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# The Frequency of Bacterial Colonization in Burn Wounds and Antibiogram pattern in Patients Hospitalized in the I.C.U of Velayat Burn and Reconstructive Surgery Center in Rasht City

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**ABSTRACT**

**Background and aim:** Bacterial infection and antibiotic resistance of their etiologic agents are among the most critical challenges facing the burn units. Updated information of bacterial agents causing infection and their resistance patterns has an essential role in the control and empirical treatment of burn infections. This study aims to determine the frequency of bacterial colonization in burn wounds.
**Material and methods:** The research designed as a descriptive-cross sectional study. Of two years, 84 patients hospitalized in a burn center in Rasht from September 2013 - September 2015 have examined. To determine the antimicrobial susceptibility of the isolates disc diffusion method or Kirby - Bauer were used. For this, we used common antibiotics in the treatment of burn infections, all of which were made by Haymdya Company. Data were analyzed using SPSS Ver16.
**Results:** The mean age of the patients was 40.72 ± 21.06 years. In this study, 64.3% and 35.7% of patients were male and female. Pseudomonas Aeruginosa (68.6%) was the most common microorganisms that cause infection and then was placed Klibsella (15.7%) and Proteus (10.7%). Most antibiotic resistance was Sulfamethoxazole, Cefotaxime, Ceftazidime, and Cefalexine; on the other hand, most antibiotic sensitivities include Ciprofloxacin, Piperacillin, and Tetracycline.
**Conclusion:** The results showed that bacteria such as Pseudomonas Aeruginosa, Klebsiella, and Proteus bacteria are common in the Velayat burn center. The main problem is the proper use of diagnostic techniques and drug therapies, especially antibiotics, may also reduce the risk of nosocomial infection.

## 1. Introduction

The burn is one of the essential accidents related to human health, which highly regarded due to its severe complications and high mortality rate.[1, 2] The severe physical and mental consequences of the accident and the long-term hospital care required, along with multiple reconstructive surgeries and extensive rehabilitation, and rehabilitation are warranted. The Burn is one of the most expensive diseases and the economic and financial pressures on the patient and those around him, and, ultimately, the country can be contemplated.[3, 4] In general, the sixth leading cause of accidental deaths in the United States burns, and the most common is heat burns. Of all the burns in the United States, about 2 million require medical care annually, 75,000 of which result in hospitalization. These hospitalizations may be short-term or even longer than two months (25,000 cases a year). These statistics show the importance of burns and their associated problems.[5] Burn wounds are an excellent place for bacterial contamination. They are both because of the damage to the skin, which is the first barrier against infection, and because of the scar tissue lacking blood vessels that provide a suitable environment for the growth of microorganisms. These conditions provide the basis for the development of multidrug resistance as well as sepsis.[6, 7, 8] Typically, burns divided into thermal, electrical, and chemical types. These injuries can destroy layers of skin. In the first degree burn, only the epidermis damaged, in the second degree burn the epidermis and part of the dermis, and in the third degree, the whole dermis damaged.[7] Grade 4 burns also involve deeper tissues such as muscle and bone. In second degree burns, the scars are red, blisters appear, and the sores are painful, while the burns of the third degree are due to the formation of white scar and the destruction of the nerve endings the dermis. They have no pain. In addition to the depth of burn, the wound's extent is also an essential factor in assessing the patient's condition, which expressed in terms of percentages of total body surface area (TBSA).[8] Antibiotic resistance is a feature of a cell (for example, pathogenic bacteria) that enables it not to be affected by a specific antibiotic that previously caused the cell to die or not grow.[4, 6] Antibiotic resistance occurs in the following ways:

- Alteration of the cell wall (plasma membrane) of the bacterium

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- Synthesis of antibiotic inactivating enzymes (for example Penicillinase which inactivates Penicillin)
- Synthesis of enzymes to prevent the entry of antibiotics into the bacterial cell.

