

Research Article**Prevalence of burn wound infections in the burn unit, Al Noor Specialist Hospital, Makkah, Saudi Arabia****Ghulam Murtaza¹, Osama Fathi Abu Al-Ola².**^{1,2} Specialist Plastic Surgery, Al Noor Specialist Hospital Makkah Saudi Arabia.Emails:^{1*} drgmughal@hotmail.com, ² alreqep@yahoo.com**ABSTRACT****Objectives**

The issue of bacterial wound infection is very high in the healthcare system, especially in burn patients, who are exposed to a very high risk because of the loss of skin integrity and damaged immune system. The most prevalent pathogens that are most likely to be isolated in wound infection caused by burns are *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Acinetobacter baumannii*. This research was conducted to find out which organisms are the leading causes of wound infections in adult and pediatric patients admitted to the burn unit at Al Noor Specialist Hospital, Makkah, and the effect of wound infection on the inpatient stay.

Methodology

This cross-sectional survey involved the use of data that is extracted from the

medical records of the patients through a structured data collection sheet. A review of all the patients who were admitted to the Burn Unit of Al Noor Specialist Hospital, Makkah, Kingdom of Saudi Arabia, in the period between January 2024 and December 2025 was conducted. The sample was selected based on the convenience sampling method using records that were accessible in the Care-Ware electronic medical records system. Therefore, patients with at least one positive culture of the wound were eligible. Since the objective of the study was to cover all the patients with the necessary credentials to be in the study at the time of the study, there was no need to randomize the study. The data obtained were subjected to descriptive and inferential statistical analysis.

Results

Out of 400 patients that were involved in the study, 54.9% were pediatric and 60.8% were males. The commonest organism in the wound culture among minor burn patients was *Staphylococcus aureus*. These isolates had a prevalence rate of 62.5 of methicillin-resistant *Staphylococcus aureus* (MRSA). Infected patients having burns showed longer hospital stay than non-infected patients.

Conclusion

The percentage of pediatric burns is very high, which points to the necessity to develop age-specific prevention and education methods. Moreover, patients with burn wounds have a high morbidity rate due to the infections that are linked with long hospitalization, which explains why the development of early diagnosis and prevention of infection measures is significant.

Keywords: burns, wound infection, Methicillin-resistant staphylococcus aureus

Introduction

Burns injuries are one of the most significant international public health problems and they cause significant morbidity, extended hospital stay and costs on healthcare. The World Health Organization estimates that burns cause one

hundred and eighty thousand deaths each year, with most of these deaths being in the low- and middle-income countries where there is little prevention strategies and limited acute care facilities [1]. Burns are a distinct multidisciplinary clinical entity with long-term physical, psychological, and socioeconomic effects on the survivors [2]. Bacterial wound infections are only one of the numerous complications of burn injuries, as they affect clinical outcome, determine the mortality and hospitalization duration, as well as the overall pattern of recovery [3].

Burn wounds provide an optimal microbial colonization medium since there is the loss of a skin barrier, local immunity is compromised, and the devitalized tissue is present [4]. The severity of burns, presence of involvement of total body surface area (TBSA), and postponement in wound healing are all risk factors that augment the risk of infection [5]. The infection can develop quickly and those affected may develop sepsis, graft failure and dysfunction of multiple organs, especially in resource constrained environments where early detection and infection control measures might be variable [6]. In spite of the development of critical care and antimicrobial treatment, the burn wound

infection remains a significant issue in adult and pediatric patients.

The epidemiology of pathogens of burn wounds differs according to the regions and is characterized by differences in the hospital environment, the practice of antimicrobial stewardship, and the local microbial ecology [7]. Nevertheless, a number of organisms always turn out to be predominant pathogens in burn units around the globe. Staphylococcal species, and in particular methicillin resistant (MRSA), is one of the most commonly isolated species, because it is able to colonize the skin as well as survive in a hospital setting [8]. Other highly prevalent gram-negative organisms include the *Pseudomonas aeruginosa* and *Acinetobacter baumannii* that are common in severe burns and are also linked to multidrug resistance and unfavorable clinical outcomes [9,10]. This rising prevalence of antimicrobial-resistant strains in burn units has intensified the need to have strong surveillance and infection control measures [11].

