Nursing Homes as Reservoirs of MRSA: Myth or Reality?
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Objective: To determine the prevalence and risk factors associated with methicillin-resistant Staphylococcus aureus (MRSA) colonization among residents of a long-term care facility (LTCF) and to investigate the association of prior antibiotics use and MRSA colonization.

Design: Cross-sectional analysis.

Setting: A large, 320-bed suburban long-term care facility in New York.

Participants: A representative sample of 160 nursing home residents.

Measurements: We obtained nasal swabs to screen for MRSA colonization and reviewed the medical charts for clinical and demographic data.

Results: A total of 160 residents participated. MRSA colonization was identified in 44 residents (27.5%). Only 5 variables were statistically significantly associated with MRSA colonization, namely race, renal insufficiency, increased use of antibiotics, prior MRSA infection during the previous year, and prior hospitalization within 3 years. Sharing a room with a MRSA carrier did not increase the risk for colonization.

Conclusion: This study found a large reservoir of MRSA within this LTCF population. Nursing home residents with renal insufficiency, prior MRSA infection, prior hospitalization, and higher use of antibiotics were found to be at risk for MRSA colonization. These findings demonstrate that LTCFs need to be proactive in implementing appropriate antibiotics restriction practices and should give high priority to the development of more effective infection control policies. (J Am Med Dir Assoc 2009; 10: 414–418)

Keywords: Long-term care facilities; methicillin-resistant Staphylococcus aureus; colonization; antibiotics; infection control

Currently, more than 1.4 million individuals are permanent residents in long-term care facilities (LTCFs) in the United States; this figure is expected to reach 5.3 million by 2030.1,2 Most LTCF residents are elderly and highly vulnerable to infections. Indeed, infections have been implicated in 63% of deaths occurring in nursing homes and are the cause of 49% of transfers from nursing homes to acute care hospitals.3

Resistant pathogens represent a major concern in every type of health care facility. Methicillin-resistant Staphylococcus aureus (MRSA) is one of the most problematic pathogens in nursing homes and a major cause of nosocomial infections in acute care hospitals.4 MRSA infections place a heavy burden on the US health care system, causing 12,000 hospitalizations annually and increasing the cost of care by more than $3.4 billion each year.5

The very first case of MRSA in the United States, detected in 1967, was tracked to a nursing home resident.6 Since then, outbreaks of MRSA infections have been reported mainly in acute care hospitals. Recently, such outbreaks have been reported in several nursing homes in Europe, demonstrating the potential for MRSA epidemics in LTCFs.7 The epidemiology of MRSA infections in US nursing homes has reportedly been changing in recent years, with an increase in the number of MRSA bacteremia cases reported.8

There is a lack of consensus regarding the value of screening nursing home residents for MRSA colonization in the nonoutbreak setting. Because limited financial resources prevent regular surveillance cultures in all nursing home residents, many cases of MRSA colonization may remain unrecognized. Earlier studies showed that in most nursing home residents, MRSA colonization tends to persist for several years or indefinitely.9,10 Asymptomatic individuals colonized with MRSA have been shown to have a much higher risk for subsequent MRSA infections than those who were not colonized; they may experience as much as a 10-fold increase in the rate of infections.11,12 MRSA colonization has also been associated with higher mortality in nursing...
home residents with impaired cognitive status. Most subsequent MRSA infections result from auto-infection by the same strain of Staphylococcus aureus that colonized the individual initially. Most patients colonized with MRSA usually acquire it by contact. In addition to that mode of transmission, lately there has been an increasing focus on the role of antibiotics. It has become clear that the frequent use of antibiotics, which is a common practice in nursing homes, provides a selective advantage for the growth of resistant organisms and plays a critical role in the presence of MRSA. In fact, the risk for MRSA colonization has been shown to correlate with the frequency and duration of prior antibiotic therapy.

