviews private sector initiatives as well as federal and state programs. Within this national framework, priorities have been established; reducing preventable infections is one of the priorities. As a first step, in the summer of 2010, CMS announced that as part of the Hospital Inpatient Quality Reporting Program, all hospitals must report ICU-specific CLABSI rates to the CDC’s NHSN beginning with January 2011 events. Although the policies examined in this study were mainly reputational incentives, this new federal policy has both financial and reputational incentives in that the results will be posted on the CMS Hospital Compare website; hospitals that do not comply with the submission will forgo a substantial percentage of their payment (2.35%). Furthermore, in the future, it was thought that these data will be used for value-based purchasing. However, in the most recent ruling by CMS released May 6, 2011 (CMS-2011-003-0322), the only measures related to HAI that have been identified for value-based purchasing are process measures in surgical patients (e.g., prophylactic antibiotic received within 1 hr prior to surgical incision).

There are a number of limitations to this study. This study was conducted in California and may not represent hospitals nationally. Data were collected through a self-report survey approach with a 59%–61% response rates for Surveys 1 and 2, respectively. The response rate is high compared with recent surveys of hospital personnel with reported response rates of 38% to 53% (Aiken et al., 2001; Stone, Larson, et al., 2009). Although we modified a psychometrically sound survey, in which we have previously had high test-retest reliability statistics, the positive changes may be due to pressure to “look good” and not actual changes in structures, processes, and outcomes. In an effort to minimize this bias, we did visit hospitals and conduct site visits. Although personnel freely discussed positive and negative issues related to mandatory reporting, no one discussed pressure or desire to misrepresent data. Indeed, one of the subthemes that emerged was frustration due to varying definitions, which implies the importance and fidelity to the definitions in reporting. Furthermore, some of the data that we received are the same type of data that are submitted to the state and will be used in the future CMS public reporting and value-based purchasing initiative. Whereas California does not have any validation efforts underway, other states with mandatory reporting do validate the data (see http://www.cdc.gov/hai/pdfs/stateplans/SIR_05_25_2010.pdf). Last, due to the potential to overburden respondents, we did not collect process and outcome data on all of the various types of HAI.

This study is important to nursing for a number of reasons. First, the majority (approximately 75%) of IPs are registered nurses (Stone, Dick, et al., 2009). Second, as bedside clinicians, staff nurses play an important role in the implementation of evidence-based policies that prevent infections (Stone, Pogorzelska, Kunches, & Hirschhorn, 2008). At this point, it is unknown how the increased emphasis on HAI actually affects the work of the bedside clinician. Third, there are many other outcomes of interest to nurses (e.g., pressure ulcers and falls), which have also been the focus of performance measurement, reporting, and value-based purchasing initiatives (Kurtzman & Corrigan, 2007). Although this study does not address these other nursing sensitive outcomes directly, the results may be generalizable to these other outcomes.

The intended consequence of reputational and financial incentives is to drive changes in organizational structures that may facilitate process change such as the development of care pathways and ultimately clinician behavior change; indeed, these changes may be occurring. However, at the same time, state legislation related to mandatory public health reporting requirements might divert scarce resources from patient care without improving infection prevention and control (i.e., unintended consequences). This is especially relevant because on May 26th 2011, the California Hospital Association and APIC have filed a lawsuit against the California Department of Public Health (CDPH) to delay the implementation of new public reporting requirements for surgical site infections (SSI) until the full rulemaking process on the implementation of SB 1058 is completed. At issue are new SSI requirements mandated by the CDPH in an All Facilities Letter No. 11-32, which stated the hospitals were required to collect and report data on 29 different surgical procedures. Further long-term evaluation of these policies in both California and other states is warranted.

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Biographies

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Figure 1.

Research and policy changes timeline

Note: CMS = Centers for Medicare & Medicaid Services, HAI = health care–associated infections

Table 1**Hospital Demographics and Infection Control and Prevention Department Structural Characteristics**

	Survey 1	Survey 2	
Hospital demographics	<i>n</i> (%)	<i>n</i> (%)	<i>p</i> value
Types of setting			
Urban	89 (43)	89 (44)	.81
Suburb/medium town	66 (32)	67 (33)	
Rural	52 (25)	45 (22)	
Missing data	—	2 (<1)	
Number of beds			
Mean	236	223	.42
Median	202	172	
ICU types			
Medical	38 (18)	41 (20)	.64
Medical/surgical	162 (78)	164 (81)	.52
Cardiothoracic	20 (9)	37 (18)	.01
Neonatal	57 (27)	74 (36)	.05
Pediatric	17 (8)	22 (11)	.37
Other	18 (9)	35 (17)	.01
Teaching hospital			
Yes	47 (23)	52 (25)	.47
Infection control and prevention department structural characteristics	Median (<i>SD</i>)	Median (<i>SD</i>)	<i>p</i> value
IP FTE per 100 beds			
<250 beds	0.69 (1.67)	0.48 (3.64)	.10
≥250 beds	0.40 (0.25)	0.43 (0.27)	.52
HE staffing per 100 beds			
<250 beds	0 (1.00)	0 (1.99)	.25
≥250 beds	0.22 (0.22)	0.24 (0.19)	.36
Organization and support			
Institutional support	3.9 (0.57)	3.9 (0.59)	.49
Senior management engagement	4.3 (0.76)	4.3 (0.74)	.67
Leadership on patient safety	3.9 (0.95)	4.1 (0.85)	.07

Note: ICU = intensive care unit, IP = infection preventionist, FTE = full-time equivalent, HE = hospital epidemiologist. Organization and Support Scale range from 1 to 5.

