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Different Infection Profiles and Antimicrobial Resistance Patterns between Burn Intensive Care Unit (ICU) and Common Wards

Dr. Mohammad Ekramul Haque[1*], Dr. Md. Abdullah Tareq Bhuiyan[2], Dr. Rebeka Sultana[1], Dr. Amina Rahman[3], Dr. Malaya Kumar Das[4], Dr. Noor-E-Alam Siddique[5], Dr. Shamim Ara Sultana[6]

[1]Assistant Professor, Department of Anaesthesiology, Sheikh Hasina National Institute of Burn and Plastic Surgery (SHNIBPS), Dhaka, Bangladesh
[2]Assistant Professor, Department of Anaesthesiology, Dhaka Medical College, Dhaka, Bangladesh
[3]Assistant Professor, Department of Anaesthesiology, Sheikh Hasina Medical College, Jamalpur, Bangladesh
[4]Associate Professor, Department of Anaesthesiology, Sheikh Hasina National Institute of Burn and Plastic Surgery (SHNIBPS), Dhaka, Bangladesh
[5]Associate Professor, Department of Anaesthesiology, Dhaka Medical College, Dhaka, Bangladesh
[6]Medical Officer, Department of Anaesthesiology, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

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***Corresponding author:** Dr. Mohammad Ekramul Haque
Assistant Professor, Department of Anaesthesiology, Sheikh Hasina National Institute of Burn and Plastic Surgery (SHNIBPS), Dhaka, Bangladesh. Email: sajal1253@gmail.com.

Abstract **Original Research Article**

Background: Infection is the most common cause of deaths after burns. However, the difference in infection patterns between the burn intensive care unit and burn common wards has no longer been really investigated. The current study finds out about aimed to evaluate infection profile, antimicrobial resistance, and changing patterns in burn patients in burn intensive care unit (ICU) and common wards. ***Objectives:*** The aim of the study to compare the infection profile, antimicrobial resistance, and their changing patterns in burn patients. ***Methods:*** Clinical samples were analyzed between April 2021 to March 2022 in Sheikh Hasina National Institute of Burn and Plastic Surgery, Dhaka, Bangladesh. The patient information, pathogen distribution, sources, and antimicrobial resistance were retrospectively collected. A total of 250 and 275 strains were detected in burn intensive care unit (ICU) and Common Wards, respectively. This cross- sectional study was done among patients to diagnose as different infection profiles and antimicrobial resistance patterns between burn ICU and common wards. ***Result:*** Out of 525 patients, the study population of the Burn Intensive Care Unit was 250, and the Burn common wards were 275. Most of the patients in Burn Intensive Care Unit 142(56.8%) were 18 to 30 years and Burn Common Wards 153(55.63%) belongs to 18-30 years age group. The majority of the patients in the Burn Intensive Care Unit 52.4% were flame burn and in common wards 46.27% were electric burns. In burn Intensive Care Unit, the most common pathogen sources (47.6%) were wound tissue, and in Burn common wards (90.90%) were wound tissue. ***Conclusion:*** Our existing study indicates that the infection profile is specific between burn Intensive Care Unit (ICU) and common Wards, and multidrug resistance is extra serious in burn intensive care unit (ICU) than in common wards. Therefore, exceptional infection-control techniques ought to be emphasized in extraordinary burn populations.

Keywords: burn intensive care unit, burn common wards, burn intensive care unit (ICU), common wards, antimicrobial.