This study was designed to determine the prevalence of MRSA colonization among the residents of a large suburban long-term care facility in New York and identify risk factors for colonization with this organism, and evaluate the association with prior antibiotic use. This information will be helpful in guiding the development of effective infection control policies in such facilities and might help to guide empiric therapy in case of serious illness, as failure to cover resistant pathogens is associated with increased mortality.

METHODS

The study was conducted in a 320-bed skilled LTCF, located in Queens, New York. The facility is adjacent to a tertiary care hospital. The 2 facilities are located in separate buildings and do not share any staff members.

The LTCF is divided into 8 units located on 4 different floors. On admission, residents are randomly assigned to one of these units. Residents who are known to be colonized with MRSA are not segregated from the other residents, but universal precautions with use of gloves for every patient contact and handwashing after patient care are followed routinely throughout the facility. Each resident is assigned to a single- or double-occupancy room according to the family's request and room availability.

A subacute rehabilitation facility is also located in the LTCF building, but limited to an area that is separate from the LTCF units. Rehabilitation patients were not recruited for this study.

Study Participants

All the residents living in the LTCF during the 30-day period of the study were eligible to participate in the study, except those who were receiving antibiotics at that time or had a history of bleeding diathesis. Before starting the study, the research protocol was approved by the institutional review board and written informed consent was obtained from the residents who were capable of understanding the consent form or from the health care proxy or next of kin if they were unable to understand the consent form, as determined by a primary care physician.

Microbiology

Specimens were obtained from both nares of each resident using a single Culturette swab (BBL, CultureSwab, Becton Dickinson, Inc., Franklin Lakes, NJ). The swabs were transported in a culture transport system to the microbiology laboratory, where they were streaked on agar plates and incubated at 35°C for 24 hours. Colonies suggestive of Staphylococcus species were tested for catalase activity, then underwent latex agglutination testing (BBL Staphylotest Latex Test Kit; Becton Dickinson, Inc.). Isolates identified as Staphylococcus aureus were then suspended into a tube containing 2 mL of Trypticase Soy Broth. A 10-μL aliquot of the suspension was inoculated onto an oxacillin screen agar plate (BBL Oxacillin Screen Agar, Becton Dickinson, Inc.) and incubated at 35°C. Each plate was checked for growth after 24 hours. Any colonies detected at that time were considered positive for MRSA.

Data Collection

The medical charts of all participants were reviewed for clinical data, laboratory values, and prior antibiotic therapy. Additional medical information and data regarding antibiotic use were obtained from pharmacy records, hospitalization records, and the patients' previous primary care physician.

Statistics

Basic descriptive statistics, such as frequencies and cross-tabs were used to describe the study population. The chi-square test was used to detect differences in individual factors among groups. The Student t test was used to compare means between groups.

RESULTS

Among the 320 people living in this LTCF, we selected randomly 192 residents from the 8 LTCF units. Sixteen of these residents refused to participate in the study and family members of another 16 residents declined participation in the study.

Among the 160 residents tested, 44 (27.5%) were found to be colonized with MRSA. The prevalence of MRSA colonization in each unit was between 18.8% and 35.7% (P = .88). In addition, there was no geographic clustering of colonized residents in any section of the units.

Demographic data, time since admission to the LTCF, and residence in a single- versus double-occupancy room did not have a significant effect on the risk for MRSA colonization (Table 1).

Time since last hospitalization did not influence the prevalence of MRSA colonization significantly, although residents who had been admitted to a hospital for any reason during the 3 years preceding enrollment were significantly more likely to be colonized with MRSA compared with those who had not been hospitalized during the same period of time (P < .05).

Renal insufficiency also increased the risk for MRSA colonization significantly, with a mean serum creatinine level of 1.5 mg/mL in the MRSA-colonized residents group compared with 1.0 mg/mL in the noncolonized group (P = .001).

