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Prevalence of methicillin-resistant *Staphylococcus aureus* and *Acinetobacter baumannii* in a long-term acute care facility

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Abstract

Background—Patients in long-term acute care (LTAC) facilities often have many known risk factors for acquisition of antibiotic-resistant bacteria. However, the prevalence of resistance in these facilities has not been well described.

Methods—We performed a single-day, point-prevalence study of a 180-bed, university-affiliated LTAC facility in Baltimore to assess the prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) and *Acinetobacter baumannii* in the anterior nares, perirectal area, sputum, and wounds.

Results—Among the 147 patients evaluated, we found a high prevalence of colonization by both MRSA (28%) and *A. baumannii* (30%). Of the *A. baumannii* isolates, 90% were susceptible to imipenem and 92% were susceptible to ampicillin-sulbactam. No isolates were resistant to both imipenem and ampicillin-sulbactam.

Conclusion—The high prevalence of resistance found in this study supports the need for increased surveillance of patients in the LTAC environment. The fact that these patients are often frequently transferred to tertiary care facilities also supports the need for coordination and collaboration among facilities within the same health care system and the broader geographic area.

Long-term acute care (LTAC) facilities are an increasingly popular health care segment in the United States.¹ These facilities are characterized by patient populations with high acuity levels, preexisting comorbid illnesses, long lengths of stay, and frequent readmissions to acute care tertiary facilities. Therefore, these patients have many known risk factors for the acquisition and development of antibiotic-resistant infections; however, there have been but a few reports on antibiotic resistance in LTAC facilities.^{2,3} The present study estimated the prevalence of the important nosocomial pathogens methicillin-resistant *Staphylococcus aureus* (MRSA) and *Acinetobacter baumannii* among patients in a university-affiliated LTAC facility.

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METHODS

Study population and data collection

This study was approved by the University of Maryland Baltimore's Institutional Review Board. On December 20, 2005, we completed a point prevalence study of a 180-bed, university-affiliated LTAC facility in Baltimore as part of an ongoing quality improvement and infection control initiative within the University of Maryland Medical System. During the study period, the facility did not use active surveillance for any organism. Patients with positive clinical cultures for MRSA, vancomycin-resistant enterococci, or multiresistant gram-negative bacteria, as well as patients known to be positive from previous admissions, were placed on contact isolation precaution, with gloves and gowns required for all health care worker contacts.

Study personnel collected anterior nares and perirectal cultures from all patients in the facility. Anterior nares cultures were collected by dipping a culturette swab (Bactiswab; Remel Co, Lenexa, KS) into the gel base of the holder to premoisten it, then inserting the swab in each nostril and rolling it approximately 5 times against the nares. Perirectal swabs also were premoistened from the base of the holder before collection and rolled approximately 5 times around the rectal area. Sputum cultures were obtained from patients on mechanical ventilation by attaching a sputum trap to the suction tubing before collection. Wounds were cultured from all patients requiring dressing changes on the study date by rolling a similarly pre-moistened swab approximately 5 times across the wound. Descriptive data were collected from patients residing in the facility on the study date using an electronic database containing administrative, laboratory, and pharmaceutical data. This database has been used for numerous epidemiologic studies, and previous validation has suggested that the positive and negative predictive values of these data exceed 99%.²⁻⁴ Comorbid conditions were defined based on the *International Classification of Diseases, Ninth Revision*.⁵

Microbiological methods

Perirectal, wound, and sputum cultures were assayed for the presence of MRSA and *A baumannii*. Anterior nares cultures were assayed only for MRSA. Analysis for MRSA was done as reported previously.^{2,3} In brief, swabs were plated on tryptic soy agar with 5% sheep's blood. Colonies morphologically consistent with *S aureus* were confirmed by positive catalase and Murex Staphaurex (Remel Co) reactions. MRSA was identified by growth on Mueller-Hinton agar with 4% NaCl and 6 µg/mL of oxacillin. To assess for *A baumannii*, culture swabs were plated on MacConkey agar. Oxidase-negative colonies, which are morphologically consistent with *A baumannii*, were then confirmed using an API 20NE kit (bioMérieux, Hazelwood, MO). *A baumannii* antibiotic susceptibility was evaluated by disk diffusion.

