Epidemiology of *Staphylococcus aureus* Blood and Skin and Soft Tissue Infections in the US Military Health System, 2005-2010

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Context Rates of hospital-onset methicillin-resistant *Staphylococcus aureus* (MRSA) infections are reported as decreasing, but recent rates of community-onset *S aureus* infections are less known.

Objectives To characterize the overall and annual incidence rates of community-onset and hospital-onset *S aureus* bacteremia and skin and soft tissue infections (SSTIs) in a national health care system and to evaluate trends in the incidence rates of *S aureus* bacteremia and SSTIs and the proportion due to MRSA.

Design, Setting, and Participants Observational study of all Department of Defense TRICARE beneficiaries from January 2005 through December 2010. Medical record databases were used to identify and classify all annual first-positive *S aureus* blood and wound or abscess cultures as methicillin-susceptible *S aureus* or MRSA, and as community-onset or hospital-onset infections (isolates collected >3 days after hospital admission).

Main Outcome Measures Unadjusted incidence rates per 100 000 person-years of observation, the proportion of infections that was due to MRSA, and annual trends for 2005 through 2010 (examined using the Spearman rank correlation test or the Mantel-Haenszel χ² test for linear trend).

Results During 56 million person-years (nonactive duty: 47 million person-years; active duty: 9 million person-years), there were 2643 blood and 80 281 wound or abscess annual first-positive *S aureus* cultures. Annual incidence rates varied from 3.6 to 6.0 per 100 000 person-years for *S aureus* bacteremia and 122.7 to 168.9 per 100 000 person-years for *S aureus* SSTIs. The annual incidence rates for community-onset MRSA bacteremia decreased from 1.7 per 100 000 person-years (95% CI, 1.5-2.0 per 100 000 person-years) in 2005 to 1.2 per 100 000 person-years (95% CI, 0.9-1.4 per 100 000 person-years) in 2010 (P=.005 for trend). The annual incidence rates for hospital-onset MRSA bacteremia also decreased from 0.7 per 100 000 person-years (95% CI, 0.6-0.9 per 100 000 person-years) in 2005 to 0.4 per 100 000 person-years (95% CI, 0.3-0.5 per 100 000 person-years) in 2010 (P=.005 for trend). Concurrently, the proportion of community-onset SSTI due to MRSA peaked at 62% in 2006 before decreasing annually to 52% in 2010 (P<.001 for trend).

Conclusion In the Department of Defense population consisting of men and women of all ages from across the United States, the rates of both community-onset and hospital-onset MRSA bacteremia decreased in parallel, while the proportion of community-onset SSTIs due to MRSA has more recently declined.

JAMA. 2012;308(1):50-59

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However, recent studies have shown encouraging decreases in the rates of health care–associated and hospital-onset invasive MRSA infections and MRSA central line–associated infections.4,12

Most previously published studies on community-onset MRSA infections and SSTIs did not present data on methicillin-susceptible S aureus (MSSA) SSTI, evaluated 1 city or local region, or were not able to simultaneously evaluate temporal changes in both the community and hospital settings. The latter consideration is important given that (1) data suggest community-onset infections due to the USA300 strain have become an increasingly important reservoir for MRSA disease overall,13 and (2) rates of health care–associated MRSA infections may be decreasing .4,12 Therefore, more recent population-based data on the burden of S aureus disease in the community are needed. This study sought to characterize the concurrent epidemiology of S aureus (MRSA and MSSA) bacteremia and SSTIs from 2005 through 2010 in the community and hospital settings in a large population composed of individuals of all ages from all regions of the United States, using information from an integrated health care network, the US Military Health System.

METHODS

Study Population

The surveillance population included all Department of Defense TRICARE beneficiaries who were eligible to receive care at a military medical treatment facility (MTF) from January 2005 through December 2010. TRICARE beneficiaries were defined as active duty members, retirees, medically eligible guard or reservists, and immediate family members of active duty members, retirees, and medically eligible guard or reservists. The Department of Defense TRICARE network is composed of 266 MTFs of varied sizes and services (predominantly primary care clinics and smaller, community-type hospitals) throughout the United States and limited locations overseas. Veterans Affairs institutions are not included. Additional information on the study population, TRICARE regions, and MTFs is provided in the eMethods at http://www.jama.com. This study involving deidentified data was approved and determined to be nonhuman subjects research by the institutional review board at the San Antonio Military Medical Center.