The pediatric patients of burns are a rather vulnerable group. The burn injuries are more frequent among children because of their development and environmental risk and the insufficient awareness of risks [12].

The immature immune systems and the thin skin they have predisposes them to deeper burns and their immature body makes them more susceptible to infection [13]. It has been established that, relative to adults, pediatric patients experience increased rates of wound colonization and wound infection, which leads to longer patient stay in hospitals and greater healthcare usage [14]. Knowledge of the pathogen patterns in pediatric burn units is thus very crucial in informing empirical therapy and creating specific prevention programs.

The burn injuries in Saudi Arabia comprise considerable amount of emergency and surgical admissions with a considerable percentage of the burden being of the pediatric cases [15]. Other regional reports have indicated changing trends of microbial isolates in the burn units with MRSA, *Pseudomonas* and *Acinetobacter* commonly reported to be the dominant pathogens [16,17]. Nevertheless, the epidemiology of burn wound infections may change in the long run because of the alteration of antimicrobial policies, infection control procedures, and hospital facilities. Local surveillance is thus very essential as it should be never-ending to make sure that the guidelines of empirical treatment are

effective and in line with the current microbial trends [18].

Hospital stay is one of the indicators of the severity of burns and the quality of care. Burn wound infections are long-documented causes of long-term hospital admission, given that they retard wound healing, require further surgical procedures, and augment the necessity of systemic antibiotics [19]. Extended hospitalization does not only raise the costs of healthcare facilities but also exposes the patients to further nosocomial risks, further complicating the recovery process [20]. Knowing the connection between infection and length of stay in particular hospital settings is important to optimize resource allocation and enhance patient outcomes.

Since the pathogen distribution and its outcomes are a key factor in the clinical and economic setting of burn wound infections, it is evident that new, region-specific burn-related wound data is urgently required. The proposed research will focus on determining the most prevalent organisms that cause wound infection in adult and pediatric patients admitted with burns, and the effect of wound infection on hospital stay. Through offering the modern epidemiological insights this study will

assist in evidence based infection control practices and guide future preventive and control solutions in the region.

Methodology

The research was a cross-sectional study and carried out at Al Noor Specialist Hospital, Makkah, Kingdom of Saudi Arabia. Burn unit Al Noor Specialist Hospital is a large regional referral center that takes both pediatric and adult burn cases in Makkah and the areas. All the medical records of the patients who were admitted as a result of burns within the period of January 2024 and December 2025 were examined. The hospital had an electronic medical records system (Care-Ware) that provided the data on a structure data collection sheet that was created in this study.

All the patients admitted to the burn unit during the study period and had at least one positive wound culture were included. Eligible patients were both patients and pediatrics regardless of gender. The patients were not included with incomplete medical records, those with chronic non-healing burn wounds and transferred to other hospitals after initial treatment to avoid confounding the microbial profile and clinical outcomes. The patients who were considered pediatric were the ones aged below 14 years of age,

and this was in line with the local clinical practice.

Only the patients with clinical indications of the possibility of infection provided wound cultures. These were wound deepening, local erythema, purulent discharge, delayed wound healing or systemic signs, including fever or leukocytosis. The wound surface was swabbed with sterile saline in order to cleanse the surface before sample collection. The aseptic method of collecting swabs was applied to the bed of the burn wounds; donor sites were not collected. Only the systemic infection was suspected when the blood culture was drawn due to the presence of fever, hemodynamic instability, or the presence of abnormal white blood cell and platelet count.

The difference between colonization and actual infection was grounded on a synthesis of clinical examination and microbiological guidelines. The wounds were considered to be infected when the patient showed clinical evidence of an infection and when the quantitative culture results revealed a microbial load of more than 10⁵ colony-forming units per gram of tissue. Antimicrobial stewardship in the hospital meant the initiation of systemic

antibiotics after clinical indications of infection.

