Epidemiology, Pathogenesis, and Management of *Staphylococcus aureus* Infections: Insights and Advances in Resistance Mechanisms

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Abstract

Background: Staphylococcus aureus is a leading cause of both healthcare-associated and community-associated infections, with a marked increase in methicillin-resistant Staphylococcus aureus (MRSA) strains complicating treatment strategies. MRSA presents significant challenges in clinical settings, not only due to its resistance to common antibiotics but also its ability to cause a range of diseases, from minor skin infections to life-threatening conditions such as bacteremia and endocarditis. The increasing prevalence of MRSA in both human and animal populations underscores the urgent need for updated epidemiological data, novel treatment strategies, and enhanced preventive measures. Methods: This review compiles data from multiple studies and clinical reports on Staphylococcus aureus infections, including its molecular mechanisms, epidemiology, pathophysiology, and current therapeutic approaches. We reviewed scientific articles focusing on MRSA epidemiology, genetic mechanisms of resistance (e.g., staphylococcal cassette chromosome mec), and treatment guidelines issued by health organizations. Additionally, the Role of biofilms and virulence factors in Staphylococcus aureus pathogenicity was explored to understand how infections develop and persist. Results: Current findings emphasize a growing concern regarding MRSA, particularly in the context of its increased prevalence in community-associated outbreaks. The genetic underpinnings of methicillin resistance, particularly the role of staphylococcal cassette chromosome mec (SCCmec), continue to evolve, with new variants emerging in both human and animal populations. Recent clinical practice guidelines for MRSA treatment highlight a multifaceted approach, including the use of newer antibiotics, surgical interventions, and, in some cases, the necessity of combining treatments to overcome resistance mechanisms. Studies on the role of biofilms have revealed critical insights into how Staphylococcus aureus evades immune responses and antibiotic treatments, making infections difficult to eradicate. Conclusion: The rising incidence of MRSA infections, coupled with the evolving resistance mechanisms of Staphylococcus aureus, necessitates ongoing surveillance, novel therapeutic strategies, and improved infection control measures Enhanced understanding of biofilm formation, resistance genetics, and virulence factors will be essential for developing more effective treatments and preventive measures. Continued research into the epidemiology and management of Staphylococcus aureus infections is critical to addressing the growing public health threat posed by MRSA.

Keywords: Staphylococcus aureus, epidemiology, methicillin resistance, biofilm formation, clinical management

Significance | Understanding Staphylococcus aureus infections aids in developing better prevention, treatment strategies, and tackling emerging resistance challenges.

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1. Introduction

Staphylococcus aureus is a major bacterial pathogen responsible for a wide range of clinical manifestations in humans. It is a ubiquitous

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organism commonly found in the environment and as part of the normal microbiota on human skin and mucosal surfaces, particularly in the nasal passages of healthy individuals (Sakr et al., 2018). However, when the skin barrier is breached or the organism gains access to internal tissues, it can cause a spectrum of infections ranging from mild superficial conditions to severe, life-threatening diseases such as bacteremia, endocarditis, and toxic shock syndrome (Tong et al., 2015). The clinical significance of *S. aureus* is heightened by its ability to develop resistance to antibiotics, particularly Methicillin-Resistant Staphylococcus aureus (MRSA), posing challenges to infection management and control (Otto, 2018).

Staphylococcus aureus is a highly versatile pathogen, functioning both as a commensal bacterium and a major cause of diverse clinical infections in humans. It colonizes approximately 30% of the human population (Tong et al., 2015) and is a primary agent in a variety of severe conditions, including bacteremia, infective endocarditis (IE), osteoarticular infections, skin and soft tissue infections (SSTIs), pleuropulmonary infections, and device-related infections (Gillespie et al., 2020). In recent decades, the epidemiology of *S. aureus* infections has undergone significant changes. These shifts include an increase in healthcare-associated infections, particularly in cases of IE and prosthetic device infections, and an epidemic of community-associated SSTIs, often driven by methicillin-resistant *S. aureus* (MRSA) strains (Diekema et al., 2019; Pantosti, 2012). Notably, strains exhibiting distinct virulence factors and resistance to β-lactam antibiotics have been pivotal in the rise of these infections (Chambers & DeLeo, 2009). Despite advancements, there is a critical need for high-quality evidence to guide the management of these infections, particularly in emerging or high-risk populations (Kong et al., 2020).

