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Journal of Acute Disease

journal homepage: [www.jadweb.org](http://www.jadweb.org)Review article <http://dx.doi.org/10.1016/j.joad.2015.06.003>

## Methicillin-resistant *Staphylococcus aureus*: An occupational health hazard in the prehospital setting

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### ARTICLE INFO

#### Article history:

Received 29 May 2015  
 Received in revised form 29 May,  
 2nd revised form 3 June 2015  
 Accepted 6 Jun 2015  
 Available online 28 Jul 2015

#### Keywords:

Infectious diseases  
 Methicillin-resistant *Staphylococcus aureus*  
 Emergency medical services  
 Prehospital care  
 Cross-transmission  
 Occupational hazard  
 Cross-transmission continuum  
 Bioterrorism

### ABSTRACT

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a serious nosocomial infection within healthcare settings, and with its community version worldwide (*i.e.* community-acquired-MRSA), it is safe now to classify it as an epidemic. The aim of this paper is to build the logic for the reader to understand why this drug-resistant infection can impose an occupational hazard towards emergency health services personnel in the prehospital settings. This logic started with a model, the author conceptualizes as a cross-transmission continuum, in which the author explains the role of emergency medical service personnel in possibly contributing to the transmission of MRSA back and forth the community. A solution to interrupt this continuum, particularly surveillance systems within the emergency medical service field, is suggested and discussed. This is especially important in the light of bioterrorism as surveillance can become a necessity in preparation for biological disasters whether they are intentional (*i.e.* bioterrorism) or natural (*i.e.* outbreaks).

## 1. Introduction

Community acquired-methicillin-resistant *Staphylococcus aureus* (CA-MRSA) is considered an epidemic and a serious threat to public health and its spread in the community is a serious challenge<sup>[1]</sup>. Severe cases have been reported that transmit between family members<sup>[2,3]</sup>.

Several studies have been done to determine the extent of CA-MRSA and the prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) colonization among the general population. In 2004, the Centers for Disease Control and Prevention conducted a National Nosocomial Infections Surveillance that reported the prevalence of MRSA in outpatient settings of 31.1% among all *Staphylococcus aureus* isolates and most of those MRSA cases were community-associated<sup>[4]</sup>. A study conducted in the US in 2004 revealed that 59% of skin infections presented to the ED

were positive for MRSA and an increased prevalence of CA-MRSA in the US by 1.5% between 2002 and 2004<sup>[5,6]</sup>.

The significance of CA-MRSA infections is related to a number of major factors. There is a possibility of a prolonged colonization for months or even years which is associated with these infections; this can increase the time of exposure and number of potential recipients since colonization with CA-MRSA can remain asymptomatic and transmissible for several years<sup>[4,7]</sup>.

Studies have shown that CA-MRSA infections can be transmitted by direct contact with infected individuals, and is contributed by close exposures and sexual contacts<sup>[5]</sup>. Also it has been proven that MRSA can contaminate surroundings and reachable objects such as keyboards, phones, stethoscopes, and ties<sup>[8–10]</sup>. Nonetheless, there is a significant decline of MRSA infections worldwide, albeit for unknown reasons<sup>[11]</sup>.

## 2. The role of emergency medical services (EMS) personnel in cross-transmission

MRSA can impact the entire of EMS system. At prehospital setting, the role of EMS personnel in the cross-transmission of CA-MRSA is well known, with findings suggesting poor

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 Peer review under responsibility of Hainan Medical College.

adherence to infection control guidelines<sup>[2,9,10]</sup>. This is evident in the significantly higher prevalence of MRSA colonization among EMS personnel when compared to its prevalence in general population<sup>[12,13]</sup>. The unique position of EMS personnel makes them a critical link between hospitals and community, thus fostering the cross-transmission of nosocomial infections back and forth of this continuum, as suggested by the following model (Figure 1):

According to the suggested cross-transmission continuum in Figure 1, there is a frequent, two-way contact between a pre-hospital healthcare provider and the community at large. When the EMS personnel provide care to community members, they are in direct and frequent contact with patients. On the other hand, community members will also be in direct contact with these providers, which initiates a cross-transmission of microorganisms in both directions. Due to the environmental contamination associated with nasal colonization of MRSA, nasally-colonized prehospital healthcare providers can transmit MRSA to the surroundings in their community, just as their colonized patients who will in return transmit MRSA into ambulances<sup>[8]</sup>. Because most prehospital healthcare ends with transferring patients to a hospital setting, these microorganisms, MRSA precisely, can be carried to the in-hospital environment and from hospitals back to the community<sup>[14]</sup>.