The information gathered was patient demographics (age and gender), burn description (type of burn, total body surface area involved), microbiological results (isolated organisms, antimicrobial resistance patterns), and clinical outcomes, such as length of stay. Each and every data that was extracted was checked against the completeness and accuracy and then placed in a spreadsheet which was later coded to be analyzed statistically.

The statistical analysis was done with IBM SPSS Statistics Windows Version 25.0 (IBM Corp., Armonk, NY, USA). Data distribution was used to explain quantitative variables like age and length of hospital stay in terms of mean, median, and interquartile range. Gender and microbial isolates as categorical variables were reported in terms of frequencies and percentages. To make comparisons among groups, Continuous variables were compared using the Student t-test or Mann Whitney U test and Categorical variables were compared using Chi square test. A p-value of below 0.05 was regarded as significant.

The study was carried out within the ethical provisions that are presented in the

Declaration of Helsinki. Data collection was done with the help of ethical approval of the Institutional Review Board (IRB) of Al Noor Specialist Hospital. The study upheld patient confidentiality and no information that could be identified was captured or disclosed.

Results

This study involved 400 burn patients. Table 1 gives an overview of the

demographic features of the population in the study. Pediatric patients (n=220; 54.9%) constituted more than half of the patients, and males were the largest number of admissions (n=243; 60.8). The average age was 18.6 years (median 11 years; IQR 28). The median total body surface area (TBSA) was 14.8% (9; IQR 12). The average length of stay was 15.9 days (median 11days; IQR 16).

Table 1 – Demographic characteristics of burn patients (N=400)

Demographic variable	n (%)	Mean	Median	IQR
Age (years)	—	18.6	11	28
TBSA (%)	—	14.8	9	12
Length of stay (days)	—	15.9	11	16
Gender				
Male	243 (60.8)	—	—	—
Female	157 (39.2)	—	—	—

Pediatric (<14 years)	220 (54.9)	—	—	—
Adult (≥14 years)	180 (45.1)	—	—	—

The proportion of the most common types of burns was scald burns (n=168; 42%), flame burns (n=150; 37.5%), contact burns (n=32; 8%), electrical burns (n=28; 7%), chemical burns (n=14; 3.5%), and friction burns (n=8; 2%). The majority of the pediatric population had scald burns (64.5%), and the adults had flame burns (58.2%).

Cultures on wounds were collected on 138 patients (34.5%), and 80 out of 138 (58) of these were positive. A total of 102 patients were sampled (25.5 percent) and 41 (40.2 percent) of the sampled patients gave positive blood test results. Pediatric patients had a slight positive wound culture (60.4)

over adults (55.1). Conversely, pediatric patients had a lower positive blood culture of 29.6% compared to adults (47.8%).

Staphylococcus aureus (34.1%), Pseudomonas aeruginosa (23.4%), Acinetobacter baumannii (10.6), Klebsiella pneumoniae (8.5) and Enterobacter cloacae (7.1) were the most commonly isolated bacteria in wound cultures. Out of all S. aureus isolates, 62.5 represented the number of methicillin-resistant Staphylococcus aureus (MRSA), and 37.5 was the number of methicillin-sensitive Staphylococcus aureus (MSSA) isolates. These events are highlighted in the table 2.

Table 2 – Microorganism profile of wound and blood cultures

Microorganism	Wound cultures (%)	Blood cultures (%)
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MRSA	21.3	19.5
MSSA	12.8	7.3
<i>Pseudomonas aeruginosa</i>	23.4	4.9
<i>Acinetobacter baumannii</i>	10.6	9.8
<i>Klebsiella pneumoniae</i>	8.5	14.6
<i>Enterobacter cloacae</i>	7.1	4.9
Coagulase-negative Staphylococci	3.5	22.0
<i>Candida albicans</i>	2.1	3.7
Other Gram-negative bacilli	10.7	13.3

S

. aureus was the most prevalent pathogen in the patients with 40% or higher burn (31.8%), *Pseudomonas aeruginosa*

(27.3) and *Acinetobacter baumannii* (18.2%). Conversely, patients with TBSA less than 40% had better percentages of

MSSA coupled with reduced Gram-negative isolates.

