Research Article **Phytopharmacology Research Journal (PRJ) Open Access**

Received: November 2025 | Revised: 1December 2025 | Accepted: 10 December 2025 | Published online : 15 December 2025 | ISSN : 2959-9687

Assessing the Impact of Hospital Stay on Antibiotic Use and Microbial Resistance in Wound Infections; A Retrospective Study

Abdul Khaliq Jan[1*¥], Salma Rahman[2¥], Bashir Ullah[2], Zul Kamal[2, 3*], Aiman Bilal[4], Kashif Ali Khan[2], Muhammad Suliman[2], Syed Waqas Shah[2], Junaid Ahmad[2]

[1]Department of Chemistry, Shaheed Benazir Bhutto University Sheringal, Dir Upper 18300, Khyber Pakhtunkhwa, Pakistan

[2]Department of Pharmacy, Shaheed Benazir Bhutto University Sheringal, Dir Upper 18300, Khyber Pakhtunkhwa, Pakistan

[3]College of Chinese Materia Medica, Chongqing University of Chinese Medicine, Puguobao Road, 402760, Chongqing, P.R. China

[4]Dir College of Nursing and Allied Health Sciences, Timergara, Dir Lower, 18000 Khyber Pakhtunkhwa, Pakistan

¥ Abdul Khaliq Jan & Salma Rahman equally contributed

***Correspondence**
Abdul Khaliq Jan
Email: abdukhaliq@sbbu.edu.pk
Zul Kamal
Email: zulkamal@cqctcm.edu.cn

Funding information
Shaheed Benazir Bhutto University Sheringal, Dir upper, Khyber Pakhtunkhwa, Pakistan

Abstract

Wound infections arise when microorganisms, specifically bacteria, fungi, or viruses colonize and multiply within a wound, resulting in tissue damage and delayed healing. This study decisively investigates the patterns of antibiotic prescription for surgical wounds, antibiotic consumption, and the length of hospital stays. Conducted in the surgical wards of a tertiary care hospital in Peshawar, the research evaluated the prescriptions of 120 patients diagnosed with surgical wounds and surgical site infections. The participant demographics revealed a balanced distribution, with 65 males (54.2%) and 55 females (45.8%). Patients were categorized by age as follows: 1-10 years (n=4), 11-20 years (n=15), 21-30 years (n=24), 31-40 years (n=23), 41-50 years (n=25), 51-60 years (n=13), 61-70 years (n=11), and 71-80 years (n=5). Participants hailed from various districts, including Peshawar (n=17), Kurram Agency (n=11), Khyber (n=11), Dir Lower (n=10), Karak (n=9), Charsadda (n=8), Nowshera (n=7), Kohat (n=6), Hangu (n=6), Rawalpindi (n=4), Mardan (n=4), Dera Ismail Khan (n=4), Swat (n=4), Shangla (n=4), Lakki Marwat (n=3), Bannu (n=1), Swabi (n=2), Sargodha (n=2), Barra (n=1), Bajaur (n=1), Dir Upper (n=1), and others (n=4). A total of 132 antibiotics were prescribed, with the following distribution: Cefoperazone + Sulbactam (n=41), Ceftriaxone (n=25), Linezolid (n=13), Co-Amoxiclav (n=31), Piperacillin + Tazobactam (n=15), and Moxifloxacin (n=7). The recorded duration of hospital stays further highlights the situation: 2 days (n=18, 15%), 3 days (n=38, 31.6%), 4 days (n=43, 35.8%), and 5 days (n=21, 17.5%). This study firmly underscores the urgent issue of high antibiotic consumption and its direct link to antimicrobial resistance, indicating that certain antibiotics are increasingly ineffective against prevalent pathogenic infections.