Data Collection

Within the Department of Defense health care system, all microbiology laboratory data are recorded electronically into each MTF’s Composite Health Care System. These passive surveillance data have been stored in the Composite Health Care System in the health level 7 format by the Department of Defense beginning on January 1, 2005, and used for analysis and public health surveillance purposes by the EpiData Center Department, Navy and Marine Corps Public Health Center. All microbiologically positive blood (including coagulase-negative staphylococci) and wound or abscess cultures from January 1, 2005, through December 31, 2010, were identified from health level 7 microbiology data. Culture results without microbiological growth are not captured in health level 7 data. Clinical data from each infection, including patient outcomes, were not available.

From all positive S aureus blood and wound or abscess cultures, only unique S aureus isolates, defined as the first isolate per patient per calendar year for each specimen source (blood, wound, or abscess), were included for further analysis. The number of individuals in the beneficiary population and demographic characteristics were obtained from the Military Health System Mart database. Data regarding self-reported race or ethnicity were not available for analysis.

Definitions

S aureus isolates were categorized into 1 of 2 groups according to susceptibility results for oxacillin, cefoxitin, cefazolin, and imipenen: (1) MRSA: isolates resistant to at least 1 of the listed antibiotics, or (2) MSSA: isolates sensitive to all of the above listed antibiotics that were tested.14 Community-onset infections were defined as (1) isolates collected in ambulatory clinics or emergency departments, or (2) inpatient isolates collected within the first 3 calendar days of hospital admission. Hospital-onset infections were defined as inpatient isolates collected more than 3 calendar days after admission similar to previous studies.5,15 The classification of infections as health care–associated community onset” was not used because information on health care exposures other than hospital admission was not available.

Statistical Analyses

Characteristics of the study population and S aureus cultures were summarized with descriptive statistics. Proportions were compared with χ² tests. Unadjusted incidence rates were used to describe the burden of S aureus bacteremia and SSTIs in the Department of Defense TRICARE beneficiary population per 100 000 person-years of observation overall and by year. The mid-year beneficiary population identified in a given calendar year was used as an estimate of the person-years for that period. Ninety-five percent confidence intervals for the unadjusted incidence rates were calculated using a normal approximation.16 We also calculated overall and annual incidence rates standardized to US population data for 2000 and adjusted for age and sex using the direct method, but because standardization and adjustment had little effect on these rates, we are primarily reporting the unadjusted rates.

To determine the relationship between infection rates and calendar year, as well as the direction and strength of the association, the Spearman rank correlation test and coefficient (r) were used. The Mantel-Haenszel χ² test for linear trend was used to examine trends in the proportion of infections due to S aureus or MRSA over the 6-year study period. Active duty service members encounter unique exposures affecting S aureus infection risk. Therefore, subanalyses were performed for active duty and nonactive duty beneficiaries. In all analyses, P values were 2-sided with values of less than .05 considered statistically significant. No adjustment was
made for multiple comparisons. All statistical analyses were performed using SAS version 9.2 (SAS Institute Inc).

RESULTS

Demographic characteristics of the overall study population remained similar from 2005 through 2010 (Table 1). Nonactive duty individuals were distributed among age and sex categories, while active duty beneficiaries were predominantly 18 to 44 years of age and male (eTable 1 and eTable 2 at http://www.jama.com). From 2005 through 2010, there were a total of 62,326 person-years. In the first year of observation (2005), 52% of individuals in the study population were men and 84% were nonactive duty.

There were 2643 blood and 80,281 wound or abscess annual first-positive S aureus cultures and 181,317 positive wound or abscess cultures in the Department of Defense Military Health System (Table 2). S aureus was isolated from 12% of all blood cultures and 62% of all wound or abscess cultures. The percentage of all blood and wound or abscess cultures due to S aureus and MRSA significantly decreased from 2005 through 2010 (P < .001 for trend). During this same time, more than 9.2 million people were eligible to receive care within the Department of Defense health care system each year, providing more than 56 million person-years of observation (nonactive duty: 47 million person-years; active duty: 9 million person-years). In the first year of observation (2005), 52% of individuals in the study population were men and 84% were nonactive duty.