The prevalence of drug-resistant strains such as MRSA has escalated globally, exacerbating the healthcare burden. MRSA's resistance stems from the mecA gene, which encodes a modified penicillin-binding protein (PBP2a) that reduces the efficacy of beta-lactam antibiotics (Katayama et al., 2000). Consequently, infections caused by MRSA require alternative treatment strategies, typically involving vancomycin or other advanced antimicrobial agents. However, the rising prevalence of vancomycin-intermediate and vancomycin-resistant strains further complicates therapeutic options (Liu et al., 2011).

S. aureus infections are also influenced by the bacterium's diverse virulence factors, which include toxins, surface proteins, and biofilm-forming abilities. These factors enable the pathogen to evade the host immune response, establish chronic infections, and resist antimicrobial treatments (Foster, 2019). Biofilm formation on medical devices, for instance, presents significant challenges in clinical management and often necessitates surgical intervention.

The epidemiology of *S. aureus* highlights its pervasiveness across community and healthcare settings. Approximately 30% of the population are transient carriers of *S. aureus*, and 15% are persistent carriers, with higher colonization rates observed in healthcare workers, immunocompromised patients, and those with frequent hospitalizations (Sakr et al., 2018). The ease of transmission via direct contact or fomites underscores the importance of stringent infection control measures, particularly in hospital environments.

This review comprehensively examines the epidemiology, pathophysiology, clinical manifestations, and management strategies of key *Staphylococcus aureus* infection syndromes. While providing an overview of these areas, the primary focus is on bacteremia, infective endocarditis (IE), osteoarticular infections, and skin and soft tissue infections (SSTIs). In-depth discussions of *S. aureus* colonization and the molecular mechanisms of drug resistance, which are covered in recent reviews (Huang & Davis, 2013; Pichon et al., 2012), are excluded. By addressing these critical infection aspects, the review aims to equip clinicians with the latest insights for managing this persistent and challenging pathogen.

The review also discusses a detailed examination of the biology, pathophysiology, and clinical implications of *S. aureus* infections. It explores current diagnostic techniques, treatment strategies, and preventive measures, with a strong emphasis on the need for innovative approaches to combat rising drug resistance. By consolidating existing knowledge, this review identifies research gaps and outlines strategic objectives to mitigate the growing threat posed by *S. aureus*.

This review discussion is multifaceted, aiming to address several critical aspects of *S. aureus* infections. First, it investigates the molecular mechanisms underlying the pathogenicity and drug resistance of *S. aureus*, providing insights into how this bacterium adapts and survives in hostile environments. Second, the review evaluates current diagnostic and therapeutic approaches, highlighting their limitations and areas requiring improvement. Third, it examines emerging trends in antimicrobial resistance and explores innovative solutions to counteract this escalating issue. Finally, the review offers actionable recommendations to improve infection control practices and patient outcomes. By addressing these objectives, it aims to enhance understanding of *S. aureus* infections and contribute to the development of effective solutions for better patient care and public health outcomes.

2. **Etiology of *Staphylococcus aureus* Infections**

Staphylococcus aureus is a Gram-positive bacterium that typically appears purple when subjected to Gram staining. It exhibits a cocci shape and commonly forms clusters resembling bunches of grapes. This bacterium thrives in environments with high salt concentrations, able to survive in media containing up to 10% salt, which is characteristic of its resilience in various settings. On

culture media, its colonies often exhibit a golden or yellow hue, a trait reflected in the bacterium's name, *aureus* (meaning golden). *S. aureus* is a facultative anaerobe, meaning it can grow in both the presence and absence of oxygen, with an optimal growth temperature range of 18°C to 40°C (Lowy, 1998).

The identification of *S. aureus* is typically done using standard biochemical tests. These include catalase positivity, a feature common to all pathogenic *Staphylococcus* species, and coagulase positivity, which distinguishes *S. aureus* from other *Staphylococcus* species (Chambers & DeLeo, 2009). Additional tests include novobiocin sensitivity, used to differentiate *S. aureus* from *Staphylococcus saprophyticus*, and mannitol fermentation, which helps distinguish it from *Staphylococcus epidermidis* (Rasigade & Vandenesch, 2014).