Table 2**Work Processes of the Infection Prevention and Control Departments**

	<u>Time 1</u>	<u>Time 2</u>	
	<u>N = 190</u>	<u>N = 193</u>	
	%	%	<i>p</i> value
Percentage of total time IPs spent on specific activities			
Routine surveillance	37	41	.02
Policy and meetings	14	12	.13
Consultations	12	11	.18
Isolation and outbreaks	12	12	.59
Education	11	9	.01
Occupational health	6	6	.42
Other	8	9	.15
Total	100	100	
Percentage of total time IPs spent in specific locations			
Department offices	47.4	52.7	.03
Inpatient	32.1	30	.30
Outpatient offices	6.2	6.5	.76
Long-term care facilities	5.6	4.6	.33
Other	8.5	6.4	.02
Total	100	100	
	<u>N = 174</u>	<u>N = 174</u>	
	<i>n</i> (%)	<i>n</i> (%)	<i>p</i> value
IP perception of impact of mandatory reporting			
Time			
More	21 (12)	23 (13)	.60
No effect	23 (13)	17 (10)	
Less	130 (75)	134 (77)	
Influence			
More	89 (51)	82 (47)	.72
No effect	71 (41)	77 (44)	
Less	13 (8)	15 (9)	
Resources			
More	54 (31)	50 (29)	.74
No effect	91 (52)	87 (50)	
Less	31 (18)	36 (21)	
	<u>N = 192</u>	<u>N = 198</u>	
	<i>n</i> (%)	<i>n</i> (%)	<i>p</i> value
AST			
AST in department	44 (23)	55 (29)	.17

	<u>Time 1</u>	<u>Time 2</u>	
	<u>N = 190</u>	<u>N = 193</u>	
	%	%	<i>p</i> value
Specific AST functions used			
Data mining	16 (37)	32 (60)	.02
Automatic alerts	25 (58)	48 (87)	<.01
Built-in templates	34 (79)	49 (91)	.10
Integration	19 (44)	30 (56)	.27

Note: IP = infection preventionist, AST = automated surveillance technology. Due to missing data, the sample sizes for each category were different.

Table 3

Presence and Adherence to Evidence-Based Policies

HAI type	Policy	Policy present		Correct implementation >95% of time			
		Time 1		Time 2		Time 1	
		n (%)	p value	n (%)	p value	n (%)	p value
CLABSI	Chlorhexidine use	142 (93)	.07	162 (98)	.07	82 (65)	108 (78)
	Barrier precautions	138 (90)	<.01	162 (98)	<.01	62 (50)	104 (75)
	Optimal site selection	130 (87)	.02	152 (95)	.02	49 (42)	59 (46)
	Daily infection check	110 (75)	<.01	145 (89)	<.01	32 (33)	35 (28)
VAP	Raising of head	125 (86)	<.01	153 (96)	<.01	42 (39)	60 (46)
	DVT prophylaxis	121 (88)	.16	147 (93)	.16	46 (45)	56 (45)
	Stomach ulcer prophylaxis	118 (87)	.27	139 (91)	.27	46 (45)	58 (49)
	Sedation vacation	115 (82)	.02	143 (91)	.02	36 (36)	42 (34)
CAUTI	Portable sonograms	38 (32)	<.01	80 (53)	<.01	5 (19)	7 (12)
	Condom catheters	37 (36)	<.01	79 (57)	<.01	1 (4)	5 (8)
	Reminder/stop order	24 (21)	<.01	72 (46)	<.01	3 (18)	6 (10)
	Discontinuation by nurses	14 (13)	.14	30 (19)	.14	3 (27)	4 (17)
SSI	Selection of prophylactic antibiotics	137 (87)	.36	137 (83)	.36	—	—
	Discontinuation of antibiotics	139 (87)	.82	150 (88)	.82	—	—
	Glucose control	61 (50)	<.01	110 (73)	<.01	—	—
	Hair removal	140 (88)	.44	155 (91)	.44	—	—
	Normothermia	82 (70)	.12	110 (79)	.12	—	—

Note: HAI = health care-associated infections, CLABSI = central line-associated bloodstream infections, VAP = ventilator-associated pneumonia, DVT = deep-vein thrombosis, CAUTI = catheter-associated urinary tract infections, SSI = surgical site infection.

Table 4

Comparison of Health Care–Associated Infections Over Time

	Time 1			Time 2			<i>p</i> value
	<i>N</i>	<i>M (SD)</i>	Median	<i>N</i>	<i>M (SD)</i>	Median	
CLABSI							
Medical ICU	19	1.9 (2.1)	1.9	16	2.3 (1.7)	2.1	.16
Medical/surgical ICU	92	2.3 (3.5)	0.9	99	1.1 (1.9)	0.0	<.01
VAP							
Medical ICU	15	1.6 (2.3)	0	14	1.4 (1.6)	0.8	.89
Medical/surgical ICU	92	2.6 (4.3)	0	94	1.3 (2.1)	0.0	.01
CAUTI							
Medical ICU	7	2.1 (3.5)	0	12	2.2 (2.9)	1.3	.42
Medical/surgical ICU	39	3.1 (3.4)	2.0	63	2.4 (3.2)	1.2	.33

Note: CLABSI = central line–associated blood stream infection, CAUTI = catheter-associated urinary tract infection, ICU = intensive care unit, VAP = ventilator-associated pneumonia. Sample sizes change based on data submitted.