

# Racial and Ethnic Disparities in Healthcare-Associated Infections in the United States, 2009–2011

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**BACKGROUND.** Little is known about racial and ethnic disparities in the occurrence of healthcare-associated infections (HAIs) in hospitalized patients.

**OBJECTIVE.** To determine whether racial/ethnic disparities exist in the rate of occurrence of HAIs captured in the Medicare Patient Safety Monitoring System (MPSMS).

**METHODS.** Chart-abstracted MPSMS data from randomly selected all-payer hospital discharges of adult patients (18 years old or above) between January 1, 2009, and December 31, 2011, for 3 common medical conditions: acute cardiovascular disease (composed of acute myocardial infarction and heart failure), pneumonia, and major surgery for 6 HAI measures (hospital-acquired antibiotic-associated *Clostridium difficile*, central line-associated bloodstream infections, postoperative pneumonia, catheter-associated urinary tract infections, hospital-acquired methicillin-resistant *Staphylococcus aureus*, and ventilator-associated pneumonia).

**RESULTS.** The study sample included 79,019 patients who had valid racial/ethnic information divided into 6 racial/ethnic groups—white non-Hispanic ( $n = 62,533$ ), black non-Hispanic ( $n = 9,693$ ), Hispanic ( $n = 4,681$ ), Asian ( $n = 1,225$ ), Native Hawaiian/Pacific Islander ( $n = 94$ ), and other ( $n = 793$ )—who were at risk for at least 1 HAI. The occurrence rate for HAIs was 1.1% for non-Hispanic white patients, 1.3% for non-Hispanic black patients, 1.5% for Hispanic patients, 1.8% for Asian patients, 1.7% for Native Hawaiian/Pacific Islander patients, and 0.70% for other patients. Compared with white patients, the age/gender/comorbidity-adjusted odds ratios of occurrence of HAIs were 1.1 (95% confidence interval [CI], 0.99–1.23), 1.3 (95% CI, 1.15–1.53), 1.4 (95% CI, 1.07–1.75), and 0.7 (95% CI, 0.40–1.12) for black, Hispanic, Asian, and a combined group of Native Hawaiian/Pacific Islander and other patients, respectively.

**CONCLUSIONS.** Among patients hospitalized with acute cardiovascular disease, pneumonia, and major surgery, Asian and Hispanic patients had significantly higher rates of HAIs than white non-Hispanic patients.

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The US Census Bureau predicts that in 30 years no individual racial or ethnic group will represent a majority of the country as a whole.<sup>1</sup> Racial and ethnic minority groups are growing at a faster rate than the total US population, resulting in a diverse population in nearly every state. Between 2000 and 2010, the Hispanic population alone accounted for more than half of the total US population growth.<sup>2</sup> Similarly, the Asian population grew at a faster rate than all other ethnic groups during this time period.<sup>3</sup> Due to the changing demographics, the frequency with which racial and ethnic minorities interact with the US healthcare system is rising.

The existence of racial and ethnic disparities in outcomes and process of care has been extensively documented,<sup>4</sup> with one study estimating excess healthcare costs of \$24 billion between 2006 and 2009 for black and Hispanic men alone.<sup>5</sup> However, there have been fewer investigations into racial and

ethnic disparities in patient safety, specifically concerning healthcare-associated infections (HAIs). In fact, others have previously noted the gap in knowledge regarding racial and ethnic disparities in HAIs.<sup>6</sup> Prior studies have been based on administrative data,<sup>7,8</sup> have assessed only a single HAI,<sup>8</sup> or have focused on patient safety events in the Medicare population,<sup>9</sup> resulting in a knowledge gap for the younger, all-payer patient population.

In this study, we measured racial and ethnic disparities in the rates of 6 HAIs included in the Medicare Patient Safety Monitoring System (MPSMS), a national chart abstraction-based longitudinal database of 21 healthcare-associated adverse event measures jointly developed by federal agencies and private healthcare organizations. Despite the name of the system, during the study period charts were taken from an all-payer sample, not only from patients covered by Medicare.

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These measures are considered relevant because they capture common and costly adverse medical events, which are thought to be frequently preventable with optimum care,<sup>10</sup> in hospitalized patients.