A significant characteristic of *S. aureus* is the presence of methicillin-resistant *S. aureus* (MRSA), which carries the mec gene. This gene, located on the bacterial chromosome as part of the *Staphylococcal* chromosomal cassette mec (SCCmec), provides resistance to a variety of antibiotics, depending on the type of SCCmec region present (Katayama et al., 2000). The mec gene encodes the penicillin-binding protein PBP-2a, which has a reduced affinity for beta-lactam antibiotics, such as methicillin, nafcillin, oxacillin, and cephalosporins, enabling *S. aureus* to continue cell wall synthesis despite the presence of these drugs. This resistance mechanism allows MRSA strains to thrive even in the presence of multiple antibiotics (Huang & Davis, 2013).

3. Epidemiology of *Staphylococcus aureus* Infections

Staphylococcus aureus is primarily found on the skin and mucous membranes of humans, which serve as its main reservoir. It is estimated that up to half of adults carry *S. aureus*, with around 15% of the population carrying the bacterium persistently in the anterior nares (Boucher & Corey, 2008). Certain populations, including healthcare workers, intravenous drug users, and immunocompromised individuals, are at increased risk of colonization, with prevalence rates reaching up to 80% in some high-risk groups (Chambers & DeLeo, 2009).

Transmission of *S. aureus* typically occurs through direct person-to-person contact or via fomites, which are inanimate objects that can harbor the bacteria (Diekema et al., 2019). The emergence of MRSA has contributed to an increase in the incidence of healthcare-associated infections, with community-associated MRSA strains now also becoming a significant concern (CDC, 2003).

3. Pathophysiology of *Staphylococcus aureus* Infections

Staphylococcus aureus is responsible for a broad spectrum of infections, ranging from skin and soft tissue infections (SSTIs) to more invasive conditions like bacteremia, infective endocarditis, osteomyelitis, septic arthritis, and pneumonia (Tong et al., 2015). The pathogenicity of *S. aureus* depends on the specific strain and the site of infection, with some strains causing invasive infections and others triggering toxin-mediated diseases (Dayan et al., 2016).

The ability of *S. aureus* to evade the host immune response plays a critical role in its virulence. Key mechanisms include the production of an antiphagocytic capsule, sequestration of host antibodies, biofilm formation, and intracellular survival (Otto, 2018). For example, in infective endocarditis, *S. aureus* adheres to extracellular matrix proteins and fibronectin through cell wall-associated proteins, such as fibrinogen-binding proteins and clumping factors (Gillespie & Göller, 2020). Additionally, *S. aureus* produces superantigens, particularly toxic shock syndrome toxin-1 (TSST-1), which contributes to diseases like toxic shock syndrome and sepsis (Foster, 2019).

Infections related to prosthetic devices are often exacerbated by the bacterium's ability to form biofilms, which protect the bacteria from both immune responses and antibiotic treatment (Sakr et al., 2018). Biofilm formation is regulated through quorum sensing, a process that allows bacteria to coordinate their behavior based on population density (Otto, 2018). Pneumonic infections caused by *S. aureus* are frequently associated with the production of virulence factors like Panton-Valentine leukocidin (PVL), which is particularly harmful in patients with influenza or cystic fibrosis (Gillespie & Göller, 2020).

4. Clinical Manifestations and Diagnosis

The clinical presentation of *S. aureus* infections is influenced by the infection site and severity. A detailed history and physical examination are essential for diagnosing *S. aureus* infections, as symptoms can vary widely. Common signs of localized infection include erythema, swelling, and abscess formation, while systemic symptoms may include fever, hypotension, and signs of sepsis (Tong et al., 2015). A history of recent hospitalizations, antibiotic use, or underlying health conditions such as diabetes or immunocompromised states can raise suspicion for the presence of MRSA, which requires different treatment approaches (Chambers, 2005).

Physical examination may reveal signs of skin infections, such as impetigo or cellulitis, or more severe presentations like septic arthritis or osteomyelitis. Diagnostic workup often involves culture of infected tissues or blood to confirm the presence of *S. aureus* and its resistance profile (Liu et al., 2011).

