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ResearchArticle

BACTERIAL ISOLATES FROM INFECTED WOUNDS AND THEIR ANTIBIOTIC SUSCEPTIBILITY PATTERN

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Abstract

When the skin is damaged, it creates a wound, which is the body's primary inherent defense against the spread of infection to deeper tissues. We took swabs from the wounds and cultured them in the right medium. Standard microbiological techniques were used to identify the bacterial pathogens. Cultures were positive from 173 (23.9%) of 239 wound swab samples. Males made up 60.1% of the culture-positive cases, while those between the ages of 16 and 30 made up 35.3%. The most common bacteria found in these samples were Staphylococcus aureus (36.1%), Escherichia coli (34.8%), Pseudomonas spp. (17.3%), and Proteus spp. (5.6%). The majority of bacterial isolates tested positive for resistance to amoxicillin (90%), cephalosporins (60%), and ciprofloxacin (53%), while only a small percentage (14%) and 17% were resistant to imipenem and 13% were resistant to amikacin. Most of the wounds tested positive for bacterial growth. Gram-negative bacteria constituted the vast majority of those found. The most often isolated pathogen was Staphylococcus aureus, followed by Klebsiella pneumoniae and Pseudomonas aeruginosa. The most frequently isolated germs across all patients were Staphylococcus aureus and Pseudomonas aeruginosa. The current investigation found a significant percentage of antibiotic resistance among the isolates. As a result, it's important to keep an eye on things and take antibiotics sparingly.

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Keyword : Antimicrobial resistance, Bacterial pathogen, Wound infection

Introduction:

An infected wound is one in which microorganisms have invaded and multiplied to the point that they are causing the host to react locally and/or systemically. Wounds contaminated with germs harm surrounding tissue and slow recovery [1]. Infections produced by germs may enter the body via any break in the skin, whether it from an accident, surgery, or burn [2]. It has been estimated that around 50% of wounds contaminated with bacteria become clinically sick [3]. The risk of wound infection rises with the degree of contamination. [4]. There is a continuum from a polluted wound to a colonized wound to a local infection to a spreading infection to a systemic infection (sepsis). Exudates consisting of dead leucocytes, cellular debris, and necrotic tissues may be produced in response to skin and soft tissue infections caused by trauma, surgery, or burns.

Many different kinds of bacteria and fungi may colonize the surface of chronic wounds [6]. The bacterial pathogens Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Klebsiellapneumoniae, Streptococcus pyogenes, Proteus spp., Streptococcus spp., and Enterococcus spp. [7] are often linked with wound infection. These microorganisms have developed a natural resistance to many medicines and antiseptics, allowing them to live for extended periods of time, proliferate on few resources, and colonize injured skin.

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Acute surgical wounds, traumatic wounds like those sustained in an accident, burn wounds, and chronic wounds like diabetic foot, leg, and pressure ulcers are just some of the many types of wounds that patients may present with. The saprophytic microflora of the skin contaminates all wounds; however the specific organisms present and the extent to which they do so are wound-specific (2). Due to the fact that nonhealing outcomes have been studied and evidence presented for both acute and chronic wounds (5,10), it is essential that these aspects be taken into consideration in the wound care process. The presence of particular pathogens, rather than the total number of bacteria present, has been shown to be more significant in several investigations of polymicrobial chronic infections (11,12). After an infection has been diagnosed clinically, a sample should be cultured to determine the organism(s) responsible for the illness and to direct further antibiotic treatment.

One of the most prevalent nosocomial infections is a bacterial infection of a wound, which is a primary cause of morbidity and death worldwide. The phrase "poor nation face: greater hospital infection burden" refers to the conclusion reached by a group of researchers headed by the World Health Organization that developing nations had much higher infection rates than the industrialized world. Inadequate sterilization of the surgical site, contamination of the wound, inappropriate antibiotic choice, or the inability of an immunocompromised patient to mount an adequate defense against infection all contribute to the development of wound infection. All incisions are vulnerable to wound contamination. Malnutrition, heart failure, or low tissue oxygen levels can impede the healing process and make the patient more susceptible to reinfection. [1, 2, 3]. Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae, Streptococcus pyogenes, Proteus species, Streptococcus species, and Enterococcus species are typical bacterial pathogens that cause wound infections. Clinical decision-making may be aided by identifying bacterial infections and their antimicrobial susceptibilities, as in the provision of a suitable antibiotic for empirical therapy.

