

**Impact of a Standardized Protocol to Address Outbreak of Methicillin-resistant
Staphylococcus Aureus Skin Infections at a large, urban County Jail System**

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Abstract

Outbreaks of infections caused by methicillin-resistant *Staphylococcus aureus* (MRSA) have been reported in incarcerated populations nationwide. We compared rates before and after the implementation of a standardized treatment guideline in the San Diego County jail system. This guideline included mandatory culturing, personal and environmental hygiene measures, standardized antibiotic treatments based on sensitivity patterns, and close surveillance of cases. We found that our guideline reduced the proportion of soft tissue infections caused by MRSA (90.3% to 57.8%) and decreased the proportion of inmates diagnosed with MRSA after 10 days in custody. Documented resolution of the infection improved from 30.7% to 68.7% of cases. The average number of different antibiotic regimens decreased from 3.06 to 1.78 per patient. We conclude that our guideline resulted in a decrease in MRSA transmission, fewer antibiotic courses and improved resolution of cases.

Introduction

Staphylococcus aureus are bacteria commonly carried on the skin or in the nose of asymptomatic individuals, but can result in significant illness and morbidity when causing infection of the skin and underlying soft tissues. Infections caused by methicillin-resistant Staphylococcus aureus (MRSA) are common in hospitals and nursing homes (Enright et al 2002). Because MRSA is resistant to all commonly prescribed beta-lactam antibiotics commonly used to treat skin and soft tissue infections, treatment of such infections represents a challenge for clinicians.

Recently, large outbreaks of MRSA infections have been reported in prison and jail populations nationwide (CDC 2000; CDC 2003a; CDC 2003b; Pan ES, et al, 2003). We noted a similar outbreak of skin infections in our community incarceration system consisting of seven jail facilities (Jones 2002). To address these infections, we conducted intensive surveillance of all skin infections at our facility and developed a standardized treatment protocol for MRSA infections, along with close follow-up of patients in our system to determine the efficacy of our protocol.

Methods

We conducted a two-phase study to investigate and address an apparent increase in skin and soft tissue infections seen in our jail system beginning in early 2002. In phase one of our study, we conducted intensive surveillance of all skin and soft tissue infections diagnosed among our jail inmate population. This included mandatory culturing and sensitivity testing of all draining or incised abscesses, boils, cysts, furuncles, or any other open lesions or wounds that could be compatible with a staphylococcal infection. In

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addition, photographs were taken of these lesions when possible. Data was also collected on each of the inmates in terms of onset of illness and infection, date of incarceration, wound site, jail location (of the 7 jail facilities), housing history (i.e. transfers between the jail facilities), past medical history including history of hospitalizations and intravenous drug use, course of illness including resolution of the infection, and custody release date. All data, including culture and sensitivity results, were collected and maintained by one of the investigators (GH) in a single wound infection database.

In phase two of the study, we instituted a standardized treatment protocol and control measures based on the results of phase one indicating an outbreak of MRSA infections in our jail population. Control measures included intensive education of jail medical and law enforcement staff in terms of aseptic wound care techniques, regular hand washing, and the need for universal precautions when caring for infected inmates. Inmates with suspected, presumed or confirmed MRSA infections were placed in private rooms or isolated with other inmates with MRSA infections and movement within and between jail facilities was limited. Draining wounds were dressed daily with adherent dressings until all drainage had resolved. Inmates were encouraged to shower daily and change underwear and clothes per protocol. Environmental measures were undertaken in all the jail facilities in regards to cleaning of inmate clothing, toilets, sinks, showering/bathing areas and inmate cells. Protocols were developed for regular bedding and mattress changes and cleaning for inmates.

An antibiotic guideline and protocol were developed to standardized medical treatment regimens for patients with suspected and confirmed MRSA infections. This treatment regimen was first developed with input from an infectious diseases specialist.

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The guideline was further modified based on initial culture and antibiotic sensitivity results from our phase one intensive surveillance process. This guideline included empiric antibiotic recommendations for suspected MRSA cases, definitive first-line and alternative regimen therapies, guidelines for treatment of chronic carrier states, and management approaches and procedures for specific types of skin lesions (Appendix). After implementation of the phase two interventions, we continued our surveillance data collection as outlined above for phase one.