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Community-Onset S aureus Bacteremia and SSTIs. Unadjusted rates significantly decreased for both community-onset MRSA and MSSA bacteremia from 2005 through 2010 from 1.7 per 100,000 person-years (95% CI, 1.5-2.0 per 100,000 person-years) to 1.2 per 100,000 person-years (95% CI, 0.9-1.4 per 100,000 person-years) for community-onset MRSA (r = .94; P = .005 for trend), and from 2.9 per 100,000 person-years (95% CI, 2.5-3.2 per 100,000 person-years) to 1.7 per 100,000 person-years (95% CI, 1.5-2.0 per 100,000 person-years) for community-onset MSSA (r = .94; P = .005 for trend; Table 3). During this same period, no significant overall trend was observed in the rate of community-onset MRSA (r = .26; P = .62) or MSSA SSTIs (r = .71; P = .11). In subanalyses of community-onset S aureus bacteremia and SSTIs in nonactive duty individuals, results were similar showing that the annual unadjusted rates of community-onset MRSA (P < .001) and community-onset MSSA bacteremia (P = .005) decreased significantly from 2005 through 2010, and no significant overall trends in the rates of community-onset MRSA (P = .62) or community-onset MSSA SSTIs (P = .54) were observed (Table 4). Overall and an-
Annual rates of *S aureus* bacteremia and SSTIs for active duty individuals are provided in eTable 3. In the entire study population, rates of community-onset *S aureus* bacteremia varied by demographic characteristics (Table 5). The rate of community-onset MRSA bacteremia was highest for those aged 65 years or older (4.5 per 100 000 person-years [95% CI, 3.8-5.2 per 100 000 person-years]) and aged 65 years or older (3.4 per 100 000 person-years [95% CI, 3.1-3.8 per 100 000 person-years]). The rates of community-onset bacteremia also were higher in men (MRSA: 1.8 per 100 000 person-years [95% CI, 1.7-2.0 per 100 000 person-years]; MSSA: 2.7 per 100 000 person-years [95% CI, 2.5-2.9 per 100 000 person-years]) than in women (MRSA: 1.1 per 100 000 person-years [95% CI, 0.9-1.2 per 100 000 person-years]; MSSA: 1.9 per 100 000 person-years [95% CI, 1.7-2.0 per 100 000 person-years]). Rates of bacteremia appeared similar among the 3 TRICARE regions in the continental United States.
For community-onset *S. aureus* SSTIs, rates of both community-onset MRSA (257.6-264.8 per 100 000 person-years [95% CI, 253.6-268.8 per 100 000 person-years]) and community-onset MSSA (142.4 per 100 000 person-years [95% CI, 139.8-145.1 per 100 000 person-years]) were highest in those aged 18 to 24 years (Table 5). As with bacteremia,

### Table 4. *Staphylococcus aureus* Infections by Setting, Culture Type, and Methicillin Resistance for Nonactive Duty Study Subpopulation

<table>
<thead>
<tr>
<th>Year</th>
<th>Bacteremia</th>
<th>SSTIs</th>
<th>Bacteremia</th>
<th>SSTIs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
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<td>2009</td>
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<tr>
<td>2010</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Abbreviations: MRSA, methicillin-resistant *Staphylococcus aureus*; MSSA, methicillin-susceptible *S. aureus*; rs, Spearman rank correlation coefficient; SSTIs, skin and soft tissue infections.