Keywords: Antibiotic resistance, surgical site infections, antibiotic consumption, hospital longevity, wound infections, AMR

1.0 INTRODUCTION

Wound infections pose a serious threat when microorganisms—like bacteria, fungi, or viruses—colonize and proliferate within a wound. This not only damages tissues but also significantly delays the healing process. Surgical site infections (SSIs) are particularly concerning, as they can develop at or near the surgical incision within 30 days following a procedure. If an implant is present, this risk extends to 90 days, emphasizing the need for vigilant post-operative care to ensure patient safety and optimal recovery [1]. Surgical site infections (SSIs) are clearly categorized into three distinct types: 1. Superficial incisional SSI**: This type exclusively impacts the skin and subcutaneous tissue. 2.Deep incisional SSI: This type significantly affects the deeper soft tissues, including fascia and muscle. 3.Organ/space SSI: This type involves any anatomical component beyond the incision that was opened or manipulated during the surgical procedure. Understanding these classifications is crucial for effective prevention and management of SSI [2]. Surgical site infections (SSIs): These are infections that occur after surgical procedures and demand immediate attention. Chronic wound infections: Defined as infections that persist for more than six weeks (such as diabetic foot ulcers), these require aggressive management. Acute wound infections: These infections arise within six weeks of an injury and must be addressed promptly.

SSIs greatly affect patient outcomes, increasing morbidity and mortality, and can lead to serious complications like sepsis and organ failure [3]. According to [4] 3% of patients developing resistance die as a result of the SSIs. This also result in prolonged hospital stays, additional surgeries and extended antibiotic therapy raising the healthcare cost [5]. This increase in cost affects both healthcare systems and patients' quality of life [1]. The outcomes reported by patients are negatively affected, including physical functioning, mental health, and overall satisfaction with care. Many patients with surgical site infections have reported higher levels of anxiety and stress [6].

To effectively manage surgical site infections (SSIs), it is crucial to implement comprehensive preoperative and postoperative strategies. Prior to surgery, ensuring thorough patient preparation, performing meticulous skin antisepsis, administering appropriate antibiotic prophylaxis, and maintaining controlled blood glucose levels are essential steps that can significantly reduce the risk of SSIs. By prioritizing these measures, we can enhance patient outcomes and promote safer surgical practices [7]. The post-operative measures include proper wound care and prompt intervention when an infection is suspected. Improving patient outcomes can be achieved by implementing effective infection prevention strategies.[8].

Antimicrobial resistance (AMR) represents a serious and growing global health crisis that jeopardizes our ability to prevent and treat infections. This alarming phenomenon arises when microorganisms—including bacteria, viruses, and fungi, develop the ability to withstand the effects of antimicrobial drugs. As a result, conventional treatments fail, resulting in stubborn infections that can have devastating consequences. We must act now to address AMR and protect public health [9]. This resistance is mostly caused by misuse and overuse of antimicrobial drugs [10].

In 2019 bacterial AMR was responsible for 1.27 million deaths globally which contributed to 4.95 million deaths [11]. This shows that AMR is now a leading cause of death surpassing the mortality rates of HIV and malaria [12]. Medical interventions such as routine surgeries, chemotherapies, organ transplants rely heavily on antimicrobial drugs to prevent and treat infections [13]. The increase in drug-resistant pathogens make these procedures riskier and less effective.

The World Bank projects that by 2050, antimicrobial resistance (AMR) could add $1 trillion annually to healthcare costs and lead to a $3.4 trillion loss in global GDP each year [14]. Coordinated global efforts such as enhanced global surveillance of antimicrobial resistance, investing in the research and development of new antibiotics, and improving measures for infection prevention and control are needed to address the growing issue of microbial resistance [15].

Wound infections happen when microorganisms like bacteria, fungi, or viruses invade a wound, causing tissue damage and delayed healing. Risk factors include contamination, poor wound care, diabetes, immunocompromised status, malnutrition, obesity, and smoking [5, 6].

Wound infections represent a critical public health challenge, particularly in developing nations such as Pakistan. The alarming rise in antibiotic resistance has made treating these infections increasingly difficult, leading to greater rates of illness and death, as well as

escalating healthcare expenses. This study seeks to provide a thorough understanding of the prevalence, incidence, and epidemiology of wound infections in Khyber Pakhtunkhwa (KP), highlighting the urgent need for effective interventions in this pressing issue.

2.0 MATERIALS AND METHODS

2.1 Data collection

A comprehensive total of 120 case histories were meticulously collected between January 1, 2024, and February 29, 2024. This endeavor received the official endorsement of the chief pharmacist and the ward supervisor, ensuring adherence to professional standards. Our data collector, highly educated and ethically trained by the university, approached the task with integrity and diligence. Importantly, the collaboration was achieved through the enthusiastic agreement of physicians, nurses, and patient attendants, reinforcing the reliability and validity of the data gathered.