Statistical analyses

Data were assembled in a Microsoft Access database (Microsoft Co, Redmond, WA) and analyzed using SAS statistical software, version 9.1.3 (SAS Institute, Cary, NC). The prevalence of colonization was calculated as the proportion of patients colonized at any site with each organism. The sensitivity of culturing each individual site in detecting colonization also was assessed. These analyses used the presence of colonization at any site as the gold standard.

RESULTS

There were 147 patients in the facility on the study date. Characteristics of the study population are given in Table 1. The mean age was 52 years, and 61% of the population was male. The median length of stay was 91 days, and the median duration from the date of admission to the study date was 33 days. Diabetes mellitus, heart failure, and renal disease were the most

prevalent comorbid conditions, at 25%, 20%, and 19%, respectively. Some 55% of the patients had been admitted to the affiliated tertiary care facility in the year preceding the index admission to the study facility, and 42% had been admitted during the year after the index admission date.

Both anterior nares and perirectal cultures were obtained in all 147 patients. In addition, sputum cultures were collected from 39 patients (27%), wound cultures were collected from 31 patients (21%), and both sputum and wound cultures were collected from 35 patients (24%).

The prevalence of MRSA at any site was 30%, and that of *A baumannii* was 28% (Table 2); 2 patients were colonized with both organisms. Among the culture sites, anterior nares cultures were the most sensitive in identifying colonization with MRSA (86%); 9 patients were colonized at multiple sites. Although sputum cultures were collected only from approximately half of the patients in the facility, they were the most sensitive for identifying colonization with *A baumannii* (68%); 5 patients were colonized with *A baumannii* at multiple sites.

Among the 41 patients colonized with *A baumannii*, susceptibility to ampicillin-sulbactam, amikacin, imipenem, and trimethoprim-sulfamethoxazole was 93%, 80%, 90%, and 30%, respectively (Table 3). No isolates were resistant to both imipenem and ampicillin-sulbactam. Interestingly, the prevalence of resistance to trimethoprim-sulfamethoxazole and pi-peracillin-tazobactam in the perirectal isolates was approximately twice that of isolates from either sputum or wounds.

DISCUSSION

Our data suggest a high prevalence of MRSA and *A baumannii* during a single-day point-prevalence study at an LTAC. The prevalence of MRSA far exceeded that in patients admitted to the general medical and surgical wards, medical and surgical intensive care units, and correctional health unit of the affiliated university hospital (7%, 6%, and 13%, respectively).^{2,3,6} The proportion of *A baumannii* isolates resistant to commonly used antibiotics was low, notwithstanding several recent reports of increasing resistance to these agents.^{7,8}

We observed that perirectal *A baumannii* isolates appeared have a higher prevalence of resistance to certain antibiotics compared with isolates from other anatomic sites. Our ability to further explore this association is limited by our small sample size, but if this association were true, it could have important implications for how surveillance culture data should influence empiric therapy in patients with suspected endogenous *A baumannii* infections. However, previous studies have suggested that most *A baumannii* infections are not endogenous, but rather the result of patient-to-patient transmission.⁹

To the best of our knowledge, there have been only 2 previous reports on antibiotic resistance in LTAC patients,^{7,10} both of which described a high prevalence of resistance. Gould et al,¹⁰ analyzing data from 45 LTAC facilities, found that a markedly higher prevalence of antibiotic resistance in clinical cultures from these facilities compared with cultures from medical intensive care units reporting to the Centers for Disease Control and Prevention's National Nosocomial Infection Surveillance System. But the facilities evaluated in that study were considerably smaller than our facility (median, 24 beds; range, 7 to 43 beds). Furthermore, only 1 of the facilities included in that study performed active surveillance culturing (on admission), and then only in those patients with no history of MRSA or vancomycin-resistant enterococci colonization or infection at the referring hospital. These differences hinder our ability to compare our findings with this earlier report.