Replacement of some critical cellular metabolic processes with new metabolic processes that ignore the previous antibiotic effect.[8] Iran is one of the countries overdosed with these drugs, and antibiotic use in this country is almost equal to its total consumption in Europe. Accordingly, the use of antibiotics in Iran is five times the international standard.[10] Infections in the ICU are essential due to the high percentage of antibiotic resistance in the bacteria that cause the disease, which is currently increasing in patients. This increases the cost of treatment and the financial and, sometimes, life costs.[11] Using topical prophylactic drugs on the wound, the incidence of burn wound infection as a cause of death was reduced to 28%.[4] Factors affecting the host and pathogenic factors affect the pathogenicity of burn wound infection. Burn injury increases the patient's susceptibility to disease, and this sensitivity is proportional to the total burn rate. Loss of the function of the skin defense barrier allows the microorganisms to access a sizeable living tissue and a protein-rich environment (burn wound), which provides a unique culture.[5] Almost any organism can infect a wound that severely burned, and its immune system is severely damaged.[8] Burn wounds are an excellent environment for the growth and proliferation of microorganisms. The tissues inside the burn wound are not alive and have no blood vessels, so polymorphonuclear cells, antibodies, and systemic antibiotics cannot penetrate it. In this way, the conditions inside the wound are ready for the growth of bacteria and fungi. The primary sources of infection are the healthy skin flora and digestive system of the patient. The environment is also an important secondary source. Most of these microorganisms are present in the hospital environment, especially burn sections, and appear opportunistic pathogens due to the condition of the patient's immune system defects.[9] While the widespread use of topical and systemic antibiotics, early surgery, and patient isolation have led to a significant reduction in bacterial wound infections, some invading microorganisms significantly reduce burn wound infections in burn patients.[4, 12] Several antibiotic-resistant organisms have long been a source of severe problems for patients admitted to burn centers and seriously endanger their lives.[13] As the microbial profile of bacterial agents involved in burn infections and their antibiotic resistance pattern changes over time, awareness of the common causative agents and their susceptibility to antibiotics leads to the choice of experimental treatments. Appropriate and optimal use of antibiotics. The provincial burn intensive care unit has four beds in the hospital, which has been accepting patients with severe burns throughout Guilan province and neighboring provinces since 2007. Still, it so far has no protocol for an antibiotic prescription for these patients and doctors have the same approach in this is not the case, even in cases without cultured response and antibiograms and even without the common microbial strains prescribing antibiotics will certainly increase hospitalization costs and increase antibiotic-resistant tensions. This study aimed to determine the frequency of bacteria causing infection in burn wounds and the determination of their antibiotic resistance patterns in ICU burn patients in Rasht Research and Training Center.

## 2. Material and methods

This study is a cross-sectional descriptive study that all patients admitted to the ICU burn ward of Rasht province from September 2013 to September 2015 were included in the survey to assess burn wound infection. Inclusion criteria are burn patients who underwent burn wounds during their ICU admission and received a positive wound culture response and antibiogram results. The usual protocol of this hospital during the daily visit is to have the fever or the clinical symptoms of infection such as infectious secretion, smell, inflammation, and the high volume of the blood of the burn wound of the ICU patients. According to the standard protocol of this hospital and during daily visits of physicians if they have a fever or other clinical symptoms of infection as well as apparent symptoms of burn wound infection such as purulent discharge, bad smell, inflammation and hypertension from burn wounds of specimen ICU patients to determine bacterial infection. The wound and antibiotic susceptibility determination were performed using standard sample techniques and sent to the hospital microbiology laboratory. Exclusion criteria include failure to perform antibiograms based on Guideline ISI or inappropriate antibiotic use due to germs grown in burn wounds. If the culture response is positive twice a week until the discharge from the hospital, the wound is re-cultured. The method of wound culture was as follows, after inoculation of the clinical specimens into the culture media of McKankar agar (Merck) and blood agar (Merck) and incubation for 24 hours at 37 ° C, microscopic and macroscopic examination of the colonies performed. Identify the bacterium, pure smear colonies were prepared and stained by the hot method. All samples were identified and separated by conventional differential media. The disk diffusion or Kirby-Bauer method used to determine the antibiotic susceptibility of the isolates. Common antibiotics used to treat burn infections, including Imipenem, Gentamicin, Piperacillin, Amikacin, Ciprofloxacin, Vancomycin, Cefotaxime, Ceftriaxone, and Cotrimoxazole, all of which were provided by Hymedia Corporation. The 24-hour culture of cobblestones was prepared as 0.5 McFarland and plated on a Muller Hinton agar plate. The discs placed on the surface of the plate with aseptic techniques. Plates incubated in a 35 ° C incubator for 24 h. After incubation, the growth halo diameter measured and compared with the reference tables provided by the Clinical and Laboratory Standard Institute (CLSI) for resistance to each antibiotic.[14] The questionnaire designed for this study included age 14-14, 15-45, 64-45, 65%, burn percentage, degree of burn, gender, and the results of patients' wound cultures and their antibiogram response. duration admission to theDuration, they received antibiotics before culturing, the type of antibiotics administered before culturing, the anatomic location of, and burns collected from the patients' records. Statistical tests analyzed by SPSS software.[15] Descriptive statistics used to calculate frequency, percent, mean and standard deviation. Numerical data such as age and percentage of body burns (TBSA) expressed as mean ±standard and classification information such as organisms derived from culture in abundance and percentage. The percentage of different prognostic variables compared using Chi-Square test and P-value <0.05 was considered statistically significant. The information collected from the patient's file and the results of the research will remain confidential with the research team. All data obtained from patients will be kept confidential. The results of the investigation will be published in the aggregate form of the study group, and individual results will be presented without mentioning unique names and personal details. Also, patient satisfaction and control were free of coercion, threat, seduction, and seduction. The researcher was required to provide information on the method and purpose of the investigation, the benefits, nature, and duration of the investigation to the extent relevant to the case, and to provide convincing answers to his questions and provide the necessary remedial measures in the event of an unconventional loss.