INTRODUCTION

Infection is the most frequent complication and the main motive of loss of life in burn sufferers [1]. According to one estimate burn injuries account for an estimated 265,000 deaths annually across the globe and 40 per cent of these burn injuries occur exclusively in South and Southeast Asia. In Bangladesh, more than 3000 people are died from burn injuries annually [2]. Burn patients are predisposed to infection due to the fact of the loss of skin barrier protection and the acquired immunosuppression. The diagnosis of infection relies upon on physical examination, infection biomarker detection, and microbiology culture. Antibiotic use and wound care are two necessary components of infection manipulate [1]. However, the first use of antibiotics is commonly carried out except microbiological results, broadly speaking primarily based on the epidemiology of microbiology. Therefore, it is imperative to inspect the pathogen distribution,

antimicrobial resistance, and their altering patterns to direct antimicrobial Prescription and reduce antimicrobial misuse. Numerous research exhibits that burns infection is positively associated with burn severity, such as burn area, burn depth, inhalation injury, and burn severity scores. Therefore, one-of-a-kind infection manages and treatment strategies need to be utilized with extreme and no extreme burn patients. In our center, extreme burn patients, who have giant burn areas (children: >30%, adults: >50%), suffered >10% whole body surface area (TBSA) of full-thickness burns, want tracheotomy or mechanical ventilation, or blended with inhalation injury or complicated with different injuries, are enrolled in the burn intensive care unit burn intensive care unit (ICU)), which is on a separate flooring from common wards. In a 1-year preliminary study, we beforehand discovered that the profile and antibiotic resistance of microorganisms in the burn intensive care unit (ICU) have been needless to say unique from these in burning frequent wards (common wards) [3]. However, the sample size used to be extraordinarily low, and many new techniques of wound care, poor strain wound therapy, have been extensively utilized in current years [4]. Furthermore, pathogen distribution and antimicrobial resistance may have modified a lot in the previous 9 years. As a result, it is pressing to inspect the adjustments in microbiology and the infection profile of burn patients and confirm the variations between the burn intensive care unit (ICU) and common wards.

MATERIALS AND METHODS

This research was carried out on a descriptive and cross-sectional observational study. The research was conducted between April 2021 to March 2022 in Sheikh Hasina National Institute of Burn and Plastic Surgery, Dhaka, Bangladesh on Burn ICU and Common Wards. Here, included 525 patients of this study, of these 250 populations admitted Burn Intensive Care Unit and rest of the 275 patient's population in common words. The age of the population in this study was defined as 18 and older. Data were collected from the burn microbiology laboratory in this institute and from medical records. The following data were extracted: demographic data (gender, age), clinical features (burn etiology, burn area), sample sources, microbe type, and antimicrobial resistance. A repeated result of the same pathogen from the same sample source of the same patient was excluded. However, the same pathogen from a different sample source of the same patient was included.

RESULTS

Table I: Study Population of burn patients in Burn Intensive Care Unit and Burn Common Wards

	Burn Intensive Care Unit n (%)	Burn Common Wards n (%)
Total Sample	250	275

Table I shows Study Population of burn patients in Burn Intensive Care Unit and Burn Common Wards where the patients of Burn Intensive Care Unit were 250 and Burn Common Wards were 275.

Table II: Age distribution of burn patients in Burn Intensive Care Unit and Burn Common Wards

Age Distribution	Burn Intensive Care Unit n (%)	Burn Common Wards n (%)
18-30	142(56.8)	153(55.63)
31-40	53(21.2)	59(21.45)
41-50	40(16)	44(16)
51-60	15(6)	19(6.9)

Table II shows that age distribution of burn patients in Burn Intensive Care Unit and Burn Common Wards. Based on Burn Intensive Care Unit, where 142(56.8%) were 18 to 30 years, 53(21.2%) were 31 to 40 years, 40(16%) were 41 to 50 years and 15(6%) were 51 to 60 years. And according to Burn Common Wards, where 153(55.63%) were 18 to 30 years, 59(21.45 %) were 31 to 40 years, 44(16%) were 41 to 50 years and 19(6.9%) were 51 to 60 years.