## METHODS

### Study Sample

Our study sample was drawn from the MPSMS<sup>10,11</sup> and was restricted to 6 HAI measures: hospital-acquired antibiotic-associated *Clostridium difficile*, central line-associated bloodstream infections (CLABSIs), postoperative pneumonia, catheter-associated urinary tract infections (CAUTIs), hospital-acquired sterile-site methicillin-resistant *Staphylococcus aureus* (MRSA), and ventilator-associated pneumonia (VAP). Due to the small number of cases, the hospital-acquired vancomycin-resistant *Enterococcus* measure was excluded from this analysis. Because both race and ethnicity information became available starting in 2009, we restricted our sample to patients discharged between January 1, 2009, and December 31, 2011, with 3 common medical conditions: acute cardiovascular disease (composed of acute myocardial infarction and heart failure), pneumonia, and major surgery as defined by the Centers for Medicare & Medicaid Services' Surgical Care Improvement Project (SCIP).<sup>12</sup> Patients with missing race or ethnicity information or patients younger than 18 years were excluded from the study sample.

### Patient Characteristics

Patient characteristics included demographics (age, gender, race, and ethnicity) and comorbidities. Race and ethnicity information was represented by 2 variables in the MPSMS data: race (white, black, Asian, American Indian/Alaska Native, and other) and ethnicity (Hispanic, non-Hispanic). Abstractors determined a patient's race and ethnicity by searching for appropriate documentation in the medical record face sheet. If the face sheet did not contain information about race/ethnicity or had conflicting documentation, abstractors searched emergency department records, history and physicals, nursing admission assessments, physician assessments, and electrocardiograms. A predetermined inclusion list for each race and ethnic group, vetted by the Agency for Healthcare Research and Quality (AHRQ) Disparities Team, informed abstractors on how to categorize patients into the 6 groups. The "other" group is composed of patients who could not be categorized into one of the 5 race and ethnicity categories or had "mixed race" documented in the medical record or face sheet. Patient comorbidities were also identified from the medical records, including history of heart failure, obesity, coronary artery disease, renal disease, cerebrovascular disease, chronic obstructive pulmonary disease, cancer, diabetes, and smoking. Using the race and ethnicity information, we classified each patient into 1 of 6 mutually exclusive categories: white non-Hispanic, black non-Hispanic, Hispanic, Asian, Native Hawaiian/Pacific Islander, and other.

## Outcomes

Our outcomes were HAI-related adverse event rates for which patients were at risk during hospitalizations. For example, for MRSA to be considered hospital acquired, the patient must not have been documented as a carrier of MRSA or have a positive culture and sensitivity for MRSA on admission and must have had a positive culture and sensitivity for MRSA obtained from a sterile site more than 2 days after arrival to the hospital. Algorithms for all these events are available online (<http://www.qualidigm.org/index.php/current-initiatives/mpsms/>).

Our primary interests were 2 composite outcomes of the 6 included infection measures used in a previous study:<sup>11</sup> (1) the rate of occurrence of HAIs for which patients were at risk and (2) the rate of patients with 1 or more HAIs. The unit of analysis was at the individual HAI level for the first outcome and the patient level for the second outcome. Not all patients were at risk for all HAIs. For example, only patients who underwent bladder catheterization were at risk for CAUTI. Furthermore, a patient might have had more than 1 HAI.

### Statistical Analysis

We fitted mixed-effects models with a logit link function to evaluate the relationship between race/ethnicity and the rate of occurrence of adverse events and the rate of patients with 1 or more adverse events. Models were fitted with state-specific random intercepts to account for within-state and between-state variations and were adjusted for patient characteristics (age, gender, and comorbidities). Due to small sample size, Native Hawaiian/Pacific Islanders were combined with other for these analyses. All models included 4 dummy variables: black non-Hispanic, Hispanic, Asian, and a combined group of Native Hawaiian/Pacific Islander and other patients, with the reference group being white non-Hispanic. Analyses were conducted using SAS (ver. 9.2). We obtained institutional review board approval through the IRB Solutions Human Investigation Committee, which waived the requirement for informed consent.