### Table 5. Community-Onset *Staphylococcus aureus* Infections for Overall Study Population

<table>
<thead>
<tr>
<th>Age group, y</th>
<th>Person-Years</th>
<th>Bacteremia</th>
<th>SSTIs</th>
<th>Bacteremia</th>
<th>SSTIs</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤4</td>
<td>2 378 465</td>
<td>1.0 (0.7-1.3)</td>
<td>112.2 (108.7-115.6)</td>
<td>4.5 (3.8-5.2)</td>
<td>87.2 (84.1-90.3)</td>
</tr>
<tr>
<td>5-14</td>
<td>6 536 589</td>
<td>0.2 (0.1-0.4)</td>
<td>40.8 (39.3-42.3)</td>
<td>1.3 (1.1-1.6)</td>
<td>48.2 (46.5-49.9)</td>
</tr>
<tr>
<td>15-17</td>
<td>2 156 319</td>
<td>0.2 (0.0-0.4)</td>
<td>70.4 (66.9-73.9)</td>
<td>0.7 (0.4-1.1)</td>
<td>57.0 (53.8-60.1)</td>
</tr>
<tr>
<td>18-24</td>
<td>7 719 143</td>
<td>1.6 (1.3-1.9)</td>
<td>261.2 (257.6-264.8)</td>
<td>1.4 (1.2-1.7)</td>
<td>142.4 (139.8-145.1)</td>
</tr>
<tr>
<td>25-34</td>
<td>6 478 229</td>
<td>0.9 (0.7-1.2)</td>
<td>143.0 (140.1-145.9)</td>
<td>1.4 (1.1-1.7)</td>
<td>99.0 (96.6-101.4)</td>
</tr>
<tr>
<td>35-44</td>
<td>5 636 860</td>
<td>0.6 (0.4-0.8)</td>
<td>70.0 (67.9-72.2)</td>
<td>1.4 (1.1-1.7)</td>
<td>59.9 (57.9-61.9)</td>
</tr>
<tr>
<td>45-64</td>
<td>13 025 242</td>
<td>1.5 (1.2-1.7)</td>
<td>30.0 (29.0-30.9)</td>
<td>2.6 (2.5-3.1)</td>
<td>29.4 (28.4-30.3)</td>
</tr>
<tr>
<td>≥65</td>
<td>11 137 620</td>
<td>3.1 (2.8-3.5)</td>
<td>10.2 (9.6-10.8)</td>
<td>3.4 (3.1-3.8)</td>
<td>11.0 (10.4-11.7)</td>
</tr>
</tbody>
</table>

Sex

- Male: 28 851 430
- Female: 27 134 948

Beneficiary status

- Active duty: 8 818 911
- Nonactive duty: 47 934 159

TRICARE region

- Overseas: 2 675 863
- United States: 18 133 805

Abbreviations: MRSA, methicillin-resistant *S. aureus*; MSSA, methicillin-susceptible *S. aureus*; SSTIs, skin and soft tissue infections.

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men had higher rates of community-onset MRSA and community-onset MSSA SSTIs than women. However, unlike bacteremia, active duty members had higher rates of community-onset MRSA SSTIs (280.6 per 100 000 person-years [95% CI, 277.1-284.1 per 100 000 person-years]) and community-onset MSSA SSTIs (165.8 per 100 000 person-years [95% CI, 163.1-168.4 per 100 000 person-years]) than nonactive duty individuals (community-onset MRSA SSTIs: 46.0 per 100 000 person-years [95% CI, 45.3-46.6 per 100 000 person-years]; community-onset MSSA SSTIs: 39.4 per 100 000 person-years [95% CI, 38.9-39.9 per 100 000 person-years]). Within the continental United States, the highest rates of community-onset MRSA SSTIs (106.9 per 100 000 person-years [95% CI, 105.4-108.4 per 100 000 person-years]) and community-onset MSSA SSTIs (62.5 per 100 000 person-years [95% CI, 61.4-63.7 per 100 000 person-years]) were seen in the TRICARE region in the South United States. Unadjusted rates of community-onset bacteremia and SSTIs by demographic characteristics for the nonactive duty and active duty subgroups are provided in eTable 4 and eTable 5 at http://www.jama.com.

Hospital-Onset S aureus Bacteremia and SSTIs. For hospital-onset S aureus infections, a significant overall trend in the annual rate of infections was seen for hospital-onset MRSA bacteremia (P = .04; Table 3) and hospital-onset MRSA SSTIs (P = .02 for trend). In subanalyses of nonactive duty individuals, only hospital-onset MRSA bacteremia decreased significantly from 2005 through 2010 (P = .09). For comparison with hospital-onset SSTIs, the P value was less than .001 (both calculated using the χ² test).

Percentage of S aureus Bacteremia and SSTIs That Were MRSA

Fifty-eight percent of community-onset S aureus SSTIs were due to MRSA, significantly higher than for either community-onset bacteremia (39%; P < .001) or hospital-onset SSTIs (53%; P = .02; Figure 1). Fifty-four percent of cases of hospital-onset bacteremia were due to MRSA (P < .001 vs community-onset bacteremia). The proportion of community-onset S aureus SSTIs due to MRSA was 60% in 2005, increased to 62% in 2006, and then decreased each year to a low of 52% in 2010 (P < .001 for trend from 2005-2010; Figure 1). Significant trends were not observed for community-onset bacteremia, hospital-onset bacteremia, or hospital-onset SSTIs (Figure 2). In subanalyses of active duty and nonactive duty individuals, the annual rate reductions observed for hospital-onset SSTIs (Figure 2) were also in both groups the proportion of community-onset SSTIs caused by MRSA decreased significantly from 2005 through 2010 (Figure 3).