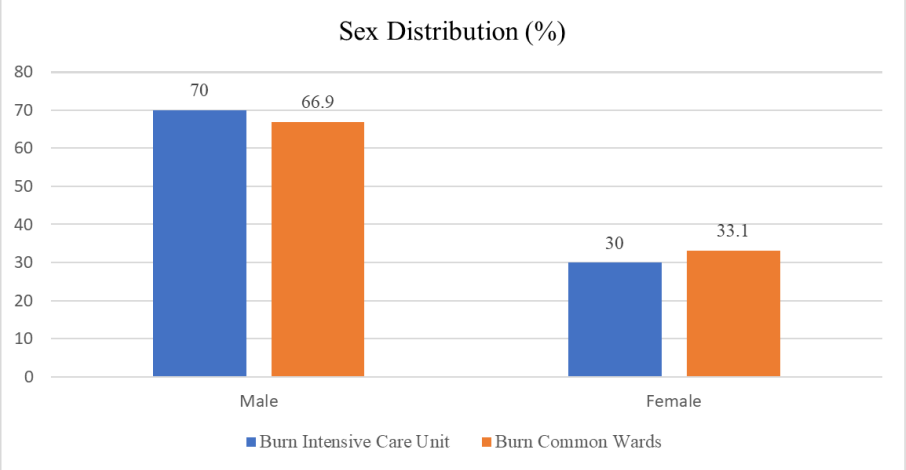

Figure I: Sex distribution of burn patients in Burn Intensive Care Unit and Burn Common Wards

Figure I show that age distribution of burn patients in Burn Intensive Care Unit and Burn Common Wards. In Burn Intensive Care Unit 70% was male and 30% were female. And in Burn Common Wards 66.9% were male and 33.1% were female.

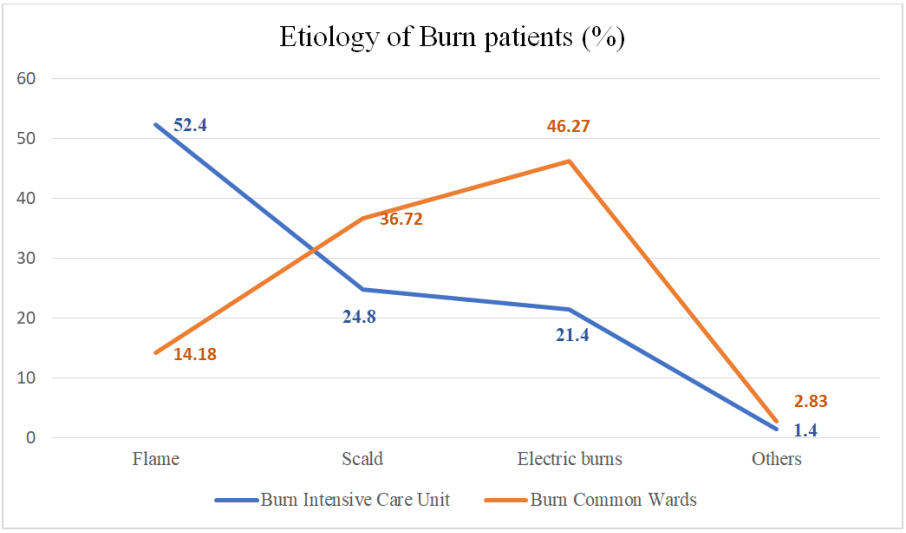

Figure II: Etiology distribution of burn patients in Burn Intensive Care Unit and Burn Common Wards

Figure II show the Etiology distribution of burn patients in Burn Intensive Care Unit and Burn Common Wards. In Burn Intensive Care Unit 52.4% were Flame, 24.8% were Scald, 21.4% were Electric burns and 1.4% were others. And in Burn Common Wards 14.18% were Flame, 36.72% were Scald, 46.27% were Electric burns and 2.83% were others.