## 3. Results

In this study, 84 patients (116 specimens) during two years (September 2013 to the end of September 2015) taken from patients with burn injuries. A sample of their burn wounds was analyzed, and the results were as follows:

According to table 1, the youngest patient was one year old, and the most past was 86 years old. The lowest burns that resulted in ICU admission were 14%, and the highest burn rate was 100%. The minimum ICU stay was four days, and the most upper ICU stay was 120 days.

**Table 1. Frequency Distribution of Some Demographic Characteristics of Patients Admitted to ICU Burn Center of Rasht City.**

| Variable | Condition | Number | Percentage |
|---|---|---|---|
| **Gender** | Male | 54 | 64.3 |
| | Female | 30 | 35.7 |
| **Range of year** | Less than 15 years | 14 | 16.7 |
| | 15-44 years old | 30 | 35.7 |
| | 45-65 years old | 23 | 27.4 |
| | More than 65years | 17 | 20.2 |
| **Age (Year)** | | 40.72±21.06 | |
| **Year of** | 20Sep 2013- 2014 | 51 | 60.7 |
| | 20 Sep2014-2015 | 33 | 39.3 |
| **Degree of burn** | II | 17 | 20.2 |
| | III | 53 | 63.1 |
| | IV | 14 | 16.7 |
| **Percentage of burn** | 50.0±22.38 | | |
| **Duration of** | 18.91±17.58 | | |

Table 2 shows that of the 116 specimens studied, 344 had limb burns, with the highest percentage of trunk burns—26.8%.

**Table2. Frequency Distribution of the place of the burn of Patients Admitted to ICU Burn Center of Rasht City.**

| Place of burn | Number | Percentage |
|---|---|---|
| **Upper limb** | 89 | 25.8 |
| **Lower limb** | 85 | 24.8 |
| **Trunk** | 105 | 30.5 |
| **Head- Face- Neck** | 65 | 18.9 |
| **Total** | 344 | 100 |

Table 3 shows that 87.9 percent of the patients' wound culture has resistance to the antibiotic.

**Table 3. Frequency Distribution of Resistance to antibiotics of Patients Admitted to ICU Burn Center of Rasht City.**

| Resistance to antibiotics | Number | Percentage |
|---|---|---|
| **Have** | 102 | 87.9 |
| **Not have** | 14 | 12.1 |
| **Total** | 116 | 100 |

**Table 4. Frequency Distribution of the Place of the Sampling Location of Patients Admitted to ICU Burn Center of Rasht City.**

| Place of the Sampling location | Number | Percentage |
|---|---|---|
| **Upper limb** | 45 | 38.8 |
| **Lower limb** | 23 | 19.8 |
| **Trunk** | 32 | 27.6 |
| **Head- Face- Neck** | 16 | 13.8 |
| **Total** | 116 | 100 |

Among 116 patients admitted to ICU, all had antibiotic use before wound culture. Among 116 patients, 137 antibiotics administered before culture; however, in 87.9% of the cases, microbial resistance for all antibiotic-free Cultivation was seen. The highest percentage of antibiotics without culture response was related to Cefazolin (56.2%).

**Table 5. Frequency Distribution of Pre-Cultivated Antibiotics in Patients Admitted to ICU Burn Center in Rasht City.**

| Antibiotic Type | Number | Percentage |
|---|---|---|
| **Cefazolin** | 77 | 56.2 |
| **Amikacin** | 14 | 10.2 |
| **Ceftriaxone** | 9 | 6.6 |
| **Vanquicin** | 10 | 7.3 |
| **Clindamycin** | 7 | 5.1 |
| **Ceftazidime** | 3 | 2.2 |
| **Cefalexin** | 3 | 2.2 |
| **Piperacillin** | 3 | 2.2 |
| **Metronidazole** | 3 | 2.2 |
| **Ceftizoxime** | 3 | 2.2 |
| **Ciprofloxacin** | 2 | 1.4 |
| **Amoxiciline** | 1 | 0.7 |
| **Cloxacillin** | 1 | 0.7 |
| **Ampibactam** | 1 | 0.7 |
| **Total** | 137 | 100 |

Of the 116 samples from burn wounds, 102 had positive infection and culture results. The most common infections were Pseudomonas (68.6%), followed by Klebsiella (15.7%) and Proteus (10.8%).

**Table 6. Frequency Distribution of Cultivated Responses in Patients Admitted to ICU Ward of Rasht City.**

| Bacterial Type | Number | Percentage |
|---|---|---|
| **E'coli** | 3 | 2.9 |
| **Proteus** | 11 | 10.8 |
| **Pseudomounas** | 70 | 68.6 |
| **Klebsiella** | 16 | 15.7 |
| **Enterobacter** | 2 | 2 |
| **Total** | 102 | 100 |

According to table 7, the Chi-square test showed that there was no statistically significant relationship between the types of bacteria causing an infection according to the hospitalization time of the studied patients (P = 0.23).