MRSA colonization occurred more frequently in Asian (55%) and less frequently in African American residents (9%) compared with white residents (27.9%) (P = .03).
Six study participants had been diagnosed with a prior MRSA infection during the 12 months preceding this study. One individual experienced 5 separate infections. Four of these 6 residents (66.6%) remained colonized with MRSA after resolution of their infection \((P < .01)\).

Several clinical parameters—including body mass index, urinary or fecal incontinence, anemia, hypoalbuminemia, long-term steroid therapy—did not correlate with MRSA colonization. Residents with a gastric tube were not at higher risk for MRSA colonization.

Although not statistically significant, presence of a Foley catheter was more frequent among the MRSA-colonized residents compared with the noncolonized group (9% versus 3%; \(P = .14)\). Despite a trend toward an increased risk of colonization among residents with diabetes (40.9% versus 28.4%; \(P = .13)\), chronic lung disease (22.7% versus 12.1%; \(P = .09)\), or cancer (20.9% versus 11.4%; \(P = .12)\), none of these associations was significant.

Antibiotic use appears to have a great influence on MRSA colonization among the residents tested (Table 2). Altogether, 77.7% of the study participants received at least one course of antibiotic treatment during the year preceding the study. However, the MRSA-positive population received 2.83 courses (range: 0 to 11) compared with 1.67 courses (range: 0 to 6) for the MRSA-negative group \((P = .001)\). The difference in mean duration of antibiotic therapy during the 12 months preceding this study, 24.4 days (range 0 to 91 days) in the MRSA-positive group compared with 13.6 days (range 0 to 65 days) in the MRSA-negative group, was also statistically significant \((P = .007)\).

However, treatment with antibiotics during the 4 weeks preceding this study did not have a statistically significant effect on MRSA colonization (21.4% versus 20.6%; \(P = .91)\).

**DISCUSSION**

With a prevalence of 27.5%, this study found a large reservoir of MRSA within this LTCF population. Although subjects were tested only for nasal colonization, mainly because it was the least invasive and most acceptable way for the patients and their families, other sites, such as wounds, axillary areas, gastrostomy tubes, or tracheostomy are a potential source of MRSA in previous reports.16–19 However, 65% to 84% of those colonized at those sites were also nasal carriers. Thus, our results may underestimate the true prevalence by limiting our screening to the nose, particularly among residents with an indwelling device.

We found no evidence that MRSA is transmitted between roommates. This suggests that the use of private rooms for MRSA carriers may be of little value for limiting the spread of MRSA among LTCF residents. This conclusion is supported by recent reports from nursing homes, but stands in contrast to studies from acute-care hospitals, where proximity to a MRSA-colonized patient is a major risk factor for spread.

It was recently reported for the first time that African Americans and Latinos may have a lower risk for MRSA colonization.23 Our data support this finding, as African American residents of our LTCF had a remarkably lower MRSA colonization rate compared with white and Asian residents. The reason for the differences in racial susceptibility to MRSA observed in that study remains unclear.
families for their participation in this study.

ACKNOWLEDGMENTS

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REFERENCES


Table 2. Antibiotic Use in MRSA-Colonized and Noncolonized Nursing Home Residents: Number of Courses of Antibiotic Therapy Received during 6- and 12-Month Periods Preceding the Study

<table>
<thead>
<tr>
<th>Variable</th>
<th>MRSA-Colonized Residents (n = 44)</th>
<th>Noncolonized Residents (n = 116)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of courses of antibiotics in past year</td>
<td>2.83</td>
<td>1.67</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Number of courses of antibiotics in past 6 months</td>
<td>1.47</td>
<td>0.80</td>
<td>.002</td>
</tr>
<tr>
<td>Number of days antibiotics were taken during past year, mean</td>
<td>24.47</td>
<td>13.69</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Number of days antibiotics were taken during past 6 months, mean</td>
<td>12.61</td>
<td>6.62</td>
<td>.002</td>
</tr>
</tbody>
</table>

MRSA, methicillin-resistant Staphylococcus aureus.