Patients then who harbored positive wound cultures had a considerably long duration of stay in the hospital than those who had negative culture (mean 21.4 vs. 12.7 days; $p < 0.01$). On the same note, positive blood cultures were linked with increased hospitalization (mean 26.2 vs. 14.1 days; $p < 0.001$). Expansion of TBSA also had a close correlation with protracted length of stay ($p < 0.001$).

Comparing the age groups on culture positivity, pediatric patients showed a bit of higher percentage of positive wound

cultures with 60.4 percentage of the pediatric wound cultures giving positive cultures. Conversely, the wound cultures of adults were positive in 55.1. The trend was different in blood cultures: blood cultures in pediatric patients were only positive in 29.6 percent of cases, but in adults, the proportions of positive results were much higher (47.8 percent). This suggests that wound infections were more prevalent in children, but bloodstream infections were more prevalent in adults, which is indicative of the possible differences in the severity of burns, systemic responses, or comorbidity between the two groups.

Table 3 - Culture Break down group wise

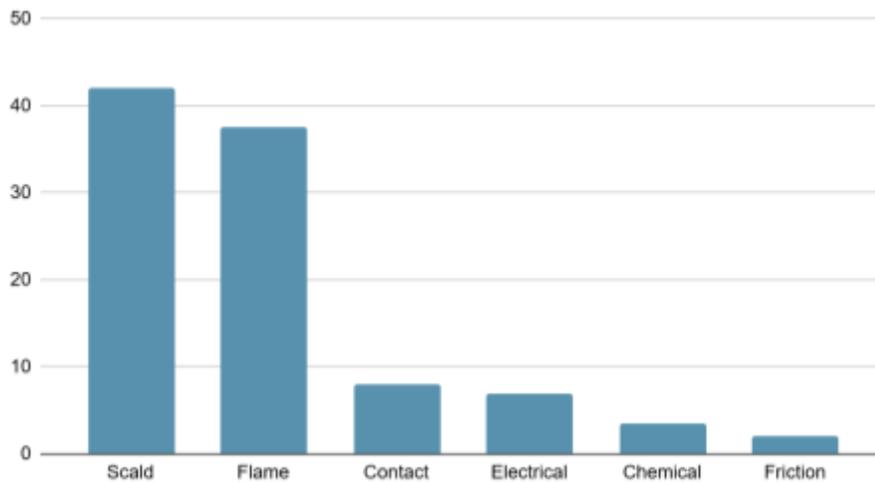
Group	Wound cultures positive	Blood cultures positive
Pediatrics	60.4%	29.6%
Adults	55.1%	47.8%

The most common pattern of injury in this cohort was scald burns with 42 percent of all admissions being scald burns.

Next, flame burns (37.5) also occurred and were more prevalent in adults. Other less common mechanisms were contact burns

(8%), and electrical (7%), which were seen equally in all the age groups, but in older children and young adults were a little bit more common. The percentage of chemical burns was found to be 3.5% of the sample with the lowest percentage of 2% of all injuries being friction burns. All in all, there

is a preponderance of scald injuries especially among the younger patients and flame burns constitute the second major class of burn mechanisms in the study population. The following are the percentages of these in the image below.



MRSA infection did not have significant effects on length of stay when compared to MSSA ($p=0.62$). Nonetheless, Gram-negative patients especially patients with *Pseudomonas aeruginosa* were more likely to stay longer at the hospital but this was not statistically significant.

Discussion

Burn injuries have remained a significant clinical and population health

issue, especially in areas in which a significant number of cases are of the pediatric type. In the current research, over fifty percent of all admissions were children, which was equivalent to global data indicating that pediatric patients are still a disproportionately affected group of scald injured. This observation is consistent with the detentions in Tunisia and North Africa, where children accounted 48-60% of

hospitalizations, scalding being the most common one [21]. The same trends have been reported in southeast Asia whereby domestic scald injuries are the cause of the majority of childhood burns [22]. The large percentage of the pediatric cases in our cohort justifies the importance of specific preventive measures that can be aimed at household safety and prevention education of those involved.