Stephens et al³ described an outbreak with molecular analysis of multidrug-resistant *A baumannii* at a 40-bed LTAC located within the confines of a larger acute care hospital in 2003

to 2004. An isolate was defined as multidrug-resistant if it was sensitive to fewer than 4 antibiotics. Similar to our study, the most common clinical sites were the respiratory tract and wounds. Although the outbreak occurred in both the LTAC facility and the associated acute care hospital, the incidence of multidrug-resistant *A baumannii* was much higher in the LTAC facility than in the acute care hospital (3.99 vs 1.54 per 1000 patient days). Furthermore, the authors noted that despite a high prevalence of multidrug resistance, all multidrug-resistant isolates were susceptible to imipenem, compared with the 90% susceptibility observed in our study.

The frequent transfer of these patients to the affiliated acute care setting, combined with the high prevalence of resistance, has important implications for infection control. Mathematical models have suggested that individual facilities play an important role in outbreaks and overall prevalence within a geographic area, underscoring the need for close collaboration among facilities.^{11,12} This collaboration is paramount because priorities and infection control resources often vary widely between acute care and long-term care settings, and efforts should be made to increase the frequency with which infection control data are transferred with patients between facilities.¹³

A limitation of the present study is that the data were not initially collected for research purposes. Thus, data on the association between colonization status and patient characteristics and outcomes, as well as on additional antibiotic susceptibilities of MRSA isolates, were not available. We also were limited by the fact that wound cultures may not have been collected from all patients with wounds, but only from those who needed dressing changes on the date of the study.

Because this was a single-day, point-prevalence study at 1 LTAC facility, our data should be interpreted with discretion. But the high prevalence of both organisms in the absence of an outbreak, as well as the consistency of our data with that of previous studies, suggest that our findings are representative of the true prevalence in this type of facility. The high prevalence of these organisms in a patient population that requires frequent readmission to affiliated tertiary care facilities supports the need for dedicated infection control resources in LTAC facilities, along with coordination and collaboration between the facilities in which these patients receive care.

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Table 1

Characteristics of the study population

Characteristic	n (%)
Age, years, mean (SD)	52 (18)
Male sex	90 (61)
Length of stay, days, median (IQR)	
Total	91 (47 to 164)
Before study date	33 (11 to 91)
Admissions to affiliated tertiary facility *	
Year before admission to the index facility	
0	67 (46)
1	44 (30)
≥ 2	36 (25)
Year after admission to the index facility	
0	86 (59)
1	38 (26)
≥ 2	23 (16)
In-hospital mortality	11 (8)
Comorbidities	
Myocardial infarction	4 (3)
Heart failure	29 (20)
Cerebrovascular disease	13 (9)
Malignancy	10 (7)
HIV/AIDS	2 (1)
Diabetes mellitus	36 (25)
Liver disease	2 (1)
Renal disease	28 (19)

IQR, interquartile range; *SD*, standard deviation.

* Percentages do not sum to 100 because of rounding.

Table 2

Prevalence of MRSA and *A baumannii* and sensitivity of surveillance cultures at each site

Organism	Prevalence at any site	Sensitivity by culture site		
		Anterior nares	Perirectal	Sputum Wound
MRSA	30%	86%	5%	23% 7%
<i>A baumannii</i>	28%	Not tested	22%	68% 22%

Table 3Antibiotic susceptibilities of *A baumannii* isolates by site of isolation

Site	Susceptibility, n (%)					
	Ampicillin-sulbactam	Trimethoprim-sulfamethoxazole	Imipenem	Amikacin	Ciprofloxacin	Piperacillin-tazobactam
Perirectal (n = 9)	9 (100)	2 (22)	9 (100)	7 (78)	0 (0)	3 (33)
Sputum (n = 10)	10 (100)	0 (0)	10 (100)	9 (90)	0 (0)	3 (30)
Wound (n = 32)	28 (88)	13 (41)	27 (84)	27 (84)	0 (0)	25 (78)
Total (n = 51)	47 (92)	15 (30)	46 (90)	43 (84)	0 (0)	31 (61)