**Table 7. Frequency Distribution of Bacteria Causing Infection in Patients Admitted to ICU Wards of Burn Disaster Center in Rasht.**

| Time | Sep 2013-2014 | | Sep 2014-2015 | | Total | | Statistical estimation |
|---|---|---|---|---|---|---|---|
| **Bacterial type** | **No** | **%** | **No** | **%** | **No** | **%** | |
| **E'coli** | 2 | 3.3 | 1 | 2.4 | 3 | 2.9 | P= 0.23 |
| **Proteus** | 5 | 8.2 | 6 | 14.6 | 11 | 10.8 | |
| **Pseudomounas** | 42 | 68.9 | 28 | 68.3 | 70 | 68.6 | |
| **Klebsiella** | 12 | 19.7 | 4 | 9.8 | 16 | 15.7 | |
| **Enterobacter** | 0 | 0 | 2 | 4.9 | 2 | 2 | |
| **Total** | 61 | 100 | 41 | 100 | 102 | 100 | |

According to table 8, the Chi-square test showed no statistically significant relationship between the types of bacterial agents leading to infection in ICU patients by sex (P = 0.31).

**Table8. Frequency Distribution of Different Types of Bacterial Factors Identified in Burn Wound Cultures in Patients Admitted to ICU by Gender-Age - Sampling Area - Degrees of Burn**

| Variable | Infection type condition | E'coli | | Proteus | | Pseudomonas | | Klebsiella | | Enterobacter | | Statistical estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage | |
| gender | Male | 1 | 33.3 | 6 | 54.5 | 50 | 71.4 | 9 | 56.2 | 2 | 100 | P= 0.31 |
| | Female | 2 | 66.7 | 5 | 45.5 | 20 | 28.6 | 7 | 43.8 | 0 | 0 | |
| Range of age | Less than 15 years | 0 | 0 | 0 | 0 | 13 | 18.6 | 0 | 0 | 0 | 0 | P= 0.15 |
| | 15-44 years | 0 | 0 | 7 | 63.6 | 28 | 40 | 7 | 43.8 | 2 | 100 | |
| | 45-65 year | 1 | 33.3 | 3 | 27.3 | 19 | 27.1 | 5 | 31.2 | 0 | 0 | |
| | More than 65 years | 2 | 66.7 | 1 | 9.1 | 10 | 14.3 | 4 | 25 | 0 | 0 | |
| Location of sampling | Upper limb | 1 | 33.3 | 3 | 27.3 | 32 | 45.7 | 4 | 25 | 1 | 50 | P= 0.89 |
| | Lower limb | 1 | 33.3 | 2 | 18.2 | 13 | 18.6 | 4 | 25 | 1 | 50 | |
| | Trunk | 1 | 33.3 | 4 | 36.4 | 16 | 22.9 | 6 | 37.5 | 0 | 0 | |
| | Head-face-neck | 0 | 0 | 2 | 18.2 | 9 | 12.9 | 2 | 12.5 | 0 | 0 | |
| Degree of burn | II | 0 | 0 | 1 | 91 | 13 | 18.6 | 2 | 12.5 | 0 | 0 | P= 0.92 |
| | III | 2 | 66.7 | 7 | 63.6 | 41 | 58.6 | 11 | 68.8 | 2 | 100 | |
| | IV | 1 | 33.3 | 3 | 27.3 | 16 | 22.9 | 3 | 18.8 | 0 | 0 | |
| Degree of burn | | 3.33±0.57 | | 3.18±0.6 | | 3.04±0.64 | | 3.06±057 | | 3±0.0 | | P= 0.9 |
| Percentage of burn | | 53.6±22.8 | | 64.5±25.7 | | 51.3±22.8 | | 52.4±21.1 | | 31±5.6 | | P= 0.29 |
| Admitted Time | | 23±18.33 | | 24.7±22.5 | | 2.3±17.5 | | 22.5±18.6 | | 28±5.65 | | P= 0.91 |

According to table 9, the Chi-square test showed that there was no statistically significant relationship between burnout rates of patients admitted to ICU by age (years) (P = 0.59).