We compared our surveillance data for 7 months prior to the initiation of the treatment guideline (pre-intervention, January 1, 2003 thru July 31, 2003) and for 7 months after initiation of the guideline (post-intervention, September 1, 2003 thru March 31, 2004). Data compared included overall inmate census in our jail system, numbers of skin or soft tissue infections and MRSA-confirmed infections, culture and sensitivity results, timing of onset from arrival to jail and MRSA diagnosis, course(s) of antibiotic treatments for each inmate, and outcome of these cases when available. Data was compared statistically using Fisher's exact for proportions and Students t-testing where appropriate with a statistical software package (STATA 6.0) with p-value < 0.05 considered statistically significant. This study was approved by our local institutional review board for human subject protections.

Results

During the study period, there was no difference in the monthly inmate census for our jail facilities between the pre-intervention daily census of the jail compared with the post-intervention period (4827.7 vs. 4933.7, respectively, p=0.33). During the pre-

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intervention period, there was an average of 57.3 wound, skin or soft tissue infection cases per month diagnosed and treated by jail medical staff, compared with 82.1 cases per month during the post-intervention period, indicating a non-statistically significant trend toward increased cases diagnosed and treated ($p=0.10$). With the implementation of the guideline, there was a significant increase in obtaining wound cultures in these cases as only 66.8% were cultured in the pre-intervention period compared with 88.7% in the post-intervention period ($p<0.001$) (Table 1).

Overall, culture results were positive for MRSA in 69.0% of inmate patients who had cultures performed. There was a significant decrease in the proportion of wound cultures positive for MRSA from the pre-intervention period to the post-intervention period (90.3% in the pre-intervention period down to 57.8% in the post-intervention period, $p<0.001$) (Table 1). Figure 1 demonstrates this decrease during the pre- and post-intervention months of our study. Moreover, the proportion of inmates who were diagnosed with MRSA after being incarcerated more than 10 days also decreased significantly from 70.2% of all MRSA-positive cases in the pre-intervention period to 49.2% in the post-intervention period ($p<0.001$) (Table 1). This finding indicates that a smaller proportion of MRSA cases were arising from inmates who were incarcerated for longer periods of time, suggesting a lower transmission rate within our facilities. There was no evidence that initiation of our protocol with guidelines regarding antibiotic choice led to a change in resistance patterns of our MRSA cases.

Treatment success rates (defined as documented resolution of the infection on medical evaluation) was 30.7% during the pre-intervention period and 68.7% during the post-intervention period ($p<0.01$). There was also documentation of improvement, but

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not complete resolution on release from jail for 7.9% of patients in the pre-intervention period compared with 12.9% in the post-intervention period. The number of courses of antibiotic treatment courses also differed between the pre- and post-intervention periods. During the pre-intervention period, patients had an average of 3.06 different antibiotic treatment courses for their infection, compared with an average of 1.78 courses in during the post-intervention period ($p < 0.01$).

Discussion

In this study, we conducted an intensive surveillance of all skin and soft tissue infections and MRSA-confirmed infections in our jail inmate population. We then instituted specific control measures along with an antibiotic treatment and skin lesion management guideline based on our local surveillance data to address the medical needs of our inmates. While there was a trend toward increased cases of wound, skin and soft tissue infections, we found a sharp decline in the percentage of cases that grew out MRSA on culture and in the proportion of culture-positive MRSA cases arising from inmates with incarceration durations greater 10 days.

Our overall number of wound, skin and soft tissue cases was likely affected by the overall changing and increasing prevalence of these infections, and particularly MRSA in our community as has been seen nationwide (Chambers, 2001; Lowy 1998; Salgado 2003; Samadi, Volturo, 2004). This may be particularly true in our jail system where the average length of stay for inmates is relatively short with a regular influx of new arrestees from the community and transferred inmates from outside facilities on a daily basis.

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Our intensive surveillance of cases resulted in excellent tracking and documentation of culture-positive of MRSA in most cases. Prior work suggests tremendous variability in the genetic makeup, resistance patterns and virulence of MRSA whether community-, hospital- or jail-acquired (Baba et al 2002; Fey et al 2003; Pan et al 2003). In our specific inmate population, we found a consistent pattern of antibiotic resistance and sensitivities for MRSA-positive wound cultures likely reflective of both the type of MRSA bacteria in our local community as well as spread of infection between inmates in our jail system.

The decrease in the proportion of MRSA-confirmed infections in these cases, and particularly in inmates who had been in our jail more than 10 days suggests our control efforts and treatment guideline was effective in treating MRSA cases in the jail and in decreasing transmission of MRSA within the jail.

