Using Clinical Guidelines and Clinical Acumen to Manage Community-acquired Methicillin-resistant *Staphylococcus aureus* Infection

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ABSTRACT

Community-acquired methicillin-resistant *Staphylococcus aureus* (CA-MRSA) infection is spread by skin to skin contact and surface to skin contact. The environment is an unrecognized, inanimate reservoir for *S aureus*, placing family members and friends at risk for acquiring CA-MRSA infection. It is essential that nurse practitioners have an awareness of the environment as a reservoir for CA-MRSA infection. This article discusses a case study of a patient exposed to environmental CA-MRSA who failed outpatient treatment and required inpatient antimicrobial therapy. Clinical acumen and application of 2011 and 2014 infectious diseases guidelines were used to promote best practice treatment.

Keywords: best practice, community-acquired methicillin-resistant *Staphylococcus aureus*, environment, guidelines, infection

Staphylococcus aureus is a type of bacteria that is found in a healthy person. It is carried on the skin or in the nose and is not harmful. The bacterium can cause minor skin infections that patients may describe as a boil or a pimple. Almost 80% of community-acquired methicillin-resistant *S aureus* (CA-MRSA) infections present as skin and soft tissue infections (SSTIs) of mild to modest severity.[1] Many people acquire infectious staphylococcus, and it resolves without treatment. Some patients have *S aureus* overgrowth, and more serious infection occurs. If the skin barrier is broken down, as seen with eczema, open wounds, and after shaving, infection and abscess formation can develop. The lesion may progress to a more serious infection, including deep skin abscesses, impetigo, cellulitis, furuncles, and carbuncles.[1] Individual variations in patients' presentation of SSTIs challenge nurse practitioners' (NPs) decision-making skills for best practice treatment. In response to the spread of methicillin-resistant *S aureus* into the community, an expert panel of the Infectious Diseases Society of America (IDSA) established the first evidence-based guidelines in 2011 for the management of patients with MRSA infections.[2] The IDSA updated the 2005 guidelines for the treatment of SSTIs in 2014.[3] Best practice treatment of SSTIs requires a combination of art and science. It is essential that NPs use clinical acumen as well as apply clinical guidelines to individualize treatment of SSTIs.

In 1928, Sir Alexander Fleming developed penicillin (PCN), the first bactericidal antibiotic.[4] It was not until the 1940s that PCN was applied in clinical practice. This long-awaited treatment controlled a multitude of infections including *S aureus*, but in 1952 it was noted that PCN and other antibiotics were unsuccessful in treating these infections.[4] The speculation was that the *S aureus* strain mutated and became resistant to antibiotics. Methicillin resistance occurs when *S aureus* produces an altered

PCN-binding protein, PBP2a, which makes the bacteria less vulnerable to PCN and other antibiotics.[5] Today, providers' inappropriate prescribing of antimicrobials is a major reason for the emergence of multidrug resistance and SSTI infections.[5] Methicillin was introduced in 1959 in the hope that it could treat *S aureus*, yet in 1961, cases of MRSA were reported in the United Kingdom and in the 1970s MRSA was found in hospitals in eastern Australia.[4] Providers used more PCN as the primary treatment for *S aureus* in the 1960s, and the prevalence of PCN-resistant strains increased. This led to the development of penicillinase-resistant penicillins such as nafcillin, dicloxacillin, and oxacillin, but 1 year later, MRSA was discovered in US.[4]

Resistance to methicillin has increased over the past 25 years, and the incidence of MRSA has grown in epidemic proportions. These resistant strains have a *mecA* gene referred to as the staphylococcal cassette chromosome (SCC) gene.[6] The SCC encodes different enzymes that are capable of excision and insertion of the *mecA* gene to other staphylococcal strains, contributing to the spread of resistance among numerous strains. Microbiologists have identified bacterial strains of chromosomes USA300, USA400, USA1000, and USA1100 associated with CA-MRSA bacteria, and the USA300 clone is suggested for the rise in CA-MRSA infections.[6] By 2005, it was reported that CA-MRSA was identified in more than 50% of *S aureus* isolates.[7] Providers' intense antibiotic prescribing allows for a selective advantage for resistant strains, resulting in widespread prevalence of MRSA infection in the environment. Resistance to methicillin is a community-based phenomenon in which host, bacterial, and environmental factors transform a commensal *S aureus* strain into a pathologic state capable of life-threatening infections. MRSA is 1 of the best examples of a resistant bacterium and has been the focus of intense scientific and political interest from a global health perspective.[8]

SIGNIFICANCE

Researchers describe the overall prevalence rate of CA-MRSA as a variable based on population and geographical location. One study found a 59% overall prevalence with a range from 15% to 74% of CA-MRSA in participants who presented to emergency departments in 11 major US cities.[9] The significance of CA-MRSA in Europe is less than that in the US. The prevalence of CA-MRSA ranges from $< 1\%$ in northern Europe to $> 40\%$ in Southern and Western Europe.[10] Increases in MRSA infection rates are occurring in young adults, children, Native Americans, Alaskan natives, and Pacific Islanders. The leading cause of bacteremia is MRSA, and prolonged infection with inappropriate treatment of CA-MRSA may cause infective endocarditis, pneumonia, central nervous system infections, necrotizing fasciitis, osteomyelitis, and ventilator-assisted pneumonia.[11] The highest rates of mortality are among persons over 65 years old, blacks, and males. The Centers for Disease Control and Prevention estimates 19,000 Americans died from invasive MRSA infections in 2005.[12] Today, the increased incidence of CA-MRSA has become a national health priority because patients seek health care approximately 14 million times a year for suspected CA-MRSA infections.[13] MRSA first emerged in the pediatric population in the 1990s, and the incidence of pediatric ambulatory visits for SSTIs has nearly tripled.[14] Close contact with people who have been infected with CA-MRSA increases the pediatric population risk for MRSA infection. After a 2007 publication regarding MRSA infections and the death of healthy adolescents, media attention regarding CA-MRSA has substantially increased. Several published reports have documented CA-MRSA outbreaks among military, religious, and sports communities.[15] Carpeted floors were identified as the surface with the highest incidence of MRSA infection in an athletic facility, and crowding and poor hygiene in community settings contribute to the spread of MRSA infection.[16]

The emergence of atypical presentations of MRSA continues to be addressed by researchers. The vagina as a colonizing reservoir in 14.5 % to 17% of pregnant women raises questions about the need to obtain routine cultures from pregnant women.[7] Heterosexual transmission has been reported, and it has been established that men who have sex with men can transmit MRSA infection.[7] Treatment choices for eye and throat MRSA are limited.[17] After recovering from an initial MRSA infection, a person