A wide variety of microorganisms are capable of infecting a wound. Many different types of bacteria, fungi, protozoa, and viruses may infect wounds. Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae, Streptococcus pyogenes, Proteus species, Streptococcus species, and Enterococcus species are among the top 10 most common bacterial species that cause wound infections. The proliferation of multidrug-resistant bacteria has complicated efforts to effectively heal wounds and prevent infection. Insight of the pathogens that cause wound infections has been shown to aid in decision-making about empirical treatment, infection prevention strategies, and antibiotic policy justifications.

Therefore, the purpose of this research was to identify bacterial pathogens linked with wound infection among patients presenting to a medical college hospital with such illness and to assess their susceptibility pattern to routinely used antibiotics.

Literature Review

Puca, V.; Marulli, R.Z.; Grande, R.; Vitale, I.; Niro, A.; Molinaro, G.; Prezioso, S.; Muraro, R.; Di Giovanni, P. (2021), The issue of antibiotic resistance in the context of treating wound infections has gained international attention. This was retrospective research aiming to do two things: determine the medication susceptibility profile of wound-infecting bacteria, and identify the microorganisms responsible for wound infections. Two hundred and thirty-nine individuals were included in the research between 2017 and 2019. The Walk Away

automated system was used to identify and analyze the susceptibility patterns of antimicrobials in 34 species that were isolated using culture procedures. Seventy-five percent of samples only had one species present, whereas 24.7% had two or more. Pseudomonas aeruginosa (40.2%), Escherichia coli (20.7%), Proteus mirabilis (11.2%), and Acinetobacter baumannii/haemolyticus (9.5%) were the most frequent Gram-negative species. Staphylococcus aureus was the most common kind of Gram-positive bacteria found (36.4%), accounting for 79.4% of all Gram-positive bacteria. In 88.2% of isolates, antibiotic resistance was found, and in 29.2% of isolates, resistance to at least six different antibiotics was found. Wounds are often not the primary location for the growth of multidrug-resistant organisms or co-infections. Due of these factors, it will be more challenging to completely eradicate the bacteria. The resolution of an infection, the promotion of wound healing, and the limiting of antibiotic resistance would all result from the early diagnosis of a polymicrobial illness and multi-drug resistant bacteria, followed by appropriate therapeutic treatment.

Authors Birru, Woldemariam, Manilal, A., et al. (2021), Infections in the bloodstream caused by bacteria are a worldwide health concern. Recent antibiotic resistance in bacteria has contributed to an increase in illness and death from these infections. 225 participants were recruited for cross-sectional research because they were thought to have BSI. Patients were chosen using a systematic random selection procedure. Bacterial pathogens were identified using blood culture. The Kirby-Bauer disc diffusion technique was used to test for antimicrobial susceptibility. Statistical Package for the Social Sciences (SPSS) version 22 was used to compile descriptive statistics and conduct multivariate logistic regression analysis. With 22 out of 225 cases confirmed by bacteria, the prevalence rate is 9.8 percent. Gram-positive cocci were responsible for the majority of BSIs (13/22) and S. aureus isolates (7/22) were the most common (31.8%), followed by Enterococci species (18.2%) and coagulase-negative Staphylococci (CoNS) (9%). Klebsiella species were the most common Gram-negative bacteria (4/22; 18.2%), followed by Escherichia coli (2/22) (9.1%), Pseudomonas aeruginosa (2/22) (9.1%), and Enterobacter species (1/22; 4.5%). All of the Gram-negative bacterial isolates tested positive for meropenem susceptibility, but only 69.2% of the Gram-positive bacterial isolates did so. About two-thirds (68.2%) of all isolates were resistant to several drugs. There was a strong correlation between the insertion of a peripheral intravenous line and BSI [p = 0.03; Adjusted Odds Ratio = 4.82; (Confidence Interval: 1.08-21.46)]. Despite a lower-than-average frequency of BSI (9.8%), the data showed that multidrug resistance was dangerously increasing, highlighting the need for improved monitoring and control measures in the region.