Staphylococcus aureus is a highly versatile pathogen responsible for a wide array of infections. Its ability to evade host immunity, form biofilms, and resist antibiotics has made it a particularly challenging pathogen to manage. Understanding the bacterium's etiology, epidemiology, pathophysiology, and clinical manifestations is crucial for improving diagnosis and treatment. As the prevalence of MRSA continues to rise, particularly in healthcare settings, ongoing

research into novel therapeutic strategies and infection control measures is essential to mitigate the growing threat posed by *S. aureus*.

5. Evaluation

The evaluation of a suspected *Staphylococcus aureus* infection involves a combination of clinical assessment, laboratory tests, and microbiological cultures. Initial evaluation typically focuses on identifying characteristic clinical signs and symptoms, such as localized swelling, redness, or systemic manifestations like fever and chills. Routine cultures, including blood and sputum samples, are commonly used to identify the pathogen. However, more advanced molecular diagnostic techniques, such as real-time polymerase chain reaction (PCR) targeting 16S rRNA genes, may be necessary to confirm the presence of *S. aureus* (Rasigade & Vandenesch, 2014). Once the organism is identified, drug susceptibility testing is crucial to determine the appropriate antimicrobial therapy. It is important to note that *S. aureus* can be part of the normal human flora, particularly on the skin and mucous membranes, and its presence in these areas does not automatically indicate infection. Caution should therefore be exercised in interpreting microbiological findings, especially when assessing non-infected individuals or those with localized colonization (Rasigade & Vandenesch, 2014).

6. Treatment/Management

The management of *Staphylococcus aureus* infections is highly dependent on the infection type, as well as the resistance profile of the strain involved. The treatment plan is tailored to the clinical presentation, with particular consideration given to the presence of drug-resistant variants such as methicillin-resistant *S. aureus* (MRSA). For methicillin-sensitive *S. aureus* (MSSA), penicillin remains the first-line treatment. However, for MRSA infections, vancomycin is typically used as the treatment of choice due to its efficacy against resistant strains (Liu et al., 2011). The duration and modality of therapy depend on several factors, including the severity and location of the infection, as well as patient-specific considerations, such as immunocompromised status or comorbidities. In some cases, adjunctive therapies, such as fluid replacement for toxin-mediated diseases or the removal of foreign devices, may be necessary, especially in cases of prosthetic valve endocarditis or catheter-associated infections (Chambers, 2005). The emergence of multi-drug-resistant MRSA strains has made these infections a growing concern, both in hospital and community settings, requiring careful consideration of resistance patterns and appropriate antimicrobial stewardship (Boucher & Corey, 2008; Dayan et al., 2016).

7. Differential Diagnosis

Several conditions may present similarly to *Staphylococcus aureus* infections and should be considered in the differential diagnosis. These include bacteremia, which may present with symptoms such as fever and systemic illness that overlap with those of *S. aureus* infections. Chemical burns can lead to skin lesions that mimic some forms of *S. aureus* infections, such as cellulitis or impetigo. Juvenile idiopathic arthritis and Kawasaki disease both present with systemic inflammation and may share symptoms such as fever and joint involvement. Leptospirosis, caused by *Leptospira* bacteria, can also present with fever and myalgia, while parvovirus B19 infections may cause erythema and joint pain. Pediatric bacterial endocarditis and osteomyelitis, while more localized, can also be mistaken for common soft tissue infections caused by *S. aureus*. Additionally, pediatric serum sickness, characterized by fever, rash, and joint pain, should be considered as a possible differential diagnosis in cases of suspected infection. Accurate diagnosis requires a thorough clinical evaluation, supported by microbiological and serological testing to differentiate these conditions from *S. aureus* infections (Diekema, Beekmann, & Chapin, 2019).