**Table 9. Frequency Distribution of Burn Degrees in Patients Admitted to ICU by Age (Year).**

| Range of year Degree of burn | Less than 15 years | | 15-44 years | | 45-65 years | | More than 65 years | | Statistical estimation |
|---|---|---|---|---|---|---|---|---|---|
| | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage | |
| II | 5 | 33.3 | 9 | 19.6 | 6 | 17.1 | 2 | 10 | P= 0.59 |
| III | 8 | 53.3 | 28 | 60.9 | 20 | 57.1 | 15 | 75 | |
| IV | 2 | 13.3 | 9 | 19.6 | 9 | 25.7 | 3 | 15 | |
| Total | 15 | 100 | 46 | 100 | 35 | 100 | 20 | 100 | |

The result showed that using Fisher's exact test, the relationship between antibiotic responses to the bacterial agents identified by culture in ICU patients admitted at the time of admission in September 2014 was assessed only in Pepsicillin - Imipenem - tetracycline antibiotics. There was a significant statistical relationship between the above mentioned antibiotic responses and the types of infections identified by culture (P <0.01).

**Table10. Antibiogram Response Pattern to Different Types of Bacterial Agents Cultivated in Patients Admitted to ICU at the Time of Admission.**

| Variable | Status infection | E'coli | | Proteus | | Pseudomonas | | Klebsiella | | Introbacter | | Total | | Statistical estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cefazolin** | Sensitive | 0 | 0 | 0 | 0 | 6 | 15 | 1 | 14.3 | 7 | 13.2 | 7 | 13.2 | P = 0.79 |
| | Resistant | 2 | 100 | 4 | 100 | 34 | 85 | 6 | 85.7 | 46 | 86.8 | 46 | 86.8 | |
| **Amikacin** | Sensitive | 2 | 100 | 3 | 60 | 19 | 59.4 | 5 | 41.7 | 0 | 0 | 29 | 56.9 | P = 0.54 |
| | Resistant | 0 | 0 | 2 | 40 | 13 | 40.6 | 7 | 58.3 | 0 | 0 | 22 | 43.1 | |
| **Ceftriaxone** | Sensitive | 0 | 0 | 1 | 20 | 5 | 16.7 | 3 | 60 | 0 | 0 | 9 | 22.5 | P = 0.12 |
| | Resistant | 0 | 0 | 4 | 80 | 25 | 83.3 | 2 | 40 | 0 | 0 | 31 | 77.5 | |
| **Ceftazidime** | Sensitive | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 14.3 | 0 | 0 | 1 | 3.7 | P = 0.37 |
| | Resistant | 0 | 0 | 3 | 100 | 17 | 100 | 6 | 85.7 | 0 | 0 | 26 | 96.3 | |
| **Cefalexin** | Sensitive | 0 | 0 | 1 | 100 | 1 | 3.1 | 0 | 0 | 0 | 0 | 2 | 4.3 | P = 0.07 |
| | Resistant | 2 | 100 | 0 | 0 | 31 | 96.9 | 11 | 100 | 0 | 0 | 44 | 95.7 | |
| **Ciprofloxacin** | Sensitive | 0 | 0 | 1 | 100 | 18 | 100 | 7 | 87.5 | 0 | 0 | 26 | 96.3 | P = 0.33 |
| | Resistant | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 12.5 | 0 | 0 | 1 | 3.7 | |
| **Tobromycin** | Sensitive | 2 | 100 | 0 | 0 | 15 | 51.7 | 5 | 71.4 | 0 | 0 | 22 | 53.7 | P = 0.12 |
| | Resistant | 0 | 0 | 3 | 100 | 14 | 48.3 | 2 | 28.6 | 0 | 0 | 19 | 46.3 | |
| **Piperacillin** | Sensitive | 0 | 0 | 4 | 80 | 24 | 88.9 | 9 | 100 | 0 | 0 | 37 | 86 | P = 0.014 |
| | Resistant | 2 | 100 | 1 | 20 | 3 | 11.1 | 0 | 0 | 0 | 0 | 6 | 14 | |
| **Imipenem** | Sensitive | 2 | 100 | 3 | 60 | 11 | 42.3 | 11 | 91.7 | 0 | 0 | 27 | 60 | P = 0.01 |
| | Resistant | 0 | 0 | 2 | 40 | 15 | 57.7 | 1 | 8.3 | 0 | 0 | 18 | 40 | |
| **Tetracycline** | Sensitive | 0 | 0 | 1 | 25 | 16 | 84.2 | 6 | 85.7 | 0 | 0 | 23 | 71.9 | P = 0.009 |
| | Resistant | 2 | 100 | 3 | 75 | 3 | 15.8 | 1 | 14.3 | 0 | 0 | 9 | 28.1 | |
| **Cefotaxime** | Sensitive | 0 | 0 | 1 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3.2 | P = 0.19 |
| | Resistant | 2 | 100 | 3 | 75 | 18 | 100 | 7 | 100 | 0 | 0 | 30 | 96.8 | |
| **Cefepime** | Sensitive | 0 | 0 | 1 | 20 | 6 | 40 | 10 | 100 | 0 | 0 | 17 | 53.1 | P = 0.19 |
| | Resistant | 2 | 100 | 4 | 80 | 9 | 60 | 0 | 0 | 0 | 0 | 15 | 46.9 | |
| **Sulfamethoxazole** | Sensitive | 0 | 0 | 1 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2.3 | P = 0.14 |
| | Resistant | 2 | 100 | 3 | 74.5 | 26 | 100 | 11 | 100 | 0 | 0 | 42 | 97.7 | |

Using Fisher's exact test, the relationship between antibiotic responses to the bacterial species identified in the ICU hospitalized at the time of admission from September 2014 to September 2015 evaluated. Significant differences observed between the antibiotics mentioned above' responses and the types of infections identified by culture (P <0.05).