Table III: Pathogen sources of burn patients in Burn Intensive Care Unit and Burn Common Wards

Age Distribution	Burn Intensive Care Unit n(%)	Burn Common Wards n(%)
Wound tissue/secretion	119(47.6)	250(90.90)
Sputum	16(6.4)	6(2.18)
Blood	43(17.2)	5(1.82)
Urine	37(14.8)	10(2.16)

Table III shows that Pathogen sources of burn patients in Burn Intensive Care Unit and Burn Common Wards. Based on Burn Intensive Care Unit, where 119(47.6%) were Wound tissue, 16(6.4%) were Sputum, 43(17.2%) were Blood and 37(14.6%) were Urine. And in Burn Common Wards, where 250(90.90%) were Wound tissue, 6(2.18%) were Sputum, 5(1.82%) were Blood, 10(2.16%) were Urine.

DISCUSSION

The infection has continually been a great challenge of burn treatment, and MDR has come to be a

world health challenge in current years. This study finds out about confirms that infection profiles confirmed special patterns between patients in burn intensive care unit (ICU) and common wards. This study finds out about the Study Population of burn patients in Burn Intensive Care Unit and Burn Common Wards where the patients of Burn Intensive Care Unit were 250 and Burn Common Wards were 275. In particular, P. aeruginosa, K. pneumoniae and A. baumannii had been the three most frequent pathogens in burn intensive care unit (ICU) in contrast with P. aeruginosa, K. pneumoniae and A. baumannii in common wards. Third, the occurrence of MDR bacteria, such as P. aeruginosa, K. pneumoniae and A. baumannii, are greater in burn intensive care unit (ICU) than in common wards. This study also finds out about additionally discovered that Carbapenem-resistant K. pneumoniae (CRKP) and P. aeruginosa, K. pneumoniae and A. baumannii extensively improved from 2011 to 2019 in each burn intensive care unit (ICU) and common wards, however Carbapenem-resistant P. aeruginosa for sure reduced from 62.2% to 20% in burn intensive care unit (ICU). Last, fungal susceptibility was once decreasing in burn intensive care unit (ICU) than that in common wards though fungal distribution was once comparable between burn intensive care unit (ICU) and common wards. Therefore, different infection manipulation techniques ought to be emphasized in exceptional burn populations.

In this study, the age distribution of burn patients in Burn Intensive Care Unit and Burn Common Wards. Based on Burn Intensive Care Unit, where 142(56.8%) were 18 to 30 years, 53(21.2%) were 31 to 40 years, 40(16%) were 41 to 50 years and 15(6%) were 51 to 60 years. And according to Burn Common Wards, where 153(55.63%) were 18 to 30 years, 59(21.45 %) were 31 to 40 years, 44(16%) were 41 to 50 years and 19(6.9%) were 51 to 60 years.

The pattern sources and pathogen distribution with the aid of pattern kind have been additionally special between burn intensive care unit (ICU) and common wards. More than 90% of samples have been wound secretions and tissues in COMMON WARDS in contrast with almost 50% in burn intensive care unit (ICU). Accordingly, the percentages of blood, sputum, and urine had been appreciably greater in burn intensive care unit (ICU) than in common wards. This ought to be defined through organ dysfunction being particularly frequent in extreme burn sufferers in burn intensive care unit (ICU), and invasive inspection and remedy had been frequently carried out to guide and reveal organ features [4], which improved the threat of infection of the bloodstream and urinary and respiratory tracts. Because microorganism composition might also be distinct by using specimen type [5], we in addition analyzed the pathogen distribution in one-of-a-kind scientific pattern types. Although Gram-negative bacteria had been predominant In Wounds from Patients In burn intensive care unit (ICU) and common wards, S. aureus was once the most frequent bacteria, which is regular with previous research [6-8]. This may want to be partly defined via staphylococcus being the main normal flora in the skin; however, the variety of frequent Gram-positive bacteria types decreases than these of frequent Gram-negative bacteria sorts [9]. Overall, P. aeruginosa, K. pneumoniae and A. baumannii had been the three essential bacteria in wounds, blood, sputum, and catheters in sufferers from burn intensive care unit (ICU) and common wards. In the equal pattern type, the percentage of P. aeruginosa, K. pneumoniae and A. baumannii have been greater in patients from burn intensive care unit (ICU) than in patients from common wards, however, the proportion of S. aureus was once greater in sufferers from common wards than in sufferers from burn intensive care unit (ICU). Our preceding effects guide the thought that entheogenic contamination is inclined to show up in extreme burn patients in burn intensive care unit (ICU) [3]. Furthermore, a current meta-analysis diagnosed prior publicity to carbapenems and extended-spectrum cephalosporins, urinary/arterial/venous catheter use, mechanical ventilation, and transfusion as the principal modifiable danger elements for Gram-negative contamination in burn sufferers [10]. The above risk factors usually exist in burn patients in burn intensive care unit (ICU).

