

STAPHYLOCOCCUS AUREUS CARRIAGE AMONG HOSPITAL STAFF: COMPREHENSIVE REVIEW

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ABSTRACT

Staphylococcus aureus represent as a gram-positive bacterium which causes a broad range of clinical infections. Infection occurs due to this bacterium is prevalent in both hospitals as well as in the community. Because of the growth of multi-drug resistant bacteria such as MRSA (Methicillin-Resistant *Staphylococcus aureus*), the treatments are difficult to discover. *S.aureus* generally not initiate infection on healthy skin unless these bacteria are permitted to reach the internal tissues or bloodstream, which can cause a number of potentially dangerous infections. *Staphylococcus aureus* has been identified as a significant pathogen. Despite the antibiotic therapy, staphylococcal infections are common in hospitalized patients, and it can be fatal. It is the leading cause of disease and mortality in hospital environment. Its potential to cause disease is enhanced by virulence factors or drug resistance, as evidenced by the emergence of methicillin-resistant staphylococcus aureus (MRSA). Methicillin-resistant *Staphylococcus aureus* (MRSA) has begun as a serious nosocomial infection in many hospitals throughout the world. In hospitals, the most common sources of *s.aureus* would be septic lesions and patient and staff carriage sites. Infection is frequently preceded by carriage. This organism which lives as a commensal and has been transmitted in both healthcare and community settings is also a prominent source of bacteremia, skin and soft tissue infections and endocarditis.

Key words: Methicillin-Resistant *Staphylococcus aureus* (MRSA), nosocomial infection, antibiotic therapy, bacteremia.

INTRODUCTION

Staphylococcus aureus is a gram-positive bacterium that present in a cocci shape and formed in

clusters which are defined as "grape-like." Structure. These bacteria cause infection by producing various cell surfaces and released virulence factors, as well as the disease is aided by its tendency to acquire antibiotic resistance. Infections are widespread in both community and hospital settings (Gonzalez-Perez et al, 2019). *S.aureus* has long been acknowledged as one of the most frequent bacteria responsible for human disease. It is the most common cause of abscesses, furuncles, or cellulitis in the skin as well as soft tissues. (Melissa Conrad Stöppler, M. D., 2022). *Staphylococcus aureus* is a complex bacterium that may cause a wide range of human infections. However, the function of various virulence factors in the formation of staphylococcal infections is still unclear. Some clonal types can be able to transmit infection throughout the entire world, while others are adept at infecting people within community members. *S.aureus* is both a commensal and a pathogenic bacterium in which the primary ecological niche is the anterior nares. Yet, also numerous other regions, such as the axillae, genital, or even gastrointestinal tract, could be colonized. (Chambers, H. (2001). *S.aureus* gradually developed into a leading source of health-care-related infections with the development of hospital-based medicine. There are basically two forms of *s.aureus* that includes Community-acquired *staphylococcus aureus* (CA-MRSA) and Hospital-acquired *staphylococcus aureus* (HA-MRSA). CA-MRSA occurs in a community while HA-MRSA occurs in hospitals especially to those who working in hospital such as hospital staffs or patients. MRSA was initially identified in clinical isolates from hospitalized patients in the 1960s, but it has spread quickly in the community since the 1990s. MRSA infection occurs worldwide, although there is no single pandemic strain. MRSA, on the other hand, able to develop in waves of infection, which are frequently regarded by the recurrent emergence of dominant strains (Tenover, F. C. et al, 2006).