2.2 Study setting and design

This study was conducted in the surgical ward of a leading tertiary care hospital in Peshawar, Khyber Pakhtunkhwa (KP), Pakistan. Renowned for its excellence, this hospital boasts over 23 departments and 1,280 beds, including 150 dedicated ICU beds, supported by a team of more than 1,000 highly skilled physicians and surgeons alongside hundreds of technical staff. With a commitment to quality care, the hospital has successfully treated approximately 3,234,380 patients, performing over 90,000 surgeries and 176,071 cardiology procedures. This facility stands as a beacon of hope and healing for the community it serves.

2.3 Inclusion criteria

A detailed review of the medical records for 120 patients who underwent surgery and were treated with antimicrobial therapy for wound infections was conducted. The information gathered provides valuable insights, including: i) Patient demographics, encompassing age, gender, and existing comorbidities. ii) The specific surgical procedures carried out. iii) The antimicrobial agents prescribed, detailing their names, dosages, durations, and routes of administration. iv)) The rationale for antimicrobial use, distinguishing between preventive measures and treatments. v) Microbiology results that highlight the pathogens isolated and their susceptibility patterns vi) Patient outcomes, outlining the length of hospital stays, any complications experienced, and mortality rates. vii) This comprehensive data is crucial for improving patient care and outcomes in surgical settings.

2.4 Antibiotic consumption

The main focus was shifted toward the following

A. Total Number of antibiotics
B. Monotherapy or Combination Therapy
C. Hospital Longevity
D. Average stay in the hospital
E. Antibiotic at which the Patient was discharged
F. Switching over (if any)

2.5 Data analysis

The collected data was analyzed using GraphPad Prism Microsoft Excel for tabulating and graphical presentation.

3.0 RESULTS AND DISCUSSION

3.1 Age-wise distribution

The study was conducted in a Tertiary Care Hospital of Peshwar, surgical wards where 120 patients' prescriptions were evaluated for surgical wound management antibiotic consumption and longevity, Figure.1. Out of 120 patients age limt 1-10 n=4 , 11-20 n= 15, 21-30 n=24, 31-40 n=23, 41-50 n=25, 51-60 n=13, 61-70 n=11, 71-80 n=5.

3.2 Gender wise distribution

In the current study, both males and females are participating. Out of 120 pateints male n=65 (54.10%) and female n= 55 (45.90%), Figure 2.

3.3 Demographics and epidemiology (District-wise distribution)

From various districts, patients participated. Peshawar n=17, Kurram Agency n=11, Khyber Agency n=11, Dir Lower n=10, Karak n=9, Charsada n=8, Nowshera n=7, Kohat n=6, Hangu n=6, Rawalpindi N=4, Mardan n=4, DI Khan N=4, Swat N=4, Shangala n=4, Laki Marwat n=3, Bannu n=1, Swabi n=2, Sargodha n=2, Barra n=1, Bajauar n=1, Dir Upper n=1, Others n=4 (Figure 3).

