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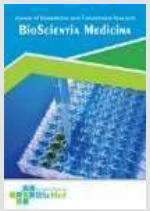

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Overview of Bacterial Patterns and Antibiotic Sensitivity in Diabetic Foot Ulcers: A Single-Center Observational Study at Dr. M. Djamil General Hospital, Padang, Indonesia

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A B S T R A C T

Background: Diabetic foot ulcers (DFUs) are a serious complication of diabetes mellitus with a high risk of infection. Patterns of causative bacteria and antibiotic sensitivity can vary between hospitals and time periods. **Methods:** This descriptive research involved all swabs and pus samples from DFU patients at Dr. M. Djamil General Hospital Padang between January and June 2023. Samples were processed through culture, Gram staining, and identification using VITEK 2. Patient medical record data was analyzed for demographic characteristics. **Results:** Of the 23 samples, 65% were gram-negative bacteria, dominated by *Escherichia coli* (30%). Gram-positive bacteria were found in 35%, with *Staphylococcus aureus* (18%) as the most. *E. coli* showed resistance to ampicillin and ceftriaxone but was sensitive to meropenem and amikacin. *S. aureus* is resistant to vancomycin but sensitive to benzylpenicillin. **Conclusion:** Gram-negative bacteria, especially *E. coli,* were more dominant in DFU at Dr. M. Djamil General Hospital Padang during the research period. The pattern of antibiotic resistance found emphasizes the importance of selecting appropriate antibiotic therapy based on sensitivity test results.

1. Introduction

Diabetes mellitus (DM) has become an increasingly worrying global epidemic, with prevalence continuing to increase significantly in recent decades. The World Health Organization (WHO) estimates that by 2045, the number of individuals living with diabetes will reach 700 million worldwide. In Indonesia itself, the prevalence of diabetes also shows an alarming trend. Based on 2018 Basic Health Research (Riskesdas) data, the prevalence of diabetes in Indonesia reached 8.5%, an increase from 6.9% in 2013. This increase in prevalence not only has an impact on individuals suffering from diabetes but also on the health system as a whole, considering that diabetes is a chronic disease that requires long-term and comprehensive treatment. One of the most frequent chronic complications of diabetes that has a significant impact on the patient's quality of life is diabetic foot ulcers (DFUs). DFU is an open wound on the foot caused by a combination of risk factors, including diabetic neuropathy, peripheral vascular disease, and repetitive trauma. Diabetic neuropathy, namely nerve damage due to high blood sugar levels, can cause loss of sensation in the feet so that the patient is unaware

of the wound or injury. Peripheral vascular disease, namely narrowing of the blood vessels in the legs, can reduce blood flow to the legs, thereby hindering the wound healing process. Repeated trauma to the foot, which patients are often unaware of due to neuropathy, can worsen the condition of the wound and increase the risk of infection.[1,2]

Infection is one of the main complications of DFU which can have a serious impact on the patient's prognosis. Infections in DFU can range from superficial infections to deep tissue infections, including osteomyelitis (bone infection). Infections that are not treated properly can cause further complications, such as gangrene, sepsis, and even amputation. Therefore, early detection and treatment of infections in DFU is very important to prevent more severe complications and improve the patient's quality of life. Various types of microorganisms can cause infections in DFU, including bacteria, fungi, and viruses. However, bacteria are the most common cause of infection in DFU. The bacteria that cause DFU infections can come from normal skin flora, environmental contamination, or nosocomial infections. The bacterial patterns that cause DFU infections can vary between hospitals, geographic regions, and can even change over time.[3,4]

Previous studies have reported various types of bacteria associated with DFU infections, both gram-positive and gram-negative bacteria. Gram-positive bacteria that are often found include: *Staphylococcus aureus*, *Streptococcus pyogenes*, and *Enterococcus spp*. Meanwhile, gram-negative bacteria that are often found include: *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, and *Proteus mirabilis*. Apart from that, several studies also reported polymicrobial infections, namely infections caused by more than one type of bacteria. Identification of the bacteria causing DFU infection is very important in determining appropriate antibiotic therapy. Selection of inappropriate antibiotics can cause therapy failure, prolong hospitalization time, increase treatment costs, and even worsen the patient's condition. Therefore, it is important to carry out microbiological examinations, including culture and antibiotic sensitivity tests, on every DFU patient who is suspected of having an infection.[5,6]

Apart from identifying the causative bacteria, understanding antibiotic resistance patterns is also very important in selecting effective antibiotic therapy. Antibiotic resistance is an increasingly worrying global health problem. Inappropriate or excessive use of antibiotics can accelerate the development of antibiotic resistance. Antibiotic-resistant bacteria can cause infections that are difficult to treat and increase the risk of complications. Research on antibiotic resistance patterns in bacteria that cause DFU infections has been carried out in various countries, including Indonesia. Several studies report an increase in resistance of gram-negative bacteria to commonly used antibiotics, such as ampicillin, ceftriaxone, and ciprofloxacin. This shows the importance of monitoring antibiotic resistance patterns regularly to optimize antibiotic therapy in DFU patients.[7,8] This study aims to determine the characteristics of DFU patients, identify bacterial patterns that cause DFU infections, and analyze antibiotic sensitivity in DFU patients at Dr. M. Djamil General Hospital Padang. It is hoped that the information obtained from this research will provide an up-to-date picture of the microbiological profile of DFU in the hospital, as well as become a basis for making clinical decisions regarding the selection of appropriate antibiotics. It is also hoped that this research can contribute to efforts to control infection and prevent antibiotic resistance in Indonesia.

2. Methods

This research uses a descriptive observational study design with a retrospective approach. A retrospective approach was chosen because the data used came from previously existing patient medical records. This design makes it possible to identify bacterial patterns and antibiotic sensitivity in diabetic foot ulcers (DFUs) at Dr. M. Djamil General Hospital Padang. in a certain time period. This research was conducted at the Microbiology Laboratory of Dr. M.

Djamil General Hospital Padang, a national referral hospital in West Sumatera Province, Indonesia. This location was chosen because it is a tertiary health service center that handles many DFU cases. The research was conducted for six months, from January to June 2023. This period was chosen to provide the latest picture of bacterial patterns and antibiotic sensitivity in DFU at the hospital. The study population was all DFU patients treated at Dr. M. Djamil General Hospital Padang during the research period. The research samples were all swabs and pus samples from diabetic foot ulcers that met the inclusion and exclusion criteria.

The inclusion criteria used in this study were: Patients with a diagnosis of DFU which was established based on clinical criteria and supporting examinations. Clinical criteria for DFU include the presence of open wounds on the feet that do not heal, accompanied by signs of infection such as redness, swelling, pain, and pus discharge. Supporting examinations that can be carried out include blood sugar checks, bacterial cultures, and radiological examinations to assess the presence of osteomyelitis; Patients undergoing swab or pus samples from ulcers for microbiological examination. Sampling is carried out by trained health personnel using aseptic techniques to avoid contamination; Patients with complete medical record data. Complete medical record data includes patient demographic information (age, gender), disease history, physical examination results, laboratory examination results, and therapy that has been given. Meanwhile, the exclusion criteria used in this study were patients