Although CA-MRSA is a community-based infection, similar strains are identified at in-hospital settings demonstrating a new form of nosocomial infections<sup>[15]</sup>. This emerging of CA-MRSA as a nosocomial infection can emphasize a link between communities and hospitals; infected patients who may still be colonized with the new strain of CA-MRSA will be discharged to the community, carrying these microorganisms back with them to widen the cross-transmission continuum even more. One meta-analysis found the association of healthcare risk factor (*i.e.* intensive care unit admission, long-term healthcare setting, antibiotics, *etc.*) in 85% of CA-MRSA colonized subjects<sup>[4]</sup>.

### 3. The need for surveillance systems

There are urgent public health and medical needs for early and reliable detection and diagnosis of MRSA infections and colonizations, and to control cross-infection more effectively<sup>[16]</sup>. The best approach to prevent and control MRSA remains uncertain, but it is well known that MRSA is a colonizing organism for most affected patients and can be detected through active surveillance and effective screening<sup>[2]</sup>.

Frequent screening of EMS personnel for MRSA infection or colonization is not recommended in the current infection control policies, but because nasally-colonized individuals contribute to the dissemination of MRSA, active surveillance systems are needed for effective and early identification of populations at high risk<sup>[8]</sup>. According to Köck *et al.*, routine MRSA surveillance testing has medical value and cost effectiveness upon application in healthcare settings<sup>[16]</sup>.

On the other hand, Simons and Alcabes questioned the necessity and the value of implementing surveillance systems nationwide<sup>[7]</sup>. They addressed that the most important step is to

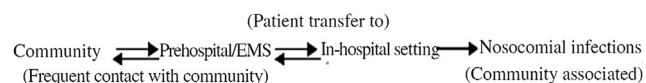


Figure 1. Cross-transmission continuum.

limit surveillance systems to the states that have a definite problem with and high incidence of MRSA in their communities. This argument is based on ensuring efficiency and cost effectiveness of these surveillance systems, where the argument of authors can be achieved only when limiting surveillance to the targeted population with a high risk<sup>[7]</sup>. However, one can argue that prehospital healthcare providers are a good target for such systems, especially in the fact that EMS personnel work inside contained environments *i.e.* ambulances, that are significantly contaminated with multi-drug resistant microorganisms in addition to MRSA<sup>[9,17]</sup>.

### 4. In preparation for bioterrorism

In the light of the threat of bioterrorism, the role of EMS personnel as first responders to biological disasters is well known<sup>[18,19]</sup>, and their level of preparation is significant to the overall preparedness of societies to such threats<sup>[20]</sup>. Effective and comprehensive response for an outbreak, whether accidental or intentional, requires the detection of the affected individuals, sources of infection, and possible contacts with the sources<sup>[21]</sup>. For this reason, effective surveillance systems that detect the release of biological agents among prehospital healthcare providers, as well as other first-responders, are considered a key element for an effective, comprehensive national response for bioterrorism and biological disasters<sup>[22]</sup>.

Surveillance systems for infectious diseases, in the realm of disaster preparedness, will help to monitor new biological incidents as soon as they occur, and will help protecting EMS personnel as first line responders to such events<sup>[12]</sup>. Al Amiry suggested that CA-MRSA can be viewed as an occupational hazard at a prehospital setting level and to further protect EMS personnel with proper guidelines that deal effectively with MRSA community outbreaks, as well as other outbreaks that may threaten humanity at large<sup>[12]</sup>.

### 5. Suggestions

Further studies are needed to understand and explain the unusual high prevalence of MRSA colonization among pre-hospital healthcare providers in the U.S. and address its risk factors. Also, there is a need for further actions to contain this high prevalence. Other studies are recommended to investigate the status of MRSA colonization among EMS personnel and determine whether it is persistent or transient through two-point or even three-point follow up surveys. This is because MRSA transmission occurs regardless of the colonization status.

### 6. Conclusions

The role of EMS personnel in transmitting MRSA back and forth with their patients needs to be further understood to better comprehend the etiology of MRSA transmission in the general population. This understanding can direct better guidelines, aid in preparing EMS personnel for potential bioterrorism, and further protecting them from exposure to uncommon microbes and unexpected outbreaks. In the face of deadly outbreaks of other pathogens (such as Ebola), it is necessary to handle infectious diseases in prehospital settings effectively and more seriously, by addressing them as serious occupational health hazards.

## Conflict of interest statement

The author reports no conflict of interest.

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