Gemechu MM, Tadesse TA, Takele GN, Bisetegn FS, Gesese YA, Zelelie TZ. (2021), In resource-poor regions of the world, HAIs rank high on the list of worries. The purpose of the research was to identify the types of bacteria that patients admitted to surgical and medical wards were exposed to, as well as the patterns of antibiotic resistance those bacteria exhibited. Cross-sectional research was carried out between November 2016 and July 2017 at the MaddaWalabu University Goba Referral Hospital. Standard disk diffusion testing was performed on processed urine and wound swabs to determine susceptibility profile. The Chi-square test was used to establish a relationship between the variables. The findings showed that out of a total of 207 patients, 24.6% contracted a HAI, with 62.7% of those cases occurring in the surgical wards and 37.3% in the medical wards. The number of males to females was 1.5 to 1. The average age was 41.65(16.48) years, while the minimum was 19 years

old. There was a total of 62 bacterial isolates, with the vast majority being gram-negative. The majority of the isolates tested were resistant to the majority of the antibiotics used, however Ceftriaxone, Norfloxacin, and Ciprofloxacin were effective against them. Empirical therapy of HAI may not be successful due to the prevalence of bacteria with high levels of resistance to antibiotics. Therefore, cultural awareness and understanding should inform therapeutic decisions.

Tom, I.M., Ibrahim, M.M., Umoru, A.M., Umar, J.B., Bukar, M.A., Haruna, A.B., and Aliyu, A. (2019), When the skin is damaged, it creates a wound, which is the body's primary inherent defense against the spread of infection to deeper tissues. Bacterial pathogen contamination of such wounds slows the healing process and makes care difficult. Here, we take a look at the variety of bacteria that might cause an infection in hospitalized patients' wounds. Microscopical examination and culture on Blood, MacConkey, and Chocolate Agar were performed on 320 wound swab samples. The antimicrobial susceptibility pattern of the isolates was determined using the Kirby Bauer disc diffusion test, and the isolates' viability was validated using biochemical testing. Single bacterial isolates made for 52.17 percent of the growth found in the samples, while polymicrobial/mixed growth accounted for 47.82 percent. Staphylococcus aureus was found to be the most common kind of bacterium by a wide margin (32.61 percent). It was found that E. coli (23.64 percent) and Pseudomonas aeruginosa (17.13 percent) were the most common types of Gram-negative bacteria overall. Most infections were caused by Enterobacter spp. and Streptococcus spp., while the most common types of wounds were burns and sepsis. The incidence of infection by Gram-negative bacteria varied significantly by wound type (Mean SD = 7.633 6.3706, f = 5.9592, df = 29, p-value = 0.001645, p 0.01). A high percentage of the Gram-positive and Gram-negative bacteria isolated were resistant to Amoxicillin and Ampicillin, respectively, according to the isolates' resistance profiles. This indicates that possible bacterial infections might infect wounds, further complicating the wound's development and the healing process.

Bessa LJ, Fazii P, Di Giulio M, Cellini L. (2015), Infection of a wound is a major contributor to chronicity because it slows the healing process. The purpose of this research was to determine what kinds of bacteria cause wound infections and how resistant they are to the most commonly used antibiotics for treatment. Two hundred and thirteen patients had wound swabs taken from them, and they were analyzed for the presence of bacteria and their sensitivity to various antibiotics. This retrospective research was conducted on patients with a wide variety of wound types between March and September of 2012. From 217 different wound infections, 28 different species were isolated. Staphylococcus aureus was found to be present 37% of the time, with Pseudomonas aeruginosa coming in second at 17%, Proteus mirabilis at 10%, E. coli at 6%, and Corynebacterium spp. at 5%. There were several microbial species present in 59 (27.1%) of the samples. S. aureus and P. aeruginosa were the most often found partners. Vancomycin and linezolid both worked well against all of the Gram-positive bacteria. The resistance rate of Gram-negative bacteria to most antibiotics was rather high, with amikacin being the most effective treatment. This research primarily aims to inform medical professionals who deal with wounds so that they may make more informed decisions about how to prevent and treat wound infections.