## RESULTS

The final study sample included 79,019 patients who had valid race/ethnic information and were discharged from January 1, 2009, to December 31, 2011, including 33,348 with acute cardiovascular disease, 23,368 with pneumonia, and 22,303 with major surgery as defined by SCIP.<sup>12</sup>

Table 1 shows the patient demographic data and the rates of common comorbidities identified through chart abstraction. Black patients were younger (average age, 61.3 years; SD, 16.4) and had a higher percentage of females (56.9%) than all other racial and ethnic groups. White patients were older, with an average age of 69.4 years (SD, 15.9). Asian patients had the lowest rate of obesity (10.7%) and the lowest percentage of females (49.1%). Overall, the most frequently occurring comorbidity was congestive heart failure/pulmo-

TABLE 1. Patient Characteristics by Race and Ethnicity in Patients with Healthcare-Associated Infections

Characteristic	Aggregate	White, non-Hispanic	Black, non-Hispanic	Hispanic	Asian	Native Hawaiian/ Pacific Islander	Other
Demographics	79,019 (100.0)	62,533 (79.1)	9,693 (12.3)	4,681 (5.7)	1,225 (1.6)	94 (0.1)	793 (1.0)
Age							
Mean (SD), years	68.0 (16.3)	69.4 (15.9)	61.3 (16.4)	63.5 (17.1)	68.4 (16.4)	62.5 (16.5)	62.2 (17.9)
Age group							
18–64 years	40,891 (51.8)	30,621 (49.0)	6,387 (65.9)	2,728 (58.3)	574 (46.9)	57 (60.6)	524 (66.1)
65–74 years	13,540 (17.1)	10,883 (17.4)	1,467 (10.8)	685 (14.6)	210 (17.1)	18 (19.2)	108 (13.6)
75–84 years	13,942 (17.6)	11,723 (18.8)	1,147 (11.8)	685 (14.6)	280 (22.9)	12 (12.8)	95 (12.0)
85 years and over	10,646 (13.5)	9,306 (14.9)	692 (7.1)	414 (8.8)	161 (13.1)	7 (7.5)	66 (8.3)
Gender							
Female	42,708 (54.1)	33,684 (53.9)	5,517 (56.9)	2,419 (51.7)	602 (49.1)	53 (56.4)	433 (54.6)
Condition							
Acute cardiovascular disease	33,348 (42.2)	25,700 (41.1)	4,641 (47.9)	2,082 (44.5)	595 (48.6)	55 (58.5)	275 (34.7)
Pneumonia	23,368 (29.6)	18,750 (30.0)	2,659 (27.4)	1,289 (27.5)	341 (27.8)	19 (20.2)	310 (39.1)
Surgical care	22,303 (28.2)	18,083 (28.9)	2,393 (24.7)	1,310 (28.0)	289 (23.6)	20 (21.3)	208 (26.2)
Comorbidities							
Cancer	15,324 (19.4)	12,989 (20.8)	1,450 (15.0)	577 (12.3)	192 (15.7)	16 (17.0)	100 (12.6)
Diabetes	28,138 (35.6)	20,730 (33.2)	4,195 (43.3)	2,280 (48.7)	552 (45.1)	47 (50.0)	334 (42.1)
Obesity	18,503 (23.4)	14,195 (22.7)	2,729 (28.2)	1,210 (25.9)	131 (10.7)	36 (38.3)	202 (25.5)
Cerebrovascular disease	13,070 (16.5)	10,424 (16.7)	1,693 (17.5)	655 (14.0)	204 (16.7)	13 (13.8)	81 (10.2)
CHF/pulmonary edema	33,006 (41.2)	25,608 (41.0)	4,674 (48.2)	1,877 (40.1)	521 (42.5)	56 (59.6)	270 (34.1)
COPD	24,694 (31.3)	20,647 (33.0)	2,621 (27.0)	997 (21.3)	223 (18.2)	22 (23.4)	184 (23.2)
Smoking	18,930 (24.0)	14,643 (23.4)	2,944 (30.4)	927 (19.8)	177 (14.5)	15 (16.0)	224 (28.3)
Renal disease	20,795 (26.3)	15,685 (25.1)	3,173 (32.7)	1,284 (27.4)	412 (33.6)	46 (48.9)	195 (24.6)

NOTE. Data are no. (%), unless otherwise indicated. CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; SD, standard deviation.

nary edema (41.2%), followed by diabetes (35.6%) and chronic obstructive pulmonary disease (31.3%).

Table 2 shows the observed HAI rates among the 6 racial and ethnic categories. The highest aggregate infection rate was for VAP (11.0%), and the lowest aggregate infection rate was for sterile-site MRSA (0.1%). These rates pertain only to the patient population at risk for the event, which varies for each type of HAI; for example, almost all patients were at risk for MRSA, and only a relatively small fraction were at risk for VAP. Among those at risk, the rate of VAP was the highest of the 6 infection measures for all racial/ethnic groups, with the exception of Native Hawaiian/Pacific Islander and other, for which CAUTI rates were the highest. The rate of at-risk patients who developed at least 1 HAI during the hospital stay was highest for Asian and Hispanic patients at 3.8% and 3.3%, respectively. This was followed by black, white, and other patients, who had rates of 2.6%, 2.6%, and 1.8%, respectively. Similarly, the occurrence rate of HAI was 1.1% for non-Hispanic white patients, 1.3% for non-Hispanic black patients, 1.5% for Hispanic patients, 1.8% for Asian patients, 1.7% for Native Hawaiian/Pacific Islander patients, and 0.7% for other patients.