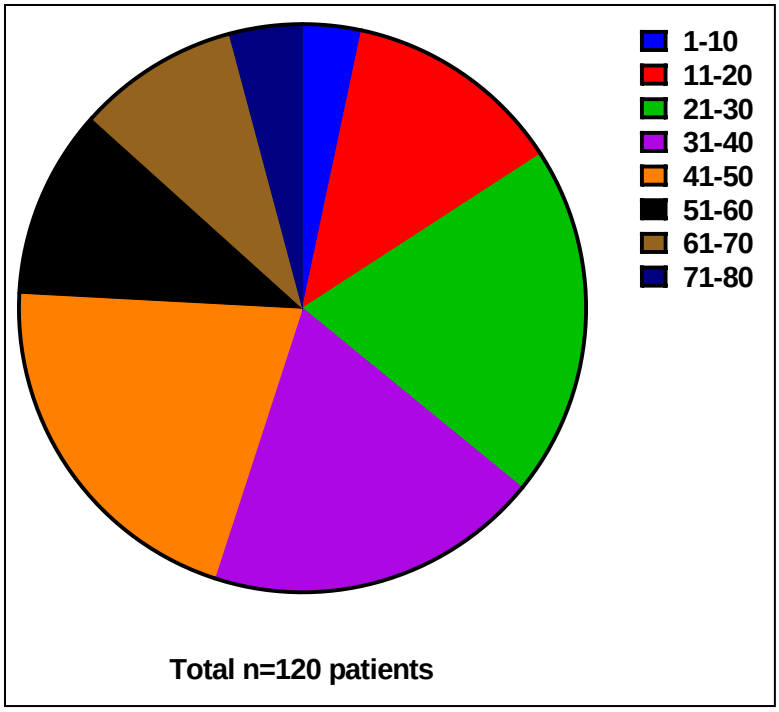

Figure 1 *Age-wise distribution*

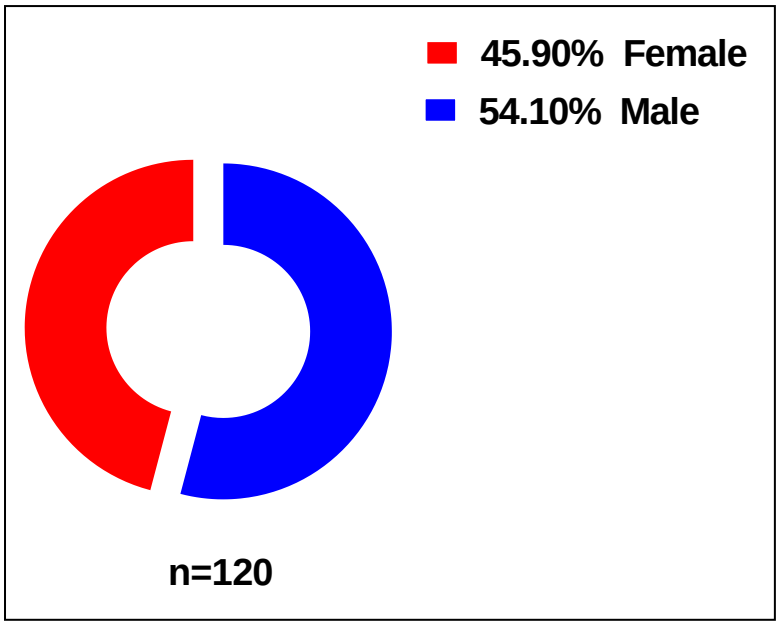

Figure 2 *Gender-wise distribution and data collection*

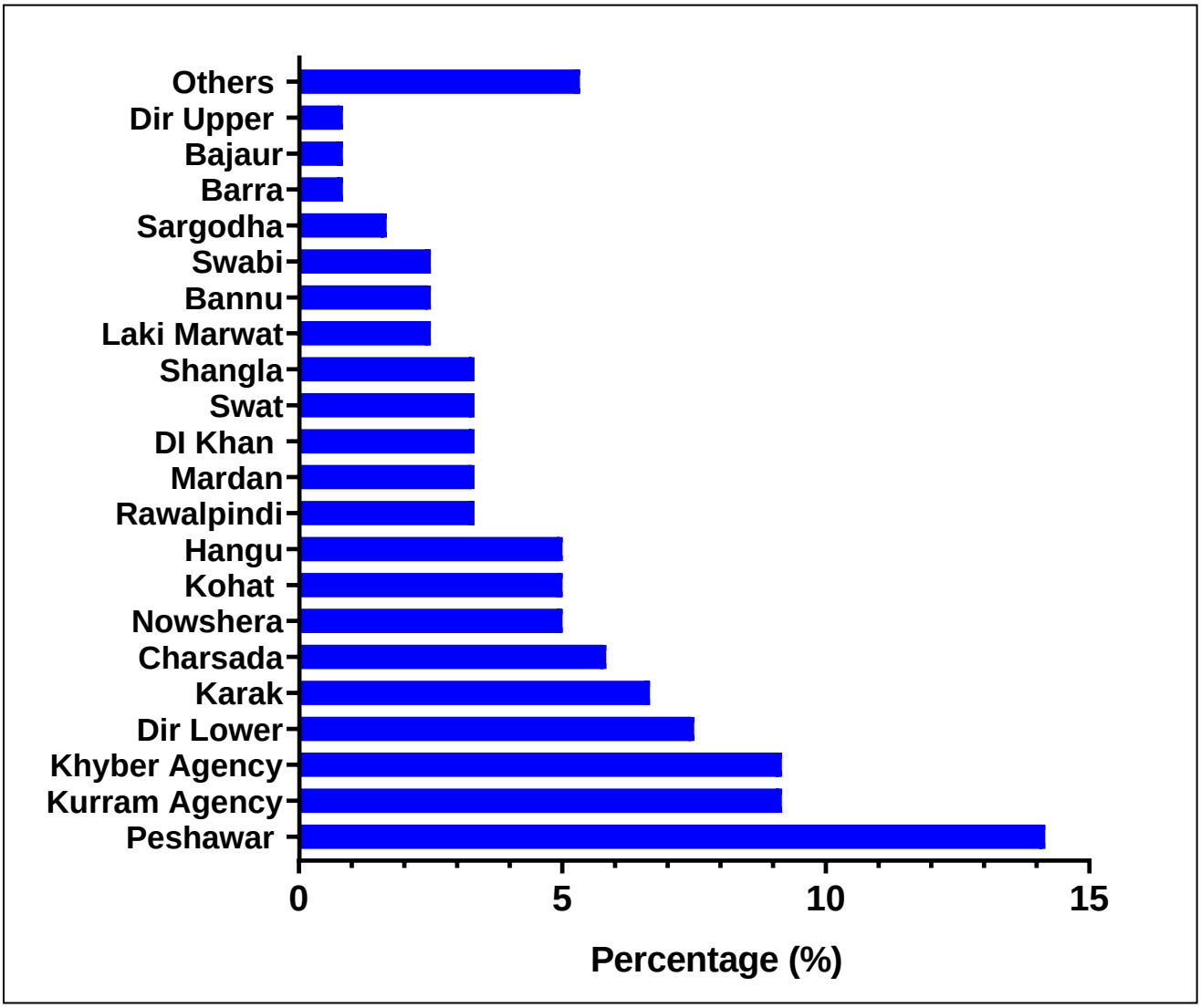

Figure 2 *Demographics and epidemiology data collected from various districts of KP, Pakistan*

3.4 Antibiotics Consumption

The current study highlights the antibiotic usage in a surgical unit, revealing a total of 132 prescriptions. Among these, Cefoperazone + Sulbactam was most commonly prescribed (n=41), followed by Ceftriaxone (n=25), Linezolid (n=13), Co-Amoxiclav (n=31), Piperacillin + Tazobactam (n=15), and Moxifloxacin (n=7). This data underscores the importance of targeted antibiotic therapy in optimizing patient outcomes.

Table 1. Total antibiotic consumption in wound infection patients

Antibiotics used	Frequency (n)
Cefoperaznoe + Sulbactam	41
Ceftriaxone	25
Linezolid	13
Co-Amoxiclav	31
Piperacillin + Tazobactam	15
Moxifloxacin	7
Total	132

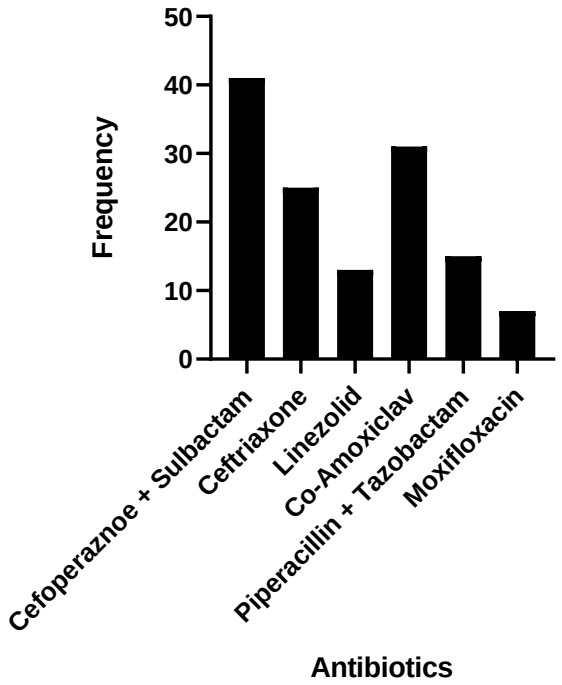

Figure 4 Frequency of total antibiotic consumption among wound infections patients

3.5 Hospital stay

Patients are stays in hospital are 2-days n=18 (15%), 3-day n=38 (31.6%), 4-day n=43(35.8%), 5-day n=21(17.5%).