COMMENT

There are several notable findings from this study examining the epidemiology of S aureus bacteremia and SSTIs. Similar to recent reports by the Centers for Disease Control and Prevention, the rates of hospital-onset MRSA bacteremia significantly decreased. We found that rates of both community-onset and hospital-onset MRSA bacteremia decreased in parallel. This may be due to an overall decline in health care-associated MRSA bacteremia rather than a decline in true community-associated MRSA bacteremia, because we were unable to subclassify community-onset infections as health care-associated community onset. The annual rates of community-onset MSSA bacteremia also decreased significantly. However, the proportions of both community-onset and hospital-onset S aureus bacteremia due to MRSA did not change significantly, suggesting balanced decreases in the rates of both MRSA and MSSA bacteremia.

For community-onset MSSA SSTIs, no significant overall trend in annual rates was observed, but the proportion of community-onset SSTIs due to MRSA declined significantly. While this may represent the replacement of MRSA with MSSA as a cause of community-onset SSTIs, rates of community-onset MSSA SSTIs did not significantly increase during the study. However, the annual rate reductions observed for community-onset MRSA SSTIs after 2008 appeared qualitatively greater than that for community-onset MSSA SSTIs, thereby explaining the increasing percentage of MSSA.

One recent study limited to patients with human immunodeficiency virus in Atlanta, Georgia, and 2 preliminary investigations (1 from Chicago, Illinois, and 1 from Atlanta) have also reported that rates of community-onset MRSA SSTIs may have peaked in 2007 or 2008. Therefore, our results for community-onset and hospital-onset S aureus bacteremia and SSTIs in a large geographically diverse population are consistent with the reported changes in hospital-onset MRSA infections from other national investigations, provide new data regarding trends in MSSA bac-
Several epidemiological investigations reporting rates of \textit{S} \textit{aureus} bacteremia and SSTIs prior to 2005 described marked increases in the burden of \textit{S} \textit{aureus} infections, particularly those due to MRSA. Regional population-based studies of \textit{S} \textit{aureus} bacteremia reported stable incidence of \textit{S} \textit{aureus} bacteremia overall, but an increasing proportion of cases due to MRSA.

Similarly, Hersh et al\textsuperscript{21} reported an increase in coded SSTI encounters from 32.1 to 48.1 per 1000 population from 1997 to 2005 coincident with the emergence of MRSA SSTIs. The first of a national scope to demonstrate that regional trends in community-onset MRSA SSTIs\textsuperscript{18,19} may reflect widespread alterations in the epidemiology of community-onset \textit{S} \textit{aureus} SSTIs across the United States.

\textbf{Figure 2.} \textit{Staphylococcus aureus} Bacteremia and Skin and Soft Tissue Infections by Onset Setting, 2005-2010

\begin{figure}
\centering
\includegraphics[width=0.75\textwidth]{figure2}
\caption{Staphylococcus aureus Bacteremia and Skin and Soft Tissue Infections by Onset Setting, 2005-2010}
\end{figure}

Error bars indicate 95% confidence intervals; MRSA, methicillin-resistant \textit{S} \textit{aureus}. The \textit{P} values were calculated using Mantel-Haenszel $\chi^2$ for linear trend for 2005-2010.

\textbf{Figure 3.} Community-Onset Methicillin-Resistant \textit{Staphylococcus aureus} (MRSA) Skin and Soft Tissue Infection (SSTI) Isolates, 2005-2010

\begin{figure}
\centering
\includegraphics[width=0.75\textwidth]{figure3}
\caption{Community-Onset Methicillin-Resistant \textit{Staphylococcus aureus} (MRSA) Skin and Soft Tissue Infection (SSTI) Isolates, 2005-2010}
\end{figure}

Error bars represent 95% confidence intervals. The \textit{P} values were calculated using Mantel-Haenszel $\chi^2$ for linear trend for 2005-2010.
gernce of community-associated MRSA. Crum et al 3 reported an increase in MRSA infections from military facilities in San Diego, California, between 1990 and 2004, with the greatest increase in rates occurring between 2002 and 2004. In an investigation describing community-associated MRSA epidemiology from 2001 through 2002, the annual incidence was 26 per 100,000 person-years, of which 77% of infections were SSTIs. 2 This incidence rate is lower than the 46 per 100,000 person-years observed in the current study for SSTIs in nonactive duty beneficiaries, but this may be due to the inability to separate health care–associated community-onset infections from community-associated infections in the current study, as well as different study populations and periods of observation.