The above pattern of observed rates does not change substantially after adjustment for patient age, gender, and comorbidities. Compared with white non-Hispanic patients, the adjusted odds ratios of occurrence of HAIs were 1.1 (95% confidence interval [CI], 0.99–1.23) for black patients, 1.3

(95% CI, 1.15–1.53) for Hispanic patients, 1.4 (95% CI, 1.07–1.75) for Asian patients, and 0.7 (95% CI, 0.40–1.12) for Native Hawaiian/Pacific Islander and other patients combined (Figure 1A). The adjusted odds ratios for at least 1 HAI followed the same pattern as the adjusted odds ratios of occurrence rates of HAIs (Figure 1B).

## DISCUSSION

We studied more than 79,000 patients admitted to the hospital with acute cardiovascular disease, pneumonia, or major surgery as defined by SCIP—which represent approximately 26% of all Medicare hospitalizations<sup>11</sup>—to define risk-adjusted racial and ethnic disparities in HAIs. For these conditions, compared with non-Hispanic white patients, Hispanic and Asian patients had higher rates of HAIs, which remained statistically significant after adjustment for baseline patient characteristics and comorbidities. Black patients had slightly higher rates of HAI than non-Hispanic whites, but the difference was not statistically significant. However, review of the unadjusted HAI rates (Table 2) demonstrates that the higher overall HAI rate in Hispanics was in large part due to higher rates of CAUTI and VAP in these patients. Asian patients had higher rates of *C. difficile*, CLABSI, and CAUTI than white patients. Also of interest is that approximately half of the MPSMS-measured HAIs were CAUTIs. The MPSMS definition of CAUTI (<http://www.qualidigm.org/index.php/current-initiatives/mpsms/>)

TABLE 2. Impact of Race and Ethnic Characteristics on Specific Healthcare-Associated Infection Measures

Measure	Aggregate (n = 79,019)	White, non-Hispanic (n = 62,533)	Black, non-Hispanic (n = 9,693)	Hispanic (n = 4,681)	Asian (n = 1,225)	Native Hawaiian/ Pacific Islander (n = 94)	Other (n = 793)
Hospital-acquired antibiotic-associated <i>Clostridium difficile</i>	291/59,900 (0.5)	224/47,980 (0.5)	37/6,885 (0.5)	18/3,476 (0.5)	10/874 (1.1)	0/64 (0.0)	2/621 (0.3)
CLABSIs	76/5,800 (1.3)	55/4,449 (1.2)	13/785 (1.7)	4/382 (1.1)	3/130 (2.3)	0/10 (0.0)	1/44 (2.3)
Catheter-associated UTIs	1,221/36,027 (3.4)	924/28,950 (3.2)	166/4,111 (4.0)	92/2,024 (4.6)	28/561 (5.0)	3/42 (7.1)	8/339 (2.4)
Hospital-acquired sterile-site MRSA	51/76,833 (0.1)	32/76,833 (0.1)	11/9,450 (0.1)	5/4,557 (0.1)	3/1,194 (0.3)	0/93 (0.0)	0/776 (0.0)
Postoperative pneumonia	518/22,803 (2.3)	415/18,456 (2.3)	60/2,453 (2.5)	32/1,351 (2.4)	7/310 (2.3)	1/22 (4.6)	3/211 (1.4)
Ventilator-associated pneumonia	171/1,552 (11.0)	118/1,109 (10.6)	25/255 (9.8)	24/130 (18.5)	4/39 (10.3)	0/3 (0.0)	0/16 (0.0)
Aggregate	2,328/202,915 (1.2)	1,768/161,707 (1.1)	312/23,939 (1.3)	175/11,920 (1.5)	55/3,108 (1.8)	4/234 (1.7)	14/2,007 (0.7)

NOTE. CLABSI, central line-associated bloodstream infection; MRSA, methicillin-resistant *Staphylococcus aureus*; UTI, urinary tract infection.