8. Other Issues

The prevention of *Staphylococcus aureus* infections continues to pose significant challenges. Despite extensive research and efforts, the development of a routine vaccine for *S. aureus* infections remains an elusive goal. Consequently, preventive strategies have primarily focused on infection control practices, including hospital decontamination procedures, proper hand hygiene techniques, and guidelines aimed at preventing the transmission of methicillin-resistant *S. aureus* (MRSA) (Sakr et al., 2018). Among these measures, topical antimicrobials such as mupirocin are sometimes used to eradicate nasal colonization in carriers of *S. aureus*, particularly those with nasal carriage of MRSA. However, the overuse of mupirocin has raised concerns, as it may contribute to resistance and impact its long-term effectiveness. Therefore, while decolonization strategies have been implemented in certain settings, their application remains a subject of debate, especially regarding their role in reducing infection rates. Efforts continue to explore more effective preventive measures, including vaccine development and novel antimicrobial therapies, to combat the ongoing challenge of *S. aureus* infections (Foster, 2019; Pichon & Vandenesch, 2012).

9. Enhancing Healthcare Team Outcomes

Staphylococcus aureus infections are commonly encountered by healthcare professionals, including nurse practitioners, primary care providers, internists, and infectious disease specialists. A critical aspect of treatment involves accurately identifying the presence or absence of drug-resistant strains of *S. aureus*, as therapeutic strategies differ significantly depending on the strain.

Antibiotic prescriptions should be carefully considered, with a recommended duration of no more than 7 to 10 days for most infections, as prolonged empirical antibiotic use has contributed to the emergence of resistant strains (Lowy, 1998). Collaborative efforts among healthcare team members are essential in managing these infections effectively. Pharmacists play a vital role in coordinating with clinicians to tailor antimicrobial therapy, ensuring the treatment is appropriate based on the identified pathogen and susceptibility patterns (Liu et al., 2011). Nurses are integral in monitoring patient progress and documenting treatment outcomes, providing necessary data for adjusting the treatment regimen if needed. This interprofessional coordination is crucial for delivering precise and effective care (Foster, 2019). Furthermore, patient education, particularly regarding proper hand hygiene, is vital in preventing the transmission of *S. aureus* infections. An interprofessional team of nurses and physicians should collaborate to educate patients on infection prevention measures, a critical component of reducing the spread of *S. aureus* within healthcare settings (Chambers, 2005).

10. Complications

Staphylococcus aureus infections, particularly those involving methicillin-resistant strains (MRSA), can lead to a range of serious complications. One of the most concerning is bacteremia, where the bacteria enter the bloodstream, potentially leading to sepsis and multi-organ failure if not promptly treated (Tong et al., 2015). Invasive infections caused by *S. aureus*, such as infective endocarditis, can damage heart valves, resulting in heart failure, stroke, or death if untreated (Gillespie & Göller, 2020). Osteomyelitis, or bone infection, is another common complication, often requiring prolonged antibiotic therapy or surgical intervention. Additionally, soft tissue infections like cellulitis and abscesses can escalate if left untreated, leading to deeper tissue damage or systemic infection (Sakr et al., 2018). For patients with prosthetic devices, *S. aureus* can form biofilms, making it difficult for antibiotics to penetrate and effectively treat the infection, potentially leading to chronic infections that necessitate device removal or replacement (Otto, 2018). Toxic shock syndrome (TSS), a life-threatening complication, is characterized by fever, rash, hypotension, and multi-organ failure. The production of superantigens, such as toxic shock syndrome toxin-1 (TSST-1), contributes to the pathophysiology of this condition (Dayan et al., 2016). In addition to these severe complications, patients with *S. aureus* infections may experience prolonged hospitalizations, increased healthcare costs, and a significant reduction in quality of life (Diekema, Beekmann, & Chapin, 2019). Managing these complications requires prompt diagnosis, effective antimicrobial therapy, and, in some cases, surgical intervention to prevent irreversible damage and improve patient outcomes (Huang & Davis, 2013).

11. Health Outcomes

The health outcomes for patients with *Staphylococcus aureus* infections depend on the severity of the infection, the presence of drug-resistant strains like MRSA, and the timeliness of treatment (Boucher & Corey, 2008). Early identification and effective management are critical in preventing complications and improving prognosis. For patients with mild infections, such as superficial skin abscesses, appropriate antimicrobial therapy often results in full recovery. However, for more severe infections like osteomyelitis, endocarditis, or septic arthritis, treatment may require prolonged courses of intravenous antibiotics, and outcomes may be less favorable (Katayama, Ito, & Hiramatsu, 2000). In some cases, surgical interventions, such as debridement or valve replacement, may be necessary to remove infected tissues or prosthetic devices (Chambers & DeLeo, 2009).