The current study also found that the highest rates of community-onset S. aureus bacteremia occurred in those at extremes of age (the very young and the elderly), whereas community-onset S. aureus SSTI rates were greatest in adults aged 18 through 24 years, men, those serving on active duty, and living in the southern United States. While these observations are in agreement with prior studies, 9,10,13,20,22 additional analyses are needed to determine if these characteristics are independent risk factors. The geographic distribution of community-onset SSTI rates may reflect both the influence of climate on SSTIs and the primary locations of military training, where rates of SSTIs are known to be high. 23

Previous studies have also used different methods to estimate the national trends in health care–associated S. aureus infections, using the International Classification of Diseases, Ninth Revision (ICD-9) codes, to estimate the proportion of infections due to MRSA because there is no MRSA-specific ICD-9 code. 22,23 The current study used documented culture results to assess the trends in hospital-onset S. aureus bacteremia and SSTIs. While the observed decrease in the annual rates of hospital-onset MRSA bacteremia from the current study is consistent with trends reported by Kallen et al 12 and Burton et al, 11 the rates in the Department of Defense population were approximately one-tenth of the rates reported by Kallen et al 12 (eg, for 2008, 0.5 per 100,000 person-years vs 6.2 per 100,000 person-years, respectively). Unlike the network of large centers from nonrural counties used in the Centers for Disease Control and Prevention report by Kallen et al, 12 the Department of Defense health care population is seen at MTFs of varied sizes in urban, semirural, and rural settings. Additionally, individuals within the TRICARE population seen at MTFs have lower rates of comorbid medical conditions, which are associated with increased S. aureus bacteremia risk compared with those seen at an urban tertiary care center, including chronic kidney disease requiring hemodialysis and intravenous drug use. 4,20

Most TRICARE beneficiaries also receive open access to care at US MTFs and a reliable income either while on active duty or following retirement. Such factors may mitigate socioeconomic differences that have been associated with increased risk of MRSA infections. 13 Findings from other studies have suggested health outcomes within the Department of Defense health care system may be different than other settings. 25,26 In addition, the overall age of the current study population may also have reduced rates of S. aureus bacteremia because rates of S. aureus bacteremia are substantially higher with increasing age. 9,20

In addition to the large size and broad geographic distribution represented by the study population, a unique strength of the current study was the ability to evaluate the epidemiology of hospital-onset and community-onset S. aureus bacteremia and SSTIs simultaneously. The lines between the hospital and community settings have become less distinct in recent years. Whether the changes in S. aureus epidemiology overall were driven by changes within either the hospital or community settings, or both, remains uncertain. Improved infection-control practices may be affecting rates of both hospital-onset and health care–acquired community-onset MRSA bacteremia. 3,27

Subsequently, one possibility is that reducing hospital-onset and health care–associated community-onset infections may have an effect on other community-onset S. aureus infections. Conversely, studies have shown community-onset MRSA infections, particularly SSTIs, may provide a substantial reservoir of disease, and USA300 strains from the community have become causes of nosocomial infections. 20,13 Regardless of the etiology, the concurrent decreases in the rates of hospital-onset and community-onset MRSA bacteremia, coupled with the reduced prevalence of MRSA as a cause of community-onset S. aureus SSTIs, are intriguing observations that require further investigation.

Historically large changes in S. aureus epidemiology and the strains responsible for disease have occurred. 28 For example, phage type 80/81 MRSA strains almost completely disappeared in the 1960s without explanation after causing widespread disease in the 1950s. 28 Recent investigations have reported longitudinal changes in the strains responsible for nosocomial or invasive MRSA infections, 29,31 but similar data for SSTIs or infections due to MSSA since 2008 are lacking.