In our study, flame burns were more prevalent in adults and this observation is also consistent with a large multicenter study conducted in China where flame injuries constituted most of the adult burn admissions and were linked to extensive TBSA and deep burns [23]. This trend can be due to work exposures, poor cooking habits or more risk-taking activities by adults. The patterns of burns occurring in our population are thus comparable to those observed in rest of the world with regard to epidemiology implying that the prevention interventions have to be age specific and contextual.

Burn patients are still under morbidity that is largely determined by infection. In our research, 58 percent of wound cultures were positive and 40.2 percent of blood cultures were positive with

higher rates of bloodstream infection among adults. This can be compared to the Turkish cohort, which reported 55% positive wound cultures and 38-percent positive blood culture, indicating that the burden of infection is still persistent in the burn units [24]. The results of our study, that were dominated by *Staphylococcus aureus* in wound culture, are in line with those of a large Indian burn center where *S. aureus* was the dominant pathogen in colonization of burn wounds in the early period [25]. But our relatively high ratio of *Pseudomonas aeruginosa* and *Acinetobacter baumannii* is an indication of the shift to the prevalence of Gram-negatives, which is becoming more universal in contemporary burn units.

Our study rate of 62.5% of all *S. aureus* isolates of MRSA is high but not as high as the 82.5% in the previous Saudi study in the same area. International comparisons are very varied: a study in South Korea found MRSA rates in burn wounds of 58% [26], a Canadian burn unit found MRSA in 22% of *S. aureus* isolates [27]. Such differences are probably due to differences in antimicrobial stewardship, infection control measures, and the local microbial ecology. Notably, as with the similar reports on the United States and

Europe, the MRSA infection did not have a significant effect on the length of stay in our cohort, which implies that the early detection of the infection and the provision of treatment with the proper antimicrobial agent can help to limit its clinical effects [28].

The second most frequent pathogens in our wound cultures were gram-negative, especially *Pseudomonas aeruginosa*. This reflects the results of a large Egyptian study, where *Pseudomonas* was a cause of 24-40 per cent of burn wound infections and with a strong relation to severe burns and slow healing rates [29]. Our study shows high prevalence of *Acinetobacter baumannii* in patients with 40% or more TBSA, which is also similar to the reports done in Greece and Italy, which have noted that *Acinetobacter* has become a leading pathogen in severe burns and ICU [30]. These species are characterized by multidrug resistance and environmental persistence, which is why the strict measures of infection control are essential.

Patients who had positive wound or blood culture had much longer length of stay in hospital which is in line with various international studies. A Brazilian cohort sample showed that the length of stay of

infected burn victims was almost twice that of non-infected victims [31]. Likewise, another research on the United Kingdom observed that bloodstream infections had an average length of stay of 12-18 days [32]. The results of our study support the high clinical and financial cost of burn-related infections and emphasize the need to detect and treat such infections early, apply antimicrobial treatment promptly, and implement powerful infection prevention measures.

In general, the current paper will bring new epidemiological and microbiological information on one of the largest burn units in Saudi Arabia. The results are consistent with the trends in the rest of the world and showcase the specific issues in the region, particularly a high rate of pediatric scald injuries and still prevalent MRSA and Gram-negative microbes. The insights can be used to guide specific prevention efforts, antimicrobial stewardship efforts, and future research to enhance the outcomes of burn care.

Conclusion

The current pre-eminence of pediatric scald injuries and the high impact of burn-associated infections in our environment is reflected in this study.

Staphylococcus aureus, especially MRSA, was the most predominant pathogen, whereas the Gram-negative organisms were more prevalent in larger burns. The MRSA was not found to extend hospital stay however, wound and bloodstream infections were strongly linked with longer hospitalization. These results highlight the importance of specific measures in the prevention, enhanced infection control actions, and continuing antimicrobial stewardship to enhance outcomes among burn patients.

Source of Funding: None

Permission: Ethical consent received.

Conflict of interest: None

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