

# Epidemiology of Skin and Soft-Tissue Infections in US Army Trainees at Fort Benning

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## Abstract

**Background.** Soldiers in training are at high risk for skin and soft-tissue infection (SSTI), especially those caused by methicillin-resistant *Staphylococcus aureus* (MRSA). Robust epidemiological, microbiological, and molecular data are vital to developing prevention strategies. The objective of this investigation was to describe the epidemiology and clinical characteristics of SSTI in a high MRSA setting.

**Methods.** In July 2012, we initiated a prospective observational cohort study among US Army Infantry trainees at Fort Benning, GA to determine overall and MRSA SSTI incidence and to describe the clinical characteristics of disease. Clinical *S. aureus* isolates underwent molecular characterization, including pulsed-field gel electrophoresis (PFGE).

**Results.** From July 2012 through July 2013, 25,181 trainees completed 14-week Infantry training. Of those trainees, 846 developed SSTI for an overall rate of 0.04 per 100 person-days. The MRSA SSTI rate was 0.01 per 100 person-days. Rates of SSTI were highest during the summer months. The median interval from training start to clinical presentation for SSTI was 40 (range 0-108) days. The most frequent clinical manifestations were cellulitis (48.7%) and abscess (32.4%) with the majority (65.5%) of infections on the lower extremities. Of the 846 SSTI subjects, 464 clinical specimens were collected, of which 388 (83.6%) were culture-positive for *S. aureus*, with MRSA accounting for 60.1%. Of the 180 MRSA isolates available for analysis, 165 (91.7%) were pulsed-field type USA300.

**Conclusions.** Skin and soft-tissue infections continue to impose a substantial burden in the trainee population. The epidemiology is dynamic, but USA300 MRSA continues as the predominant SSTI genotype. Effective strategies for SSTI prevention in this and other high-risk settings are critically needed.

## Background

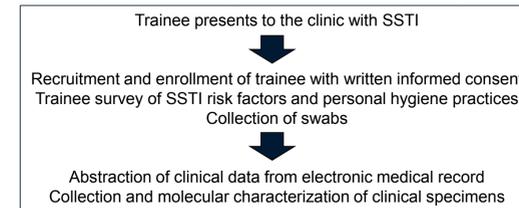
- Military personnel are at increased risk for skin and soft-tissue infection (SSTI). In 2013, a total of 64,473 ambulatory clinic visits and 1,644 hospital admissions in the military health system were related to SSTI among active duty military personnel.
- SSTI imposes a significant financial burden on the military health system. Treatment and management of SSTI account for an estimated \$14-32M in direct costs to the Army and ~\$3000 per patient.
- Among all military personnel, SSTI risk is highest among trainees. SSTI is the second leading cause of infectious disease-associated hospitalization in the first two years of military service. Community-acquired methicillin-resistant *Staphylococcus aureus* (CA-MRSA), particularly pulsed-field type (PFT) USA300, is responsible for the majority of SSTI in training populations.
- Rates of SSTI at Fort Benning, GA are the highest among all US Army training centers (~90 cases per 1000 person-years). The objective of this study was to describe the epidemiology and clinical characteristics of SSTI among a population of high-risk US Army trainees at Fort Benning.

## Methods

- Design/Population:** Prospective, longitudinal observational cohort study to describe the incidence, clinical presentation, outcomes, recurrence rates, and risk factors for overall and MRSA SSTI among US Army soldiers undergoing 14-week Infantry training at Fort Benning, Georgia. The population was all male, between 17-42 years of age, ethnically diverse, and in generally good physical condition.
- Data Collection:** Participants completed risk factor questionnaires and had culture swabs taken at several anatomic sites (nasal, oropharynx, inguinal, peri-anal). All clinical data was abstracted from the electronic medical record (Armed Forces Health Longitudinal Technology Application (AHLTA)).
- Case definition:** A participant who presented to the clinic or was admitted to the hospital with cellulitis, abscess, folliculitis, impetigo, paronychia, infected blister, or pilonidal cyst. A *S. aureus* SSTI case was defined as an SSTI with a positive culture from the corresponding clinical site. Recurrence was defined as a subsequent infection at a different body location and separated by 30 days.
- Laboratory:** Cultures were processed by the hospital microbiology laboratory according to standard protocols. All *S. aureus* isolates underwent identification and susceptibility testing using Microscan® Walk-Away -96 (Dade Behring Inc., Deerfield, Illinois), according to Clinical Laboratory Standards Institute (CLSI) methods.
- Molecular Analysis:** *S. aureus* isolates underwent typing with PFGE and PCR for *mecA* to assess for resistance. Control strains of known pulsed-field types (PFT) were obtained from the network on Antimicrobial Resistance in *Staphylococcus aureus* (NARSA; <http://www.narsa.net>). PFGE findings were resolved and analyzed using BioNumerics (Applied Math, Austin, TX).
- Rate calculations include all episodes of SSTI. Analysis was performed in SAS (Version 9.3, SAS Institute, Cary, NC).