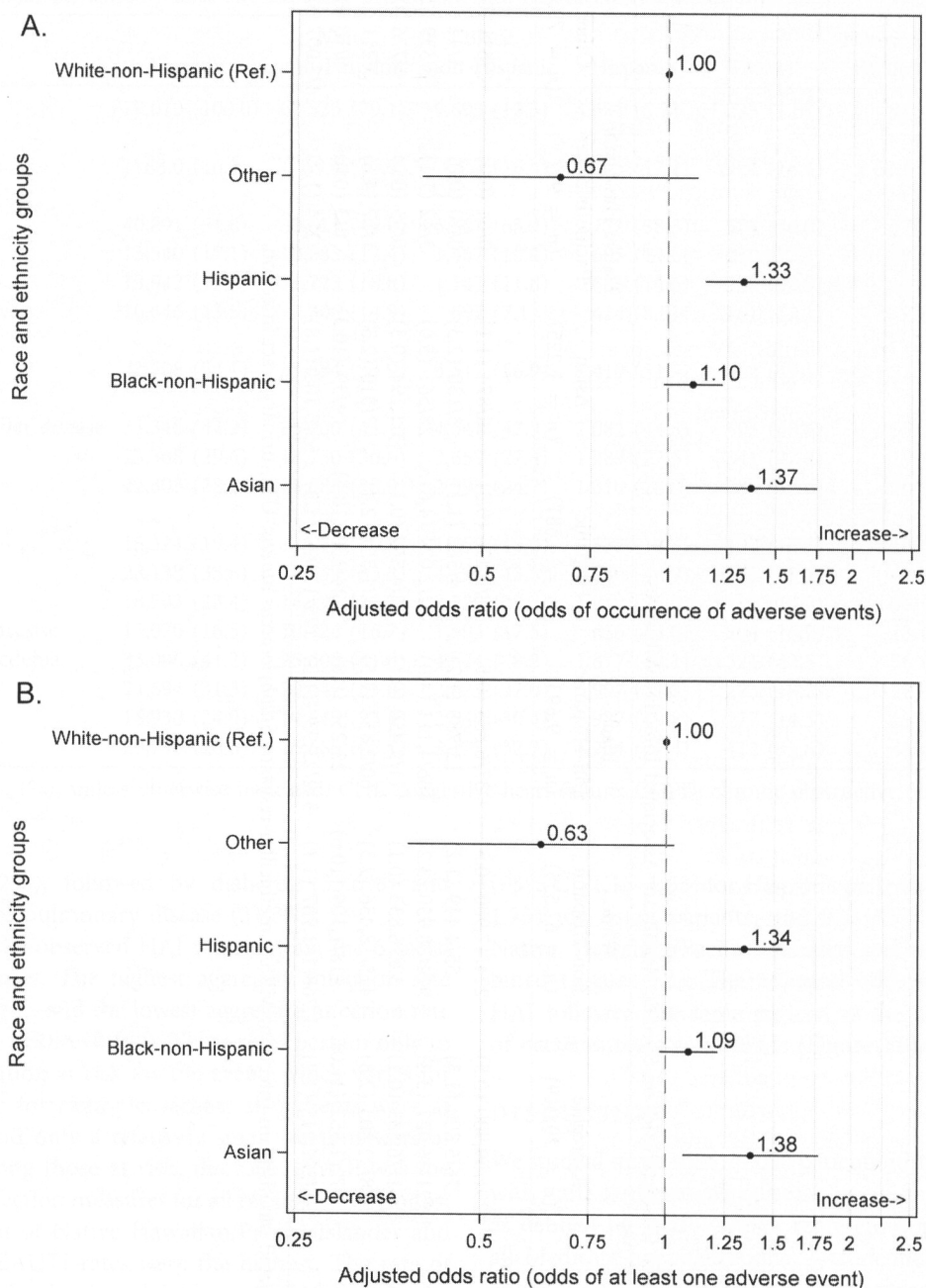


FIGURE 1. Adjusted odds ratios for the occurrence of healthcare-associated infections (A) and at least 1 healthcare-associated infection (B) by race and ethnicity.

depends primarily on the treating physician diagnosing and treating a UTI after an inpatient has received a urinary catheter and is more sensitive than the widely used National Healthcare Safety Network definition.<sup>13</sup> Conversely, the MPSMS definition of MRSA is very specific and includes only infections in normally sterile sites, such as blood or spinal fluid.