There are limitations to this observational study. First, data prior to January 1, 2005, were not available for analysis to evaluate trends in S. aureus bacteremia or SSTIs since the emergence of community-acquired MRSA. Second, clinical information allowing classification of SSTIs as surgical site infections, cutaneous abscesses, or cellulitis was not available. Wound or abscess culture results were also not categorized by tissue site, although skin and skin structure–related infections are the most common manifestation of community-onset MRSA disease. 13 Third, data regarding self-reported race and ethnicity, and clinical outcomes, including mortality, also were not available. Fourth, due to constraints of the

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available data, it was not possible to perform modeling of the rates at the person level, adjusting for covariates or sensitivity analyses. Fifth, some TRICARE beneficiaries (predominantly retirees and their dependents) may obtain care at nonmilitary facilities. Subsequently, the rates of S. aureus bacteremia and SSTIs we observed likely underestimate the true burden of disease within this patient population. However, while changing access to care and referral patterns would bias infection rates, systematic TRICARE referral and access to care policies did not change during the course of this study. Similarly, a reduction in the number of overall cultures obtained may have affected the observed rates of S. aureus bacteremia and SSTIs. However, the decreasing proportions of all cultures positive for S. aureus, including MRSA, provide further support that the trends observed for the rates of S. aureus bacteremia and SSTIs reflect true decreases in the burden of S. aureus disease, particularly MRSA. Additionally, the relatively stable size of the study population and the large number of isolates should minimize the effect of differences in local practice patterns regarding culturing on the conclusions of the current study.

The study population also has some unique characteristics. Active duty military members are young, healthy, have open access to care, and have increased risk of SSTIs due to military training and other job-related exposures. Active duty members had substantially higher rates of SSTIs, and a higher proportion of both bacteremia and SSTIs due to MRSA than nonactive duty individuals. However, nonactive duty beneficiaries comprised approximately 85% of the study population, and subanalyses revealed that even though the annual rates of bacteremia and SSTIs were different for active duty compared with nonactive duty beneficiaries, the significant trends for bacteremia and SSTIs observed for both these subpopulations were in agreement. While the overall rates of disease were likely influenced by the characteristics of the Department of Defense population, the observed trends were consistent with investigations in other US populations.

In conclusion, within the US Military Health System, which provides care to both nonactive duty and active duty beneficiaries, the burden of S. aureus bacteremia and SSTIs remains substantial, highlighting the importance of having successful prevention and treatment strategies. The rates of community-onset MRSA and MSSA bacteremia and hospital-onset MRSA bacteremia decreased from 2005 through 2010, as the proportion of community-onset SSTIs due to MRSA decreased. These observations, taken together with results from others showing decreases in the rates of health care-associated infections from MRSA, suggest that broad shifts in the epidemiology of S. aureus infections may be occurring. Additional studies are needed to assess whether these trends will continue, which prevention methods are most effective, and to what degree other factors may be contributing.

Author Contributions: Drs Landrum and Murray had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Landrum, Chukwuma, Murray. Acquisition of data: Neumann, Cook, Chukwuma. Analysis and interpretation of data: Landrum, Neumann, Cook, Chukwuma, Ellis, Hospenthal, Murray. Drafting of the manuscript: Landrum, Chukwuma, Murray. Critical revision of the manuscript for important intellectual content: Neumann, Cook, Chukwuma, Ellis, Hospenthal, Murray. Statistical analysis: Landrum, Neumann, Cook, Chukwuma. Administrative, technical, or material support: Chukwuma, Murray. Study supervision: Landrum, Murray.

Conflict of Interest Disclosures: The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none were reported.

Funding/Support: This project has been funded in part with federal funds from the National Institute of Allergy and Infectious Diseases, National Institutes of Health, under interagency agreement Y1-AI-5072. Support for this work was leveraged from grants provided by the Global Emerging Infections Surveillance and Response Program, Armed Forces Health Surveillance Center to the EpiData Center Department, Navy and Marine Corps Public Health Center (NMCOPHC). Additional support was also provided in part by an appointment to the Postgraduate Research Participation Program at the Navy and Marine Corps Public Health Center (NMCOPHC). Additional support was also provided in part by an appointment to the Postgraduate Research Participation Program at the Navy and Marine Corps Public Health Center (NMCOPHC).

Role of the Sponsors: The NMCOPHC and IDCRP reviewed and approved the manuscript, but had no role in design and conduct of the study, collection, management, analysis, and interpretation of the data; or in the preparation of the manuscript.

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Previous Presentation: These data were presented in part at the 49th Annual Meeting of the Infectious Diseases Society of America; October 19-23, 2011; Boston, Massachusetts.

Online-Only Material: The eMethods, eTables 1 through 6, eFigures 1 and 2, and eAuthor Video Interview are available at http://www.jama.com.

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