Materials and Methods

From patients in the different clinical wards and outpatient departments at Sir Salimullah Medical College and Mitford Hospital, a total of 239 specimens were collected, including wound swabs, pus, purulent exudates,

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and wound discharge. To be included in the study, patients of both sexes and of any age who were clinically determined to have a wound infection with pus or discharge draining from the infection site, or who were showing signs of infection (pain or tenderness, localized swelling, redness, or heat), or whose wounds had not healed within ten days of the injury were recruited. Patients who had received antibiotics or antiseptic dressings during the previous 24 hours were also disqualified from participation.

Specimens were obtained in a sterile manner by swabbing the affected area with a sterile cotton swab to avoid contaminating the sample with skin commensals. Aerially at 370 degrees Celsius, the samples were incubated for 24 hours after being injected into Blood agar medium and MacConkey agar media. Standard microbiological techniques, such as colony morphology, Gram staining, and biochemical assays, were used for the isolation and identification of various bacteria. Clinical and Laboratory Standards Institute (CLSI) recommendations dictated that antimicrobial susceptibility testing be performed using the Kirby-Bauer disc diffusion method with Mueller Hinton agar medium, and the zone of inhibition was evaluated.

Used were antibiotic discs containing the following drugs: Amoxycillin (10 g), Cefradin (30 g), Ceftriaxone (30 g), Ceftazidime (30 g), Cefixime (5 g), Ciprofloxacin (5 g), Cotrimoxazole (25 g), Tetracyclin (30 g), Gentamicin (10 g), Amikacin (30 g), and Imipenem (10 g).

RESULTS

Among 239 samples from wound infection, 173(72.4%) yielded bacterial growth, and remaining 66(27.6%) were culture negative (Figure 1).

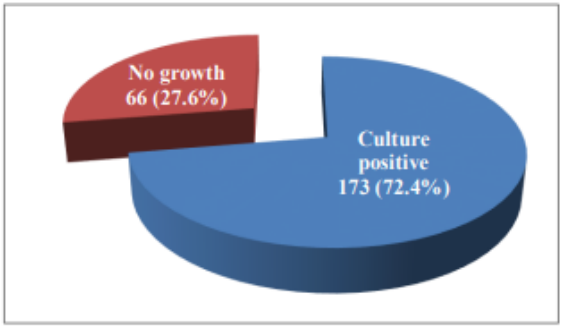

Figure 1: Distribution of sample on growth character (n=239).

Out of these culture positive cases, majority 61(35.3%) were in the age group of 16-30 years (Table 1), and males 104(60.1%) were more commonly affected than female 69(39.9%) patients.

Table 1: Age distribution of culture positive cases

Age group (In years)	Frequency	Percent
≤15	35	20.2
16-30	61	35.3
31-45	26	15.0
46-60	35	20.2
≥60	16	9.2
Total	173	100

The most frequently isolated bacteria were Staphylococcus aureus 64 (36.9%), followed by Escherichia coli 62 (35.8%), Pseudomonas spp. 30 (17.3%) and Proteus spp. 10 (5.8%) (Table 2).

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Table 2: Distribution of bacterial isolates of wound infection

Bacterial isolates	Number	Percent
Staphylococcus aureus	64	36.9
Escherichia coli	62	35.8
Pseudomonas spp.	30	17.3
Proteus spp.	10	5.8
Others*	7	4.1
Total	173	100

Although Pseudomonas aeruginosa was the most often isolated pathogen in previous research of SSI in a comparable context, we found the opposite to be true. Several variables, such as the kind of surgical site, the wound location, the prophylactic antibiotics used for infection prevention, the amount of nursing care provided, and the steps used to avoid nosocomial infections, may account for these differences.

Staphylococcus aureus was the most often found bacterium throughout this investigation. This result agrees with that of the vast majority of investigations conducted elsewhere [10, 11, 12]. Since S. aureus is a common skin and nasal flora, it may quickly spread to infect wounds. In addition, compared to other bacteria, S. aureus has a much higher infection rate because of their high number of virulence factors.The Kirby Bauer disc diffusion technique was used to determine the antimicrobial susceptibility of the bacterial isolates (Table 3). Ceftotaxime, meropenem, tetracycline, chloramphenicol, Ticarcillin, and tobramycin were all effective against the vast majority of Gram-positive isolates. Antibiotics including ampicillin, penicillin, colistin, and norfloxacin are useless against the bacteria that have been isolated from infected wounds.