For patients with MRSA infections, the prognosis can be more guarded, especially if the infection is resistant to common antibiotics like methicillin, nafcillin, and cephalosporins. These infections often require more potent antibiotics, such as vancomycin or linezolid, and longer treatment durations (Liu et al., 2011). If left untreated, MRSA infections can result in systemic spread, leading to conditions such as septic shock, organ failure, and even death (Tong et al., 2015). In addition to the immediate clinical outcomes, *S. aureus* infections, particularly MRSA, can result in long-term health consequences. Chronic infections or recurrent episodes may necessitate ongoing medical care, including repeated courses of antibiotics and monitoring for resistance (Foster, 2019). The presence of chronic *S. aureus* infections may also affect patients' overall quality of life, causing physical limitations, psychological stress, and a decreased ability to perform daily activities (Pantosti, 2012). Prevention strategies, such as proper hygiene, decolonization, and vaccination efforts, remain essential in mitigating the risk of *S. aureus* infections and improving health outcomes (Pichon & Vandenesch, 2012).

12. Nursing Interventions for Staphylococcus aureus Infections

Nurses play a pivotal role in the management and prevention of *Staphylococcus aureus* infections, which include Methicillin-resistant *Staphylococcus aureus* (MRSA) infections. Effective nursing interventions involve monitoring and administering appropriate antimicrobial therapy and ensuring patient adherence to prescribed treatment regimens (Lowy, 1998; Liu et al., 2011) (Figure 1, Table 1). Nurses also provide essential patient education about completing the full course of antibiotics, recognizing potential side effects, and scheduling follow-up appointments

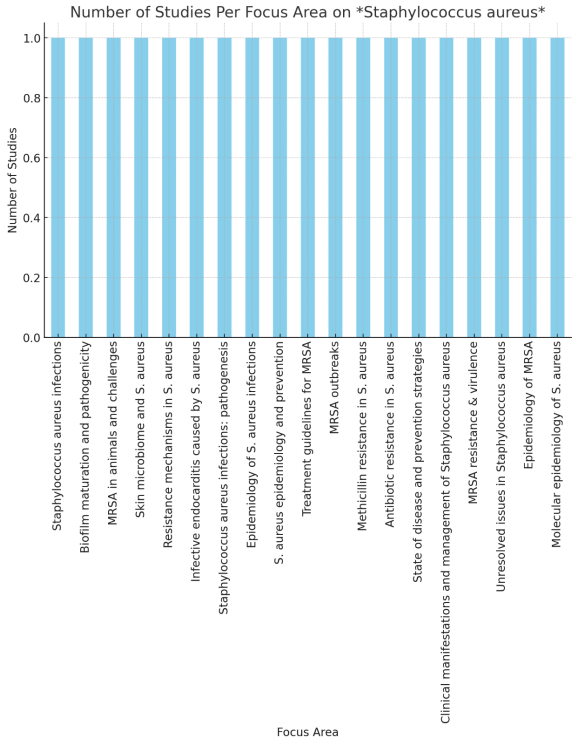

Figure 1. The number of studies in each focus area of *Staphylococcus aureus*.

Table 1. Key studies, their focus areas, and findings related to *Staphylococcus aureus*.