Table 2. Total hospital stay and longevity (in days)

Hospital stays	No. of Patients	Percentage (%)
2-days	18	15.0
3-days	38	31.6
4-days	43	35.8
5-days	21	17.5

3.6 Discussions

The investigation conducted in the surgical wards of HMC observed 120 patients' prescriptions, focusing on surgical wounds and surgical site infections. The cohort comprised both males and females, with 65 males (54.17%) and 55 females (45.83%). The age distribution revealed a diverse group of patients: 1-10 years (n=4), 11-20 years (n=15), 21-30 years (n=24), 31-40 years (n=23), 41-50 years (n=25), 51-60 years (n=13), 61-70 years (n=11), and 71-80 years (n=5).

Patients hailed from various districts, indicating the widespread need for effective healthcare: Peshawar (n=17), Kurram Agency (n=11), Khyber Agency (n=11), Dir Lower (n=10), Karak (n=9), Charsada (n=8), Nowshera (n=7), Kohat (n=6), Hangu (n=6), Rawalpindi (n=4), Mardan (n=4), Dera Ismail Khan (n=4), Swat (n=4), Shangla (n=4), Lakki Marwat (n=3), Bannu (n=1), Swabi (n=2), Sargodha (n=2), Bara (n=1), Bajaur (n=1), Dir Upper (n=1), and a few others (n=4).

In terms of antibiotic prescription, a total of 132 were given, with the following breakdown: Cefoperazone + Sulbactam (n=41), Ceftriaxone (n=25), Linezolid (n=13), Co-Amoxiclav (n=31), Piperacillin + Tazobactam (n=15), and Moxifloxacin (n=7). The data concerning hospital stays further underscores the problem: 2 days (n=18, 15%), 3 days (n=38, 31.6%), 4 days (n=43, 35.8%), and 5 days (n=21, 17.5%).

Similarly, a study at Hayatabad Medical Complex Peshawar assessed the prevalence of bacteria linked to wound infections. By analyzing 100 culture-positive samples from patients with a mean age of 6.2 years, it was found that Gram-positive cocci (49.54%) and Gram-negative bacilli (50.45%) were equally common. Notably, Staphylococcus aureus (41.28%) and Pseudomonas species (18.35%) emerged as the most frequently isolated organisms. This pressing issue of wound infections highlights the urgent need for effective control measures and diligent wound care, essential in minimizing infection rates and improving patient outcomes [16].

A further investigation was done by Alam et al. KPK Pakistan for the incidence and risk factors of SSIs. The rate of gynecological surgery was the lowest 33%, which was not statistically significant. In comparison to elective surgery that had 4.5% of SSI, emergent ones registered a higher rate with 8%. The overall 5% rate of SSI reflected triumphs and shortcomings in the infection control techniques [17].

A recent study led by Ullah and colleagues underscores the urgent need for tailored antibiotic treatments in the fight against drug-resistant *Pseudomonas aeruginosa.* Their findings highlight that two antibiotics, colistin sulfate and imipenem, demonstrated strong effectiveness against these infections. Results for aminoglycoside antibiotics were mixed, though one among them, amikacin, also performed notably well [18]. Another study by Khan et al, out of 412 patients in a KP hospital study, approximately 30% developed a SSIs. Infection rates varied by procedure, from 1.2% to 12.6%. While most patients (84.5%) received antibiotics before surgery, very few (1.5%) did not receive them afterward. The most common bacteria found in infections were *Pseudomonas aeruginosa* and *Staphylococcus aureus*, and the antibiotics Cefoperazone and Sulbactam were most frequently prescribed [19].

Qasim et al., conducted same studies on which, 103 patient samples from diabetic foot ulcers at a Peshawar hospital, nearly half tested positive for *Pseudomonas aeruginosa*. The bacteria showed troubling resistance to many common antibiotics. Every sample resisted Amoxicillin-Clavulanic acid. However, most were still susceptible to Gentamicin (79%) and Cefoperazone-sulbactam (88%). The findings highlight a significant infection risk and a clear need for careful antibiotic selection based on local resistance patterns [20].