## Methods

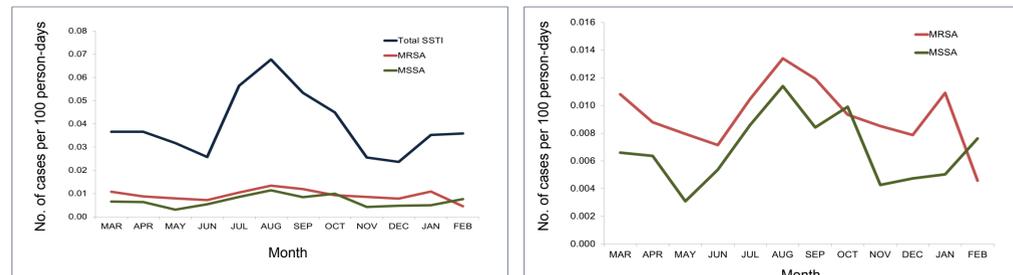
**Figure 1.** Flow of procedures for a prospective, longitudinal observational study of SSTI among US Army trainees



## Results

- Over a twelve-month period, a total of 846 cases of SSTI were identified among ~25,000 trainees, an overall rate of 3.3%. A clinical specimen was obtained from 414 subjects. Of these, 341 (82%) were culture-positive for *S. aureus*. Among the *S. aureus* isolates, 198 (58%) were MRSA.
- Rates of overall and MRSA SSTI were highest in the summer months (Figures 2a and 2b).
- Mean (range) onset of SSTI was 43 (0-108) days from the start of training.

**Figure 2.** Monthly incidence of overall SSTI (a) and MRSA SSTI (b) among US Army trainees, 2012-2013



- Cellulitis (49%) and abscess (32%) were the most frequent clinical manifestations of SSTI (Table 1).
- The most common (66%) site of infection was the lower extremities (Table 1). Five percent of subjects had a recurrent SSTI while in training.
- Nearly all MRSA clinical isolates were USA300 (Table 2). Among methicillin-susceptible *S. aureus* (MSSA) clinical isolates, 36% were USA300.

**Table 1.** Clinical characteristics of SSTI cases

| Clinical Manifestation          | n (%)    |
|---------------------------------|----------|
| Cellulitis                      | 412 (49) |
| Abscess                         | 274 (32) |
| Infected Blister                | 147 (17) |
| Folliculitis                    | 109 (13) |
| Impetigo                        | 92 (11)  |
| Paronychia                      | 36 (4)   |
| Infected Cyst                   | 11 (1)   |
| <b>Site of Infection</b>        |          |
| Lower extremity                 | 554 (66) |
| Upper extremity                 | 235 (28) |
| Head                            | 93 (11)  |
| Thorax                          | 48 (6)   |
| Groin/inguinal/perineal         | 25 (3)   |
| <b>Had a recurrence of SSTI</b> | 43 (5)   |

**Table 2.** Distribution of PFT among clinical *S. aureus* isolates

| Pulsed field type (PFT) | MRSA<br>n=180<br>n (%) | MSSA<br>n=137<br>n (%) |
|-------------------------|------------------------|------------------------|
| USA 300                 | 165 (92)               | 49 (36)                |
| Non-typeable            | 10 (6)                 | 56 (41)                |
| USA 800                 | 3 (2)                  | 6 (4)                  |
| USA 100                 | 1 (1)                  | 1 (1)                  |
| Other PFT               | 1 (1)                  | 7 (5)                  |
| USA 200                 | 0 (0)                  | 12 (9)                 |
| USA 400                 | 0 (0)                  | 5 (4)                  |

## Results

**Figure 3.** Clinical presentation of SSTI, pre- and post-treatment



- Twenty-three individuals were hospitalized for SSTI. Of those from whom cultures were taken, 15 (94%) were positive for *S. aureus*. Of those, 8 (54%) were MRSA. The mean duration of hospitalization was 2 days. The most frequent diagnosis was cellulitis (61%) and cellulitis/abscess (30%). All received antibiotics and recovered.
- Of 464 clinical isolates obtained, 388 (84%) were available for evaluation of antibiotic susceptibility (Table 3).

**Table 3.** Antibiotic susceptibilities of clinical *S. aureus* isolates

| Antibiotic    | MRSA<br>n=233<br>n (%) | MSSA<br>n=155<br>n (%) |
|---------------|------------------------|------------------------|
| Ciprofloxacin | 114 (49)               | 138 (89)               |
| Clindamycin   | 215 (92)               | 137 (88)               |
| Daptomycin    | 229 (99)               | 149 (100)              |
| Erythromycin  | 62 (27)                | 101 (65)               |
| Gentamicin    | 233 (100)              | 155 (100)              |
| Levofloxacin  | 124 (54)               | 140 (91)               |
| Linezolid     | 230 (100)              | 151 (100)              |
| Rifampin      | 230 (99)               | 152 (99)               |
| Tetracycline  | 224 (96)               | 150 (97)               |
| TMP-SMX       | 233 (100)              | 155 (100)              |
| Vancomycin    | 233 (100)              | 155 (100)              |

## Conclusions

- SSTI, especially those caused by *S. aureus*, continue to represent a significant burden in military trainees.
- SSTI demonstrate remarkable seasonality, approximately doubling rates in summer months.
- USA300 remains the predominant MRSA PFT, but also significantly contributes to MSSA SSTI.
- Additional studies of the clinical and molecular epidemiology of SSTI, specifically *S. aureus*, are needed to inform future prevention efforts, including hygiene strategies and vaccine development.

## Acknowledgements and Disclaimer

We are indebted to the Fort Benning team of clinical coordinators, clinical site managers, data managers, and administrative support personnel for their contributions to the success of this project.

Support for this work (IDCRP-074) was provided by the Department of Defense Global Emerging Infections Surveillance (GEIS) program and Military Infectious Diseases Research Program (MIDRP). Additional support was provided by the Infectious Disease Clinical Research Program (IDCRP), a Department of Defense (DoD) program executed through the Uniformed Services University of the Health Sciences. This project has been funded in whole, or in part, with federal funds from the National Institute of Allergy and Infectious Diseases, National Institutes of Health (NIH), under Inter-Agency Agreement [Y1-AI-5072].

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