Study	Focus	Key Findings
Lowy FD (1998)	Staphylococcus aureus infections	High prevalence of infections
CDC (2003)	MRSA outbreaks	MRSA outbreaks in healthcare settings
Boucher & Corey (2008)	Epidemiology of MRSA	Increase in drug-resistant strains
Rasigade & Vandenesch (2014)	Unresolved issues in Staphylococcus aureus	Unresolved challenges in pathogenesis
Chambers (2005)	MRSA resistance & virulence	Resistance and virulence factors converge
Tong et al. (2015)	Clinical manifestations and management of S. aureus	Overview of epidemiology, pathophysiology
Dayan et al. (2016)	State of disease and prevention strategies	Prevention strategies and pathophysiology
Foster (2019)	Antibiotic resistance in S. aureus	Growing concern of resistance in S. aureus
Katayama et al. (2000)	Methicillin resistance in S. aureus	Genetic element conferring resistance
Liu et al. (2011)	Treatment guidelines for MRSA	Clinical practice guidelines for MRSA treatment
Otto (2018)	Biofilm maturation and pathogenicity	Role of biofilm in pathogenicity
Sakr et al. (2018)	S. aureus epidemiology and prevention	Current strategies for prevention
Chambers & DeLeo (2009)	Epidemiology of S. aureus infections	Increased resistance in clinical isolates
Diekema et al. (2019)	Staphylococcus aureus infections: pathogenesis	Pathogenesis and clinical management
Gillespie & Göller (2020)	Infective endocarditis caused by S. aureus	Impact of biofilm on endocarditis
Huang & Davis (2013)	Resistance mechanisms in S. aureus	Mechanisms of resistance in S. aureus
Kong & Gallo (2020)	Skin microbiome and S. aureus	Influence of skin microbiome
Pantosti (2012)	MRSA in animals and challenges	Challenges of MRSA transmission in animals
Pichon & Vandenesch (2012)	Molecular epidemiology of S. aureus	Molecular epidemiology and resistance

(Tong et al., 2015). In MRSA cases, the correct use of vancomycin or alternative antibiotics must be ensured, with vigilant monitoring for drug toxicity or adverse reactions (Foster, 2019; Liu et al., 2011). Infection control is another crucial area where nursing interventions are vital. Nurses reinforce the importance of proper hand hygiene to prevent the transmission of *S. aureus* within healthcare settings (Centers for Disease Control and Prevention [CDC], 2003). In wound care, nurses must follow strict protocols for dressing changes and disposal to minimize contamination risks (Rasigade & Vandenesch, 2014). For patients with prosthetic devices, nurses assess for signs of infection and facilitate timely device removal if necessary (Chambers & DeLeo, 2009). Furthermore, patient education on proper wound care and hygiene can help prevent reinfection (Gillespie & Göller, 2020).

In cases of severe infection, such as toxic shock syndrome or sepsis, nurses provide supportive care, including monitoring vital signs, administering fluids, and managing pain (Tong et al., 2015). Psychological support is also essential, as chronic or severe infections can lead to anxiety and depression. Emotional support and facilitating communication between patients, families, and the healthcare team can enhance outcomes and ensure comprehensive care (Dayan et al., 2016).

The increasing prevalence of drug-resistant strains, especially MRSA, complicates the treatment of *S. aureus* infections (Boucher & Corey, 2008). Effective management requires a multifaceted approach, including accurate pathogen identification and resistance profiling. Methicillin-sensitive *S. aureus* (MSSA) infections are typically treated with beta-lactam antibiotics, while MRSA infections necessitate alternative treatments like vancomycin (Katayama, Ito, & Hiramatsu, 2000). Supportive care, infection control measures, and decolonization strategies, such as mupirocin, are essential to reduce transmission and prevent complications (Huang & Davis, 2013).

13. Conclusion

The management of *S. aureus* infections, particularly MRSA, requires a coordinated approach that includes accurate diagnosis, effective antibiotic therapy, infection control, and comprehensive nursing interventions. Nurses play a critical role in ensuring adherence to treatment protocols, educating patients, and preventing the spread of infection. A multidisciplinary approach, incorporating timely interventions and effective communication, significantly enhances patient outcomes and minimizes complications, thus reducing morbidity and mortality associated with *S. aureus* infections.

Author contributions

M.S.A., A.J.A., R.M.A., M.T.A., M.A.A., F.M.A., M.S.A., S.S.A.A., A.A.A., and K.O.A.A. contributed equally to this manuscript. All authors were involved in the conceptualization and design of the study. M.S.A., A.J.A., and R.M.A. conducted the primary research and data collection. M.T.A. and M.A.A. analyzed and interpreted the data. F.M.A., M.S.A., and S.S.A.A. prepared the initial draft of the manuscript. A.A.A. and K.O.A.A. reviewed and revised the manuscript for intellectual content. All authors read and approved the final version of the manuscript.

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Competing financial interests

The authors have no conflict of interest.

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