Table-3 Antibiotic Susceptibility Testing of Pathogens

Bacterial isolates	Number	Percent
Staphylococcus aureus	64	36.9
Escherichia coli	62	35.8
Pseudomonas spp.	30	17.3
Proteus spp.	10	5.8
Others*	7	4.1
Total	173	100

Table 3 displays the antimicrobial susceptibility profile of bacterial isolates. Amoxycillin resistance was 92.2%, cefradine resistance was 87.5%, and cefixime resistance was 84.4% among the most common S. aureus isolates. Ceftriaxone (76.6%) and ceftazidime (71.9%), both third-generation Cepahlosporins, also had substantial rates of resistance. Imipenem (7.8%), amikacin (17.2%), and gentamicin (21.9%) showed the lowest levels of resistance. Amoxycillin and tetracycline resistance was found at 88.7%, cefixime at 87.1%, and cefradine at 82.3% among E. coli isolates. Cotrimoxazole (75.8%), ceftazidime (74.2%), and ceftriaxone (70.9%) all showed very high levels of resistance. The Cefradine resistance rate for Pseudomonas spp. was one hundred percent. Amoxycillin (93.3% resistance), Cefixime (96.7%), Ceftriaxone (86.7%), Ceftazidime (80%), and Cotrimoxazole (80%) were all ineffective against them. Only 53.3% of patients were resistant to Gentamicicn. A large percentage of Proteus spp. were resistant to the antibiotics amoxycillin (100%), cefradine (90%), and cotrimoxazole (90%), but resistance to cefixime (70%), ceftazidime (70%), ciprofloxacin (70%), and ceftriaxone (60%), was much lower. Imipenem (86-100%) and Amikacin (70-83% sensitivity) were equally effective against all bacterial isolates from wound infections.

Table 4: Antimicrobial resistance pattern of bacterial isolates from wound infection

Antibiotic	Number (%) of isolates resistant to				
	S. aureus (n=64)	E.coli (n=62)	Pseudomonas spp. (n=30)	Proteus spp. (n=10)	Others (n=7)
Amoxycillin	59 (92.2)	55 (88.7)	28 (93.3)	10 (100)	7 (100)
Cefradin	56 (87.5)	51 (82.3)	30 (100)	9 (90)	6 (85.7)
Cefixime	54 (84.4)	54 (87.1)	29 (96.7)	7 (70)	6 (85.7)
Ceftriaxone	49 (76.6)	44 (70.9)	26 (86.7)	6 (60)	6 (85.7)
Ciprofloxacin	43 (67.2)	40 (64.5)	16 (53.4)	7 (70)	5 (71.4)
Cotrimoxazole	41 (64.1)	47 (75.8)	24 (80)	9 (90)	6 (85.7)
Ceftazidime	46 (71.9)	46 (74.2)	24 (80)	7 (70)	7 (100)
Gentamicin	14 (21.9)	15 (24.2)	16 (53.4)	2 (20)	3 (42.9)
Amikacin	11 (17.2)	17 (27.4)	7 (23.3)	3 (30)	2 (28.6)
Tetracycline	44 (68.8)	55 (88.7)	23 (76.7)	3 (30)	3 (42.9)
Imipenem	5 (7.8)	8 (12.9)	4 (13.3)	0 (0)	1 (14.3)

Rate of Recovery of Potential Bacterial Pathogens from the Wound Types Examined

Wounds with sepsis had the highest infection rate, followed by burns, and then gunshot wounds, which had the lowest infection rate. Wound sepsis is characterized by the presence of Enterobacter spp., wound ulcers by Pseudomonas aeruginosa, diabetic wounds by Streptococcus spp., burns by Streptococcus spp., and gunshot wounds by Escherichia coli (Figure 2).