In another hospital study found bacterial infections in nearly all (94.7%) of 209 orthopedic patients tested. *Staphylococcus aureus* was the most common bacteria overall (56%), followed by *Pseudomonas aeruginosa* (21%) and *E. coli* (15%). However, the type of infection influenced which bacteria was most likely: Pseudomonas was most frequent in post-operative wounds and diabetic foot ulcers, while *Staphylococcus aureus* dominated cases of bone and joint infections. The authors emphasize that quickly identifying the specific bacteria involved is key to choosing the right antibiotic and preventing serious complications [21].

4.0 CONCLUSION

This study underscores the critical connection between extended hospitalization (stays), antibiotic consumption, and AMR in wound infections. The core issue remains the persistent over prescription of antibiotics, with an estimated 30-60% of hospital prescriptions being unnecessary or inappropriate. This practice directly fuels the development of resistant bacteria, complicating treatment, prolonging patient stays, and escalating healthcare costs. The mounting AMR burden poses a tangible threat to the stability of our healthcare systems. Addressing this challenge requires a unified, practical strategy focused on three pillars: enforcing strict, evidence-based antibiotic guidelines; strengthening hospital-wide infection prevention; and committing to continuous training for all medical staff.

5.0 STUDY LIMITATIONS AND FUTURE CONSIDERATIONS

A key limitation of this retrospective analysis is its reliance on historical records, which may contain gaps in data. Future prospective studies that monitor patients in real time are needed to confirm these findings. More importantly, there is an urgent need for localized surveillance to map the specific resistance patterns within our regional hospitals. Without such targeted data and the immediate implementation of stewardship programs, the risk of untreatable infections will continue to rise, jeopardizing patient safety and public health.

ACKNOWLEDGMENTS

The author would like to acknowledge Department of Chemistry and Department of Pharmacy, Shaheed Benazir Bhutto University Sheringal, Dir upper for supporting this study.

CONFLICT OF INTEREST

All the authors declare that, they have no conflict of interest.

REFERENCES

[1] J.L. Seidelman, C.R. Mantyh, D.J. Anderson, Surgical site infection prevention: a review, Jama, 329 (2023) 244-252.

[2] M. Wynn, The impact of infection on the four stages of acute wound healing: An overview, Wounds UK, 17 (2021).

[3] K. Sandy-Hodgetts, P. Alves, B. Conway, R. Djohan, P. Idensohn, C. McIsaac, R. Morgan-Jones, K. Harikrishna, M. Rochon, M. Romanelli, Optimising prevention of surgical wound complications: Detection, diagnosis and prediction, (2022).

[4] J.C. Alverdy, N. Hyman, J. Gilbert, Re-examining causes of surgical site infections following elective surgery in the era of asepsis, The Lancet Infectious Diseases, 20 (2020) e38-e43.

[5] M.L. Costa, J. Achten, R. Knight, J. Bruce, S.J. Dutton, J. Madan, M. Dritsaki, N. Parsons, M. Fernandez, R. Grant, Effect of incisional negative pressure wound therapy vs standard wound dressing on deep surgical site infection after surgery for lower limb fractures associated with major trauma: the WHIST randomized clinical trial, Jama, 323 (2020) 519-526.

[6] X. Ding, Q. Tang, Z. Xu, Y. Xu, H. Zhang, D. Zheng, S. Wang, Q. Tan, J. Maitz, P.K. Maitz, Challenges and innovations in treating chronic and acute wound infections: from basic