In line with a number of different researches [10-12], P. aeruginosa, K. pneumoniae and A. baumannii are the predominant Gram-negative bacteria in burn intensive care unit (ICU) and common wards. Overall, the resistant price of P. aeruginosa, K. pneumoniae and A. baumannii steadily accelerated in burn intensive care unit (ICU) and common wards even though the resistance price of P. aeruginosa lowered in burn intensive care unit (ICU) and stayed low in common wards [13]. However, the curves of exclusive antibiotic resistance rates are tending to unanimity, which means rising MDR bacteria. Fortunately, all the Gram-negative bacteria have been touchy to tigecycline and polymyxin B. Prevalence of carbapenem-resistant Gram-negative bacteria has emerged as the main world public health problem due to the fact of excessive mortality and poor effective antibiotics. In our center, the main carbapenem-resistant Gram-negative bacteria have been P. aeruginosa, K. pneumoniae and A. baumannii, which encompass K. pneumoniae, E. coli, and E. cloacae. The carbapenem resistance price of P. aeruginosa, K. pneumoniae and A. baumannii was once continuously at an excessive degree in burn intensive care unit (ICU) (>90%) and expanded from about 60% in 2011–2013 to 81.8% in 2019. The carbapenem resistance fee of P. aeruginosa in burn intensive care unit (ICU) substantially reduced from 2011 to 2019 and was once equal to that in common wards in 2019 (about 20%). Furthermore, the carbapenem resistance price of K. pneumoniae considerably extended in each burn intensive care unit (ICU) and common wards and used

to be about 40% in 2017–2019. [8, 14]. However, the carbopenem resistance of P. aeruginosa, K. pneumoniae and A. baumannii is greater extreme in our middle than in all of China (Hu *et al.,* 2019) (73.6% in P. aeruginosa, K. pneumoniae and A. baumannii, 27.5% in P. aeruginosa, 25.3% in K. pneumoniae). In fact, the destroyed pores and skin barrier and non-stop antibiotic redress now not solely make burn devices the breeding floor for all these MDR organisms, however, they additionally make burn contamination greater extreme and more frequent than others [15]. The levofloxacin resistance by means of P. aeruginosa, K. pneumoniae and A. baumannii started to fall in 2015, which was once comparable to P. aeruginosa in burn intensive care unit (ICU). Strict management of the medical use of levofloxacin usually contributed to this phenomenon due to the fact resistance to levofloxacin was once very frequent and extreme earlier than 2015. After 2015, tigecycline, polymyxin B/colistin, betalactamase inhibitor, and carbapenem had been encouraged for the cure of P. aeruginosa, K. pneumoniae and A. baumannii different Gram-negative bacteria. Furthermore, the alternate of key resistance genes, such as gyrA and parC, would possibly additionally lead to the fall of levofloxacin resistance. However, extra lookup is wished to verify the gene adjustments in the future.

In our study, the Pathogen sources of burn patients in Burn Intensive Care Unit and Burn Common Wards. Based on Burn Intensive Care Unit, where 119(47.6%) were Wound tissue, 16(6.4%) were Sputum, 43(17.2%) were Blood, 37(14.6%) were Urine and 5(2.0%) were others. And according to Burn Common Wards, where 250(90.90%) were Wound tissue, 6(2.18%) were Sputum, 5(1.82%) were Blood, 10(2.16%) were Urine.