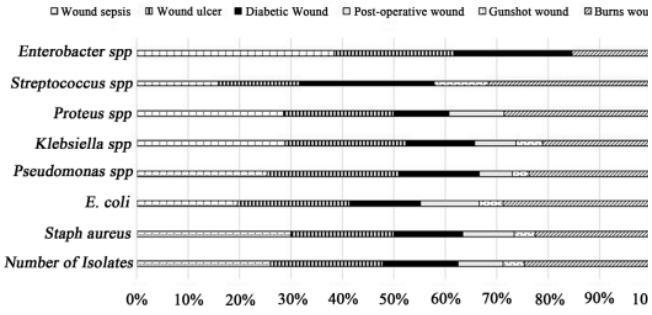

Figure 2. 100% Stacked bar representing the rate of infection of wounds by potential bacterial pathogens.

DISCUSSION

The morbidity and mortality caused by wound infections continues to be a major focus for medical professionals across the globe. It's a leading source of disease that extends hospital stays, drives up treatment costs, and is probably a major factor in the rise of antibiotic resistance. Consequently, correct wound infection care requires accurate identification of the causative organism and evaluation of the antimicrobial susceptibility pattern.

The majority of cases (35.3%) of wound infections in this research occurred in people aged 16 to 30. This is consistent with previous research showing an increased risk of infection in the second to fourth decades of life. 2,11 People in their prime working years are more likely to suffer from a wide range of injuries due to the diversity of the job they do.

Wound infection was more common in men (60.1% vs 39.9%) than in women. A male-dominated sample was also noted by other researchers. 11,19,22 This may be because more males than women work in this nation. Cases were chosen from men because either they were more likely to get medical attention in hospitals than women did, or because they worked in dangerous professions including construction, farming, transportation, and industry.

Resistance to the chosen antimicrobials was found to be rather high when analyzing the antibiotic susceptibility pattern of isolates. Amoxycillin (89-100%) and cefradine (82-100%) resistance was common among bacterial isolates. Identical findings were reported by other researchers as well. 2,5,11 Resistance to these antibiotics may have been facilitated by their widespread and indiscriminate use without sensitivity testing and by overuse of these medications by self-medication to treat many kinds of diseases owing to their cheap cost.

Cefixime (70-97%), ceftriaxone (60-87%), and ceftazidime (70-100%) resistance to third-generation cephalosporins was also quite significant. These results are consistent with what Sultana et al. reported.5 The widespread usage of Cephalosprins of the third generation in this nation may be to blame. Therefore, organisms have become resistant to

these medications as a result of the careless and excessive usage that has occurred throughout this time period. Ciprofloxacin resistance was also found to be rather high. These results are consistent with those of investigations conducted by Khanam et al. and Sultana et al. 5,21 Several other investigations, however, found increased sensitivity to Ciprofloxacin.11,19,22 It is possible that widespread clinical usage of this antibiotic without susceptibility testing contributed to its decreased sensitivity in the current investigation. Imipenem, Amikacin, and Gentamicin were shown to be the most efficient antibiotics in this investigation. This finding agrees with previous research showing that these antimicrobials were effective against the majority of bacterial strains tested. 2,11,19 This might be because, as indicated by the susceptibility data, these antibiotics are seldom administered for empirical therapy and are often reserved for inpatients.

The way germs trigger an immune response is shifting dramatically. It is concerning that bacteria are becoming more resistant to widely used antibiotics. To avoid contributing to the spread of antibiotic resistance, clinicians should consider local susceptibility patterns and current trends while deciding on a course of therapy.

CONCLUSION

There was a high success rate in isolating harmful microorganisms. Staphylococcus aureus, Klebsiella pneumoniae, and Pseudomonas aeruginosa were the most often isolated organisms. This study found that Gram-negative wound pathogens were more often isolated than Gram-positive ones. The microbiology laboratory's job is to identify the clinically important isolates, conduct antibiotic susceptibility testing, and then recommend the best course of therapy based on the wound's location and the patient's symptoms. Amoxycillin, cephalosporins, ciprofloxacin, tetracycline, and cotrimoxazole were all useless against the isolates. While Imipenem, Amikacin, and Gentamicin were quite effective against them. The clinician's ability to pick the right antibiotic and treat a wound infection correctly depends on the results of constant monitoring and surveillance. The development of antibiotic-resistant pathogens may be avoided via the prudent and careful use of these drugs.

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