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Panton—Valentine leukocidin-positive methicillin-resistant *Staphylococcus aureus* outbreak among healthcare workers in a long-term care facility

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Summary
Background: We investigated an outbreak of community-acquired methicillin-resistant *Staphylococcus aureus* (MRSA) infections that occurred among healthcare workers (HCWs) but not among residents of a long-term care facility (LTCF).
Methods: Cases of *S. aureus* infection were sought by reviewing the medical records of residents and HCWs. In order to identify risk factors for the development of an *S. aureus* infection, an unmatched case—control study was conducted. Cases were all HCWs with a clinically compatible *S. aureus* infection; controls were HCWs with no history of a clinically compatible *S. aureus* infection. Cases and controls were interviewed and anterior nasal swabs were collected.
Results: Over a period of 14 months, a total of eight cases were identified among practice nurses, giving an attack rate of 10% for this category of profession. All isolates were identified as MRSA Panton—Valentine leukocidin (PVL)-producing SCC*mec* type IV. By multivariate analysis, working in a specific zone and being a practice nurse were found to be statistically significant risk factors for infection.
Conclusions: The current outbreak indicates that HCWs may serve as vehicles for the entry of PVL-positive MRSA strains from the community into LTCFs, and that deficient hygiene practices and unrecognized carriage may facilitate spread. Given the increasing prevalence of PVL-positive MRSA infections worldwide, guidelines for the eradication of PVL-positive MRSA carriage within closed communities should be established and efforts to obtain cultures from compatible infections should be made.

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Introduction

During the last decade, community-acquired (CA) methicillin-resistant *Staphylococcus aureus* (MRSA) infections among young persons without healthcare-associated (HCA) risk factors have emerged worldwide and are becoming prevalent in several communities. These infections are caused by strains that almost exclusively carry the staphylococcal cassette chromosome (SCC) *mec* type IV and the Panton–Valentine leukocidin (PVL) genes and, unlike HCA-MRSA strains, are not multi-resistant. Most infections caused by PVL-producing MRSA strains are mild skin or soft tissue infections, however severe life-threatening cases of necrotizing pneumonia and sepsis have been reported.[1] Outbreaks of CA-MRSA have been reported in wrestling and football teams, daycare centers, institutionalized adults with developmental disabilities, military recruits, jail inmates, and men who have sex with men.[2–10] There are recent reports of transmission and outbreaks of CA-MRSA infections within healthcare facilities.[11–16]

In Greece, from June 2005 and following reports of high rates of CA-MRSA in children,[9] CA-MRSA infections became officially notifiable to the Hellenic Center for Disease Control and Prevention (HCDCP). In November 2007 we were notified of a cluster of skin infections that had occurred among healthcare workers (HCWs) working in a long-term care facility (LTCF) in Athens. We describe herein the investigations and interventions that occurred during this outbreak.

Methods

Setting

The outbreak occurred in a LTCF that provides care to handicapped patients, mostly of advanced age. At the time of notification (November 2007), there were 228 residents cared for by 209 HCWs. Residents were distributed across four zones (zones A to D). Practice nurses, cleaners, and waiters were assigned to one zone. Physicians, nurses, and administrative and technical personnel worked in all zones.

Epidemiologic investigation

Cases of *S. aureus* infection were sought by reviewing the medical records of residents and HCWs following receipt of ethical permission. Microbiological confirmation in cases was not sought before our visit, thus a case of *S. aureus* infection was defined as a clinical skin or soft tissue infection compatible with *S. aureus* infection.

In order to identify risk factors for the development of an *S. aureus* infection, an unmatched case–control study was conducted. Cases were all HCWs with a clinically compatible *S. aureus* infection. Controls were HCWs with no history of clinically compatible *S. aureus* infection. The list of controls was generated by systematically selecting one in every five HCWs from an alphabetical list. Forty-one HCWs were selected as controls, of whom 36 agreed to participate. Cases and controls were interviewed. The data shown in Table 1 were collected. Poor personal hygiene was defined as sharing clothes or towels with other HCWs, hand-washing with plain soap, not using liquid antiseptic for hand-washing, and/or poor hygiene while using the toilet facilities (e.g., sitting directly on the basins without using a disinfectant or a waterproof paper). Informed consent was obtained from all participants. The work was approved by the HCDCP.

Microbiologic investigation

During the investigation, clinical specimens were taken from one HCW with an active infection. Anterior nasal swabs were collected from all cases and controls and from 30 randomly selected residents. Environmental cultures from surfaces were sampled with moistened cotton swabs. Swabs were inoculated in mannitol salt agar plates and examined at 48 h. *S. aureus* isolates were screened for oxacillin susceptibility by the standard disk diffusion method.[17] Detection of the *mec*A gene and SCC *mec* typing were performed by PCR.[18] PVL determinants were detected by PCR.[19] *Sma*I restriction fragments of genomic DNA were separated by pulsed field gel electrophoresis (PFGE).[20]

Statistical analysis

Statistical analysis was performed using SPSS version 11 (SPSS Inc., Chicago, IL, USA). Chi-squared and Fisher's exact tests were used for comparisons between categorical variables and the *t*-test and Mann–Whitney U-test for comparisons between continuous variables. Logistic regression analysis was applied to indicate factors significantly associated with the development of *S. aureus* infection. *p*-Values of 0.05 or less were considered statistically significant.

Results

Outbreak characteristics

A review of the medical records revealed that the first case of *S. aureus* infection occurred in November 2006. From November 1, 2006 through December 31, 2007, eight cases of *S. aureus* infection were identified among HCWs, all concerning practice nurses, giving a 10% attack rate among practice nurses (8/81 practice nurses). All cases but one worked in zone A. The attack rate among practice nurses from zone A was 35% (7/20 practice nurses). Among the residents, only one case was identified (attack rate 0.4%).

Infections were furuncles and small subcutaneous abscesses located in the axilla or breast (six cases), lower extremities (two cases), and face, abdomen, and upper extremities (one case each). Full recovery was documented in all cases. No complication or invasive *S. aureus* infection occurred.

Microbiology

PVL-positive MRSA belonging to SCC*mec* type IV was isolated from the lesions of the HCW with the active infection. *S. aureus* nasal carriage was found in four (50%) of the cases, of whom three (37.5%) were colonized by PVL-positive MRSA SCC*mec* type IV and one by methicillin-susceptible *S. aureus* (MSSA). In addition, *S. aureus* nasal carriage was found in 12 (33.3%) of the 36 controls, of whom only one was identified as PVL-positive MRSA SCC*mec* type IV. Cases were more likely to