**Table 11. Antibiogram Response Pattern to Different Types of Bacterial Agents Cultivated in Patients Admitted to ICU at the Time of Admission in Sep 2104- 2105.**

| Variable | Status infection | E'coli | | Proteus | | Pseudomonas | | Klebsiella | | Introbacter | | Total | | Statistical estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cefazolin | Sensitive | 0 | 0 | 0 | 0 | 6 | 30 | 0 | 0 | 0 | 0 | 6 | 18.8 | P = 0.5 |
| | Resistant | 1 | 100 | 6 | 100 | 14 | 70 | 3 | 100 | 2 | 100 | 26 | 81.2 | |
| Amikacin | Sensitive | 1 | 100 | 4 | 66.7 | 100 | 48.1 | 2 | 50 | 1 | 50 | 21 | 52.5 | P = 0.93 |
| | Resistant | 0 | 0 | 2 | 33.3 | 14 | 51.9 | 2 | 50 | 1 | 50 | 19 | 47.5 | |
| Ceftriaxone | Sensitive | 0 | 0 | 0 | 0 | 3 | 14.3 | 1 | 100 | 0 | 0 | 4 | 16 | P = 0.31 |
| | Resistant | 0 | 0 | 2 | 100 | 18 | 85.7 | 0 | 0 | 1 | 100 | 21 | 84 | |
| Ceftazidime | Sensitive | 0 | 0 | 4 | 66.7 | 4 | 22.2 | 0 | 0 | 0 | 0 | 8 | 30.8 | P = 0.13 |
| | Resistant | 0 | 0 | 2 | 33.3 | 14 | 77.8 | 2 | 100 | 0 | 0 | 18 | 69.2 | |
| Cefalexin | Sensitive | 0 | 0 | 0 | 0 | 2 | 9.1 | 0 | 0 | 0 | 0 | 2 | 6.1 | P = 0.9 |
| | Resistant | 1 | 100 | 4 | 100 | 20 | 90.9 | 4 | 100 | 2 | 100 | 31 | 93.9 | |
| Ciprofloxacin | Sensitive | 0 | 0 | 4 | 100 | 15 | 75 | 3 | 100 | 1 | 50 | 23 | 79.3 | P = 0.48 |
| | Resistant | 0 | 0 | 0 | 0 | 5 | 25 | 0 | 0 | 1 | 50 | 6 | 20.7 | |
| Tobromycin | Sensitive | 1 | 100 | 0 | 0 | 14 | 53.8 | 3 | 100 | 1 | 50 | 19 | 55.9 | P = 0.21 |
| | Resistant | 0 | 0 | 2 | 100 | 12 | 46.2 | 0 | 0 | 1 | 50 | 15 | 44.1 | |
| Piperacillin | Sensitive | 0 | 0 | 1 | 16.7 | 16 | 66.7 | 3 | 100 | 1 | 100 | 21 | 60 | P = 0.023 |
| | Resistant | 1 | 100 | 5 | 83.3 | 8 | 33.3 | 0 | 0 | 0 | 0 | 14 | 40 | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Imipenem | Sensitive | 1 | 100 | 4 | 66.7 | 12 | 54.5 | 4 | 100 | 2 | 100 | 23 | 65.7 | P = 0.38 |
| | Resistant | 0 | 0 | 2 | 33.3 | 10 | 45.5 | 0 | 0 | 0 | 0 | 12 | 34.3 | |
| Tetracycline | Sensitive | 0 | 0 | 1 | 50 | 16 | 80 | 2 | 100 | 2 | 100 | 21 | 77.8 | P = 0.3 |
| | Resistant | 1 | 100 | 1 | 50 | 4 | 20 | 0 | 0 | 0 | 0 | 6 | 22.2 | |
| Cefotaxime | Sensitive | 0 | 0 | 0 | 0 | 3 | 18.8 | 0 | 0 | 1 | 100 | 4 | 17.4 | P = 0.39 |
| | Resistant | 1 | 100 | 2 | 100 | 13 | 81.2 | 3 | 100 | 0 | 0 | 19 | 82.6 | |
| Cefepime | Sensitive | 0 | 0 | 0 | 0 | 6 | 33.3 | 4 | 100 | 0 | 0 | 10 | 37 | P = 0.024 |
| | Resistant | 1 | 100 | 2 | 100 | 12 | 66.7 | 0 | 0 | 2 | 100 | 17 | 63 | |
| Sulfamethoxazole | Sensitive | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 50 | 1 | 3.2 | P = 0.16 |
| | Resistant | 1 | 100 | 2 | 100 | 23 | 100 | 3 | 100 | 1 | 50 | 30 | 96.8 | |

According to this table, by Fisher's Exact Test, showed the relationship between antibiotic responses to bacterial Pseudomonas disease agents (P <0.05) in ciprofloxacin identified from the culture in patients admitted to the ICU from September 2014 to September 2015.