Due to growing awareness of MRSA outbreaks nationwide and in particular amongst the incarcerated population, a number of efforts have focused on developing guidelines and recommendations for preventing the spread of MRSA, controlling outbreaks, and treating infections with specific antibiotic protocols. Recently, the Federal Board of Prisons issued practice guidelines for MRSA which included recommendations for staff education and precautions, sanitation and hygiene, surveillance and infection control measures, inmate containment and transfer policies, outbreak management, and specific antibiotic guidelines for primary infection, recurrent infections, empiric treatment and decolonization of asymptomatic carriers (Board of Prisons 2003).

Unlike the national Board of Prisons recommendations, we were able to create and tailor our control measures and treatment guidelines for our specific inmate

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population and MRSA isolates within our community. Our database allowed us to analyze the MRSA outbreak not just in our local community, but specifically within our jail population. As a result, we were able to create and adjust our treatment guideline to address the specific sensitivity and resistance pattern of MRSA isolates obtained from our inmates. This approach likely improved the overall efficacy of our guidelines and approach.

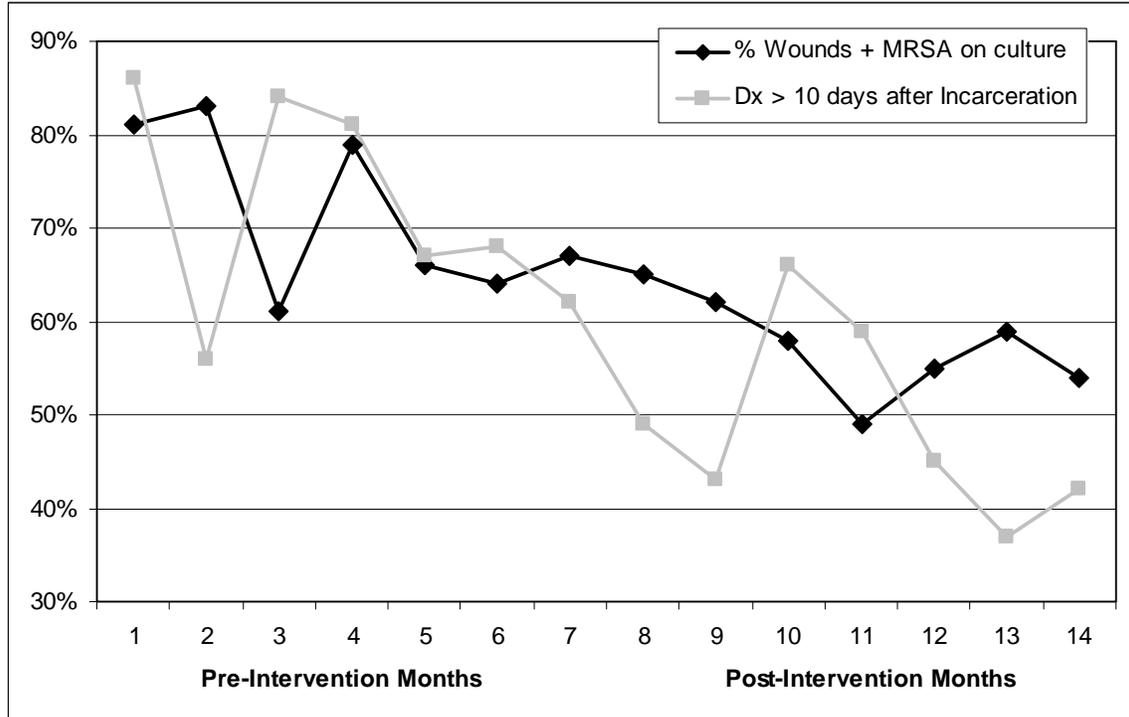
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Table 1

	Average daily census	Monthly average of wound soft tissue or skin infections diagnosed	% where culture was obtained	% MRSA confirmed on culture	% of MRSA cases diagnosed in inmates at >10 days of incarceration
Pre-Intervention	4827.7	57.3	66.8%	90.3%	70.2%
Post-Intervention	4933.7	82.1	88.7%	57.8%	49.2%

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Figure 1: Percentage of wound cultures positive for MRSA during the pre- and post-intervention months (black line). Percentage of MRSA cases arising from inmates incarcerated for more than 10 days at the time of diagnosis.



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Appendix: San Diego Sheriff's Medical Services Guideline (see attached)