science to clinical practice, Burns & Trauma, 10 (2022) tkac014.
[7] C. Fu, L. Meng, M. Ma, N. Li, J. Zhang, Effect of wound irrigation on the prevention of surgical site infections: A meta-analysis, International Wound Journal, 19 (2022) 1878-1886.
[8] M.G. Tuuli, J. Liu, A.T. Tita, S. Longo, A. Trudell, E.B. Carter, A. Shanks, C. Woolfolk, A.B. Caughey, D.K. Warren, Effect of prophylactic negative pressure wound therapy vs standard wound dressing on surgical-site infection in obese women after cesarean delivery: a randomized clinical trial, Jama, 324 (2020) 1180-1189.
[9] E.J. Monk, T.P. Jones, F. Bongomin, W. Kibone, Y. Nsubuga, N. Ssewante, I. Muleya, L. Nsenga, V.B. Rao, K. van Zandvoort, Antimicrobial resistance in bacterial wound, skin, soft tissue and surgical site infections in Central, Eastern, Southern and Western Africa: A systematic review and meta-analysis, PLOS Global Public Health, 4 (2024) e0003077.
[10] J. Rickard, Bacterial Resistance in Surgical Infections in Low-Resource Settings, Surgical infections, 21 (2020) 509-515.
[11] E.M. Alvarez, L.M. Force, R. Xu, K. Compton, D. Lu, H.J. Henrikson, J.M. Kocarnik, J.D. Harvey, A. Pennini, F.E. Dean, The global burden of adolescent and young adult cancer in 2019: a systematic analysis for the Global Burden of Disease Study 2019, The Lancet Oncology, 23 (2022) 27-52.
[12] N.V. An, H.T. Kien, L.H. Hoang, N.H. Cuong, H.X. Quang, T.D. Le, T.B. Thang, T.T. Viet, L.C. Thuc, D.V. Hung, Antimicrobial Resistance Patterns of Pathogens Isolated from Patients with Wound Infection at a Teaching Hospital in Vietnam, Infection and Drug Resistance, (2024) 3463-3473.
[13] M. Raouf, T. Ghazal, M. Kassem, A. Agamya, A. Amer, Surveillance of surgical-site infections and antimicrobial resistance patterns in a tertiary hospital in Alexandria, Egypt, The Journal of Infection in Developing Countries, 14 (2020) 277-283.
[14] I. Fong, Antimicrobial resistance: a crisis in the making, New Antimicrobials: For the Present and the Future, (2023) 1-21.
[15] S. Greco, R. Putans, L. Springe, Antimicrobial and antibiotic resistance in developing countries: Health economics, global governance, and sustainable development goals, in: Antimicrobial Resistance, CRC Press, 2022, pp. 113-140.
[16] S.L. Shuaib, M. Haq, B.B. Khan, F. Haq, I. Haq, I. Ahmad, W. Ullah, A. Nazir, M. Farooq, H. Israr, Molecular Identification of Different Bacteria isolated from Infected Wounds at Hayatabad Medical Complex Peshawar Pakistan, Pakistan Journal of Medical & Health Sciences, 16 (2022) 875-875.
[17] Q. Alam, N.M. Khan, W. Muhammad, A. Sattar, Bacteriology of open fractures, experience at a tertiary care hospital, Pak J Surg, 38 (2022) 244-248.
[18] A. Ullah, W. Sultan, S. Mazhar, F. Shireen, M. Rabnawaz, K. Khan, M.M. Kamal, A. Hamid, A. Azam, M. Umair, Antimicrobial Susceptibility Patterns of Pseudomonas Aeruginosa Isolates in A Tertiary Care Hospital, Peshawar, Pakistan, BioScientific Review, 6 (2024) 133-140.
[19] F.U. Khan, Y. Fang, Z. Khan, F.U. Khan, Z.I. Malik, N. Ahmed, A.H. Khan, A.u. Rehman, Occurrence, associated risk factors, and treatment of surgical site infections in Pakistan, European Journal of Inflammation, 18 (2020) 2058739220960547.
[20] M. Qasim, A. Haroon, M. Ullah, N. Amir, H. Imtiaz, T. Tara, F. Shireen, N. Qayum, M.J. Ullah, I. Ullah, Prevalence and Antibiotic Susceptibility Pattern of Pseudomonas Aeruginosa from the Foot Ulcer of Diabetic Patients in Hayatabad Medical Complex Peshawar, Pakistan, Journal of Health and Rehabilitation Research, 4 (2024) 414-420.
[21] S. Akhtar, M.A. Shah, D. Khan, M. Shabir, A. Karim, W.A. Khan, Pattern of Bacterial Infection in Orthopedic Department at Tertiary Care Hospital, Pakistan Journal of Medical & Health Sciences, 17 (2023) 109-109.