**Table 12. Antibiogram Response Pattern to Pseudomonas Bacterial Agent in Patients Admitted to ICU at the Time of Admission in Sep 2014- 2015.**

| Antibiotic | Time Condition | Sep 2012- Sep 2013 | | Sep2013- Sep 2014 | | Total | | Statistical estimation |
|---|---|---|---|---|---|---|---|---|
| | | Number | Percentage | Number | Percentage | Number | Percentage | |
| Cefazolin | Sensitive | 6 | 15 | 6 | 30 | 12 | 20 | P = 0.18 |
| | Resistant | 34 | 85 | 14 | 70 | 48 | 80 | |
| Amikacin | Sensitive | 19 | 59.4 | 13 | 48.1 | 32 | 54.2 | P = 0.44 |
| | Resistant | 13 | 40.6 | 14 | 51.9 | 27 | 45.8 | |
| Ceftriaxone | Sensitive | 5 | 16.7 | 3 | 14.3 | 8 | 15.7 | P = 0.81 |
| | Resistant | 25 | 83.3 | 18 | 85.7 | 43 | 84.3 | |
| Ceftazidime | Sensitive | 0 | 0 | 4 | 22.2 | 4 | 11.4 | P = 0.1 |
| | Resistant | 17 | 100 | 14 | 77.8 | 31 | 88.6 | |
| Cefalexin | Sensitive | 1 | 3.1 | 2 | 9.1 | 3 | 5.6 | P = 0.56 |
| | Resistant | 31 | 96.9 | 20 | 90.9 | 51 | 94.4 | |
| Ciprofloxacin | Sensitive | 18 | 100 | 15 | 75 | 33 | 86.8 | P = 0.048 |
| | Resistant | 0 | 0 | 5 | 25 | 5 | 13.2 | |
| Tobromycin | Sensitive | 15 | 51.7 | 14 | 53.8 | 29 | 52.7 | P = 0.87 |
| | Resistant | 14 | 48.3 | 12 | 46.2 | 26 | 47.3 | |
| Piperacillin | Sensitive | 24 | 88.9 | 16 | 66.7 | 40 | 78.4 | P = 0.08 |
| | Resistant | 3 | 11.1 | 8 | 33.3 | 11 | 21.6 | |
| Imipenem | Sensitive | 11 | 42.3 | 12 | 54.5 | 23 | 47.9 | P = 0.56 |
| | Resistant | 15 | 57.7 | 10 | 45.5 | 25 | 52.1 | |
| Tetracycline | Sensitive | 16 | 84.2 | 16 | 80 | 32 | 82.1 | P = 0.73 |
| | Resistant | 3 | 15.8 | 4 | 20 | 7 | 17.9 | |
| Cefotaxime | Sensitive | 0 | 0 | 3 | 18.8 | 3 | 8.8 | P = 0.09 |
| | Resistant | 18 | 100 | 13 | 81.2 | 31 | 91.2 | |
| Cefepime | Sensitive | 6 | 40 | 6 | 33.3 | 12 | 36.4 | P = 0.73 |
| | Resistant | 9 | 60 | 12 | 66.7 | 21 | 63.6 | |
| Sulfamethoxazole | Sensitive | 0 | 0 | 0 | 0 | 0 | 0 | ------ |
| | Resistant | 26 | 100 | 23 | 100 | 49 | 100 | |

## 4. Discussion

The most common problem with burn treatment is infection, which accounts for more than 50% of all deaths from burns. Burn wounds provide an ideal environment for the growth of a variety of infectious organisms. Burn injury increases the patient's susceptibility to infection, and this sensitivity is proportional to the total burn rate. Loss of the function of the skin defense barrier allows microorganisms to access a sizeable living tissue and a protein-rich environment (burn wound) that provides a unique culture.[5] Therefore, the determination of Bacteria's antibiotic resistance pattern is necessary for the determination of appropriate antibiotics in these patients. In this study, among 116 samples from burn wounds, 102 cases had positive infection and culture results. The most common infections found to be Pseudomonas (68.6%) followed by Klebsiella (15.7%) and Proteus (10.8%), which is inconsistent with some similar studies and not consistent with some studies. A study by Muhammad Saaiq and colleagues in a two-year study from 2010 to 2010 at a burn hospital in Pakistan examined the bacterial causes of burn wounds in 95 patients with positive reported cultures. The results showed that Pseudomonas Aerosinosa was the most common pathogen and Klebsiella Pneumoniae, Staphylococcus Aureus, Proteus, Ecoli, and Acinetobacter were subsequently reported.[16] On the other hand, in a study of Hisham A. Abbas et al. in a 2013 study over three month at an Egyptian hospital burn center, they investigated the bacterial causes of burn wounds and their antibiotic resistance in 109 patients admitted to the center. And the results showed that in 48 cases (46.36%), Polymicrobial infection was observed, and Staphylococcus Aureus was the most common pathogen. Subsequently Pseudomonas Aerosinosa, Klebsiella Pneumoniae, Staph epidermidis, Protus, and Acinetobacter were respectively.[17] Which is inconsistent with the present study. In a study by Edward F. and his colleagues in 2009, six years, from 2003 to 2008, examined the incidence and bacteriology of burn wound infections at a military burn center and concluded that of 13727 wound cultures. A total of 3507 positive bacterial cultures reported, and the most common isolate was Asinobacter, followed by Pseudomonas Aerosinosa, Klebsiella, and Staphylococcus Aureus, respectively.[18] Pseudomonas Aeruginosa found to be the most common causative agent in this study. Consistent with studies in other parts of the country and elsewhere[5, 10, 11] and in some studies where Pseudomonas Aeruginosa was the most common isolated infection and in tiny percentage is in second place.

In the present study, 75% of patients admitted to the ICU ward showed antibiotic resistance, which is in agreement with the results of other studies. In a 2003 study by Mehmet Faruk et al., 78% of ICU burn patients showed antibiotic resistance.[19] In the study of Askarian and colleagues in Shiraz, 73% of ICU patients showed antibiotic resistance.[20] Similar results were also obtained in a poverty study by Faghri in Isfahan.[21] The antibiotic resistance observed in the present study is much higher than the antibiotic resistance found in similar research elsewhere.[10, 11, 20] The differences in findings are probably due to variation in clinical samples, time to study, and treatment strategies in each geographic region. Comparing the time of this study with other studies, the differences in these findings may indicate an increasing resistance of these strains to antibiotics, which means that the rate of resistance increases with time. In a 2007 study by Mohammadi Mehr and his colleagues, the most resistant antibiotics included Cefotaxime Clavonic acid, Ceftazidime Clavonic Acid, Amikacin, and Imipenem identified in the intensive care unit of Tehran's Besat Hospital.[22] In a study by Hisham A. Abbas et al. in a 2013 study, the highest antibiotic resistance was observed in the gram-positive Jeta-mycine, ampicillin, and Cefazolin, and in the gram-negative, Amoxicillin, Amoxicillin-Clavolinic Acid-Jeta-Mycine.[17] The differences in findings are probably due to variations in clinical samples, time to study, and treatment strategies in each geographic region. The study found that the highest antibiotic susceptibility was Ciprofloxacin, Piperacillin, and Tetracycline, respectively, consistent with other studies that reported the highest antibiotic susceptibility of ciprofloxacin in the 2010–2012 study.[16] Similar results also obtained in the study of Askarian and colleagues in Shiraz [20] It also found in this study that there was no statistically significant relationship between the incidence of infection in ICU patients and their gender consistent with other studies. Also, in a 2009 study by Edward F and colleagues, no statistically significant difference was observed.[18] The study does not show a statistically significant difference in the incidence of infection in ICU patients by age, which is consistent with the findings of Hisham A. Abbas, Muhammad Saaiq et al.[16, 17] Elevated mean age in all studies may indicate that the age group over 60 years are at higher risk of antibiotic-resistant infections in ICU patients. Burn injuries by removing the skin's defense barrier and damaging the host's local defense provide suitable conditions for the development of opportunistic infections. Therefore, colonization of bacteria is unavoidable even if routine antimicrobial agents used.[7, 12] Important in this study was the high prevalence of Klebsiella spp. In burn wounds, which was highly prevalent after Pseudomonas Aeruginosa. A comparison of the present study results and recent studies in this area indicates an increasing trend in the relative frequency of Klebsiella in burn wounds in past years.[9, 11, 12, 13, 15] Strategies to control the increasing spread of multiple drug-resistant strains and the treatment of burn infections should have designed and developed. Proper management of dealing with nosocomial diseases, especially burn infections, is also essential. More attention paid to the development and application of new non-pharmacological therapies such as pharmacotherapy.

## 5. Conclusion

This study showed that bacteria such as Pseudomonas aeruginosa, Klebsiella, and Proteus bacteria are common in the Velayat burn center. The main problem in the Velayat burn center and how to deal with this bacteria is the proper use of diagnostic techniques and drug therapies, especially antibiotics, which may also reduce the risk of nosocomial infection. Adequate management of dealing with nosocomial diseases, especially burn infections, is also essential.

## Conflict of Interest

The authors declared that there is no conflict of interest.


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