Invasive fungal infections are one of the most extreme issues in burn patients and are related to negative consequences (Maurel *et al.,* 2020) [16]. Burn wounds are the predominant sources of fungi in our center, comparable to Pakistan (Jabeen *et al.,* 2020) [17]. However, the incidence of fungal infection is decreased in our middle (11.8% in burn intensive care unit (ICU) and 8.1% in common wards) than in India (26%) (Sharma *et al.,* 2016) [18] and comparable to that inMorocco (10%) (Rafik *et al.,* 2016) [19]. C. Albicans had been the most frequent yeasts in India and Morrocco, and C. tropicalis used to be the most frequent in Pakistan. However, C. Albicans is the most frequent in our center. Although the recommendations for fungal infection diagnosis and therapy have been applied on account that 2013 (Luo *et al.,* 2014) [20], the prognosis and therapy of invasive fungal infections are nevertheless nonspecific and inadequate. Therefore, it is vital to understand burn patients with high-risk elements of fungal infection. Several researches exhibit that massive burn region and depth, extended broad-spectrum antibiotic therapy, and improved postburn days had been chance elements for fungal infections in burn patients [17, 19]. Bacterial coinfection and the presence of allografts may want similarly amplify the mortality of patients with fungal infections [16]. In this study, we additionally determined that 45.2% and 58.6% of patients with fungal infections have difficulty with a bacterial infection in common wards and burn intensive care unit (ICU), respectively. Our preceding learns confirmed that 54.63% of foremost burn patients with candidemia had bacteremia [21]. Therefore, our results, in part, guide that bacterial coinfection ought to extend the threat of fungal infection. Further scientific investigations with giant pattern sizes in a couple of facilities are nonetheless required to verify these findings. Our consequences additionally discovered that amphotericin B was once the most positive agent for fungi, accompanied by voriconazole and fluconazole. However, the susceptibility rate of non-albicans candida to voriconazole and fluconazole considerably decreased. Unfortunately, we have now not automatically detected sensitivity to echinocandins. Amphotericin B and voriconazole had been the antifungal drugs used most often in our center.

This study about in addition confirms that contamination profile suggests specific patterns between burn patients in burn intensive care unit (ICU) and common wards. Pathogen distribution additionally differed with the aid of pattern sources. Lower percentages of Gram-positive bacteria and greater percentages of Gram-negative bacteria and fungi had been located in burn intensive care unit (ICU) than in common wards. P. aeruginosa, K. pneumoniae and A. baumannii have been the most frequent pathogens even though the ranks have been one of a kind in burn intensive care unit (ICU) and common wards. Furthermore, the drug-resistance rates of nearly each and every pathogen had been greater in burn intensive care unit (ICU) than in common wards, and the MDR bacteria, specially the CREs, grew to be a clear and serious chance in current years. The prevalence rate of MRSA stayed at an excessive degree in burn intensive care unit (ICU). Regarding the exclusive elements of microbiological epidemiology between burn intensive care unit (ICU) and common wards, different target strategies of infection control and prevention should be formulated and implemented for different burn populations.

Limitations of the Study

This was a cross-sectional study with a small sized sample. So, the findings of this study may not reflect the exact scenario of the whole country.

CONCLUSION

Appropriate infection manipulates policies, particularly cleans care, may want to be beneficial for reducing the infection rate and resistance pattern and optimizing affected person care. Moreover, understanding the antimicrobial pattern of resistance in

burn facilities can grant appropriate treatment for these victims. Knowing the resistance pattern in the hospital setting, we can manipulate the use of antibiotics in kind, time, and dose.

RECOMMENDATION

This study can serve as a pilot to much larger research involving multiple centers that can provide a nationwide picture, validate regression models proposed in this study for future use and emphasize points to ensure better management and adherence.

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