While there is extensive literature on racial and ethnic disparities in medical treatment and outcomes,<sup>4</sup> the literature on racial and ethnic disparities in patient safety is sparser, and

there are limited data on racial and ethnic disparities in HAIs. Studies using the claims-based AHRQ patient safety indicators<sup>14</sup> have demonstrated higher rates of postoperative sepsis in blacks and Hispanics<sup>7,8</sup> and in Asians.<sup>7</sup> Freedberg et al<sup>15</sup> found a higher risk of recurrent *C. difficile* infection in black patients, while Murphy et al<sup>16</sup> found that race and ethnicity predicted a risk of postdischarge *C. difficile* but not hospital-onset *C. difficile*. Klevens et al<sup>17</sup> found an almost doubled risk of hospital-acquired MRSA in blacks compared with whites. In a multicenter study of more than 17,000 patients, Dick et al<sup>18</sup>

found that both black and white patients had similar rates of CLABSI and VAP. Race and ethnicity had not previously been thought to be a significant risk factor for CAUTI.<sup>19</sup>

Several factors contribute to disparities in healthcare processes and outcomes, including language barriers, unconscious bias, and the more frequent use of lower-quality healthcare facilities by minorities.<sup>4</sup> There is much evidence that the direct and indirect effects of economic and educational disparities play an important role.<sup>4</sup> For this reason, our findings of a greater risk of HAIs in Hispanic and Asian patients compared with black patients were somewhat surprising. Nationally, both Asians and Hispanics have significantly higher mean household incomes and educational attainment than blacks, with Asians having a higher mean household income and educational attainment than non-Hispanic whites.<sup>20,21</sup> Therefore, economic and educational disparities are unlikely to be the major explanation for our findings. However, both Hispanics and Asians have much lower rates of English proficiency than blacks and non-Hispanic whites.<sup>22</sup> Our finding of higher risk-adjusted national HAI rates in Hispanic and Asian patients suggests that language barriers may play an important role in the occurrence of HAIs. Poor communication between healthcare providers and patients could result in increased HAI rates, either directly or indirectly.<sup>23</sup> For example, ineffective communication could result in patients manipulating indwelling devices in a manner that could increase the risk of infection or result in prolonged hospital stays for unrelated reasons, which could also increase length of exposure to risk for HAIs. Limited English proficiency is known to be a risk factor for adverse events in hospitalized patients,<sup>24</sup> but we found no studies that specifically examine the role of language barriers in HAIs. Although the use of a professional interpreter is recommended whenever communicating with patients with limited English proficiency, this recommendation is frequently not adhered to.<sup>25</sup> Our findings, therefore, provide a potential opportunity for improving HAI rates that has previously received little attention.

Our study has some limitations that warrant discussion. Although we reliably abstract race and ethnicity information from a patient's chart, the accuracy of this documentation is unknown. For example, a nonresponsive patient would be unable to provide information about their race or ethnicity, thereby leaving that determination up to the admitting clinician and introducing an opportunity for error. We used a composite rate of HAIs, encompassing 6 different infections. As there are many factors that contribute to the development of HAIs and these differ among the specific infections, our use of a composite rate may have obscured important racial and ethnic differences in relation to specific infection types. The total number of several individual HAI types was small, so comparisons based on the 6 types of individual HAI rates must be made with caution. Finally, our data set includes only hospital admissions for acute cardiovascular disease, pneumonia, and major surgery as defined by SCIP, so the results are not representative of all-cause admissions.

Our study has strengths worth highlighting. First, it was

based on a very large patient sample derived from randomly selected hospital admissions across the country<sup>11</sup> and thus provides a more complete picture than similar studies based on a limited number of hospitals or a limited geographic region. Furthermore, unlike other data sets, such as the National Healthcare Safety Network,<sup>13</sup> our data were obtained from chart abstraction, thereby avoiding the potential bias associated with self-reported data.

In summary, we have shown that in a large national sample of patients hospitalized for acute myocardial infarction, heart failure, pneumonia, and conditions requiring surgery, Hispanic and Asian patients had higher risk-adjusted rates of HAIs than whites. There was a nonsignificant trend toward an increased risk among black patients. The primary cause for the differences seen was elevated CAUTI rates. The higher HAI rates in Asian and Hispanic patients suggest the possibility that language barriers between patients and healthcare providers could contribute to the occurrence of HAIs, either directly or indirectly. Improved availability and more frequent use of professional translation services might be a new opportunity for intervention to lower HAI rates. Our finding of higher CAUTI rates in Hispanic and Asian patients in particular warrants further investigation as to the specific causes.

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