HOSPITAL ACQUIRED STAPHYLOCOCCUS AUREUS

Despite the availability of effective anti-staphylococcal drugs, hospital-acquired *s.aureus* bacteremia (SAB) remains a significant issue with significant morbidity and death. The term HA-MRSA denotes to methicillin-resistant *staphylococcus aureus* obtained in a hospital or healthcare setting (P R, V., & M, J. ,2013). Various risk factors have been acquired with hospital-associated *S. aureus* such as tumors, diabetes, excessive alcohol consumption, high blood pressure and so on. Corticosteroid therapy also increases the risk of *s.aureus* infection in general as well as anemia or those with blood transfusion and surgical treatment may enhance the chance of contracting Hospital acquired *s.aureus* in the hospital. (Allan G. Jensen, 1999). Since many patients in healthcare facilities have weaker immune systems or have had surgeries, the chance of more serious staph infection is increased. In healthcare, patients in intensive care units (ICUs), who have had specific types of operations, and patients who have been implanted with medical device in their body are at a higher risk of developing a more severe staph infection. Those who work in hospitals that deals with patients and surgeon particularly healthcare workers susceptible to obtain HA-MRSA compared to individuals who rarely visits hospital settings. The clinical affiliation of HA-MRSA would be nosocomial pneumonia and Catheter-acquired UTI unlike CA-MRSA often manifest necrotizing pneumonia and osteomyelitis (Khan, S., 2020). HA-MRSA strains are invasive infections which can be transmitted via doctors and nurses. A large percentage of Pediatric-ICU and Neonates ICU admissions are caused by HA-MRSA. Young children and neonates with risk factors, particularly those with lung illness, have a worse prognosis if HA-MRSA left untreated (Al Johani, S., 2016). Symptoms or infections vary among CA-MRSA and HA-MRSA whereby bloodstream infections were more prevalent in HA-MRSA while for CA-MRSA would be skin or soft tissues infection.

SYMPTOMS OF STAPHYLOCOCCUS AUREUS

Even before the emergence of **Community-acquired *S. aureus***, it happened to be a significant contributor to skin and soft tissue infections (SSTIs). The most frequent bacterial skin infection that is caused by *s.aureus* in children would be impetigo. Impetigo often manifests as bullous or papular lesions that develop on exposed regions of the body. Although the cutaneous abscess is often recognized as the hallmark infection of *s.aureus*, various symptoms of skin infection are

frequently found clinically. In a couple of cases, *s.aureus* can produce cellulitis. Another cutaneous condition produced by *s.aureus* is necrotizing fasciitis. Children frequently manifest with a quick onset of fever as well as bone soreness or a limp. The pain can be aching and intense, but it can also be mild in neonates. (Elizabeth P Baorto, M. D. ,2021). Besides that, the initial manifestation of patients with *s.aureus* would be fever together with malaise.



Figure 1 Skin & soft tissue infections (Fowler, V. G. 2015)

ANTIBIOTIC RESISTANCE FOR STAPHYLOCOCCUS AUREUS

Apart from its abilities to generate a wide range of life-threatening infections, *S. aureus* is essential as a human pathogen due to its ability to evolve antibiotic resistance (Lowy, F. D., 2003). The discovery of an antibiotic is often achieved through the development of bacterial antibiotic resistance, since antibiotic usage allows for the selection of resistant strains. *S. aureus* can be classified as methicillin-sensitive *Staphylococcus aureus* (MSSA), or methicillin-resistant *Staphylococcus aureus* (MRSA) based on antibiotic sensitivity (MRSA). Drug resistance in *s.aureus* has progressively developed in recent decades as a result of bacterial evolution and antibiotic overuse, the infection rates of MRSA has risen globally, and clinical anti-infective therapy for MRSA has become increasingly challenging (Wang, Y.,2020). Evidence has gathered suggesting that resistance mechanisms of *s.aureus* are quite complicated, particularly for MRSA, that is resistant to a wide range of antibiotics. With the broad use of penicillin in the 1950s, penicillin-resistant *S. aureus* were introduced in the clinic. *S. aureus* strains can develop penicillin resistance by generating enzymes that degrade the antibiotic, such as penicillinase. This is a type of β -lactamase that degrades the β -lactam ring of the penicillin molecule. In order to prevent this, molecules that are resistant to penicillinase have been produced. Among these are methicillin, oxacillin, dicloxacillin as well as flucloxacillin (Rayner and Munckhof, 2005). Genetic mutation and modifications are regarded to be the mechanism that induce *S. aureus* to become resistant to methicillin, resulting in

Methicillin Resistant *s.aureus* or MRSA. Apart from penicillin, Macrolides, lincosamides, as well as streptogramins, initially generated in 1952, are part of a class of antibiotics termed as MLS. They specifically target the bacterial 50S ribosomal subunit, thus suppressing protein production. (Daum, R. S.,1997). As some individuals experience allergy towards penicillin, MLS antibiotics were replaced as an alternative treatment option for *S.aureus*. Basically, MLS acts by modifying the ribosomal thus prevents the antimicrobial agents from binding to its target site.



Figure 2 indicates that the *s.aureus* is susceptible to the antibiotic

(<https://sitn.hms.harvard.edu/flash/2011/issue103/>)

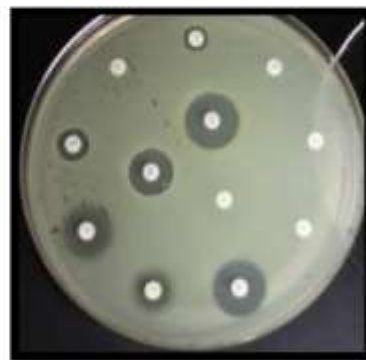


Figure 3 indicates that the *s.aureus* is resistance towards the antibiotic

(<https://sitn.hms.harvard.edu/flash/2011/issue103/>)

TREATMENT OF STAPHYLOCOCCUS AUREUS.

S.aureus infections are treated differently depending on the type of infection and whether or not drug-resistant strains are present. Vancomycin has been regarded as an optimum medication for chronic MRSA infection, both in hospital acquired *s.aureus* as well as community acquired *s.aureus*, that can potentially cause infections like pneumonia and sepsis (Holmes et al., 2015). Vancomycin is often administered via intermittent dosing. It has long been considered the last line of defense against *s.aureus* (Micek, 2007). When antimicrobial treatment is required, the duration and form of treatment are primarily determined by the type of infection and other variables. If isolates are susceptible to MSSA, or methicillin sensitive *S. aureus* strains, penicillin is the treatment of choice, while vancomycin is the drug of choice for MRSA strains. Alternative treatment may be required in addition to antimicrobial therapy in some circumstances. For toxin-mediated disease, fluid replenishment is frequently necessary, as is the removal of foreign devices for prosthetic valve endocarditis or catheter-associated infections. MRSA infections are becoming a severe problem in both the hospital and the community since many MRSA strains are resistant to numerous medications. Besides that, Vancomycin is preferable for the treatment of severe MRSA infections and is only administered intravenously as the oral formulation is poorly absorbed by the gastrointestinal tract. Apart from that, Linezolid (Zyvox) exhibits bacteriostatic effect against *Staphylococcus aureus* and is authorized for the treatment of severe skin and soft-tissue infections, as well as pneumonia, in both adults and children. (Sarah E. Boyd, M.D., 2005).



Figure 5 shows the liquid medicine (vancomycin) for *s.aureus* infection (Han, D. H., 2019)

CONCLUSION

To summarize, *s.aureus* is a severe illness that is associated with both early and late mortality. Methicillin resistance is usually correlated with nosocomial, and healthcare associated infections, and it may be a major cause of mortality in SAB patients. Clinicians should be aware of the extent of *S. aureus* bacteremia in among patients, and infectious disease consultations should always be undertaken to enhance patient outcomes. Vancomycin's limited range of antibacterial action (less effective against MSSA) and the necessity for a slower rate of infusion are two practical drawbacks that may limit its usage in surgery (Elizabeth P Baorto, M. D., 2021). Due to the poor prognosis and significant costs involved with this infection, SAB remains to be an increasing burden on the healthcare system. The most recent epidemiological trends indicate that it is a problem that will develop as the number of at-risk individuals increases, while resistance issues have now expanded from health-care settings to the community. The increased number of patients with prosthetic devices, particularly cardiac devices, seems to be a significant concern, since they contribute greatly to the rising frequency of *Staphylococcus aureus*. To improve the outcomes, a comprehensive plan in the examination of patients with *s.aureus* is required, with a better diagnostic set-up with a greater yield of echocardiography. However, numerous alternative medicines for the treatment of significant MRSA infections have been available in recent years, and a number of prospective antibiotic drugs are in the pipeline. Even though the prospect of future *staphylococcus aureus* treatment appears to be promising, randomized clinical controlled studies are required to demonstrate the significance of these promising new antibiotics for this bacterium (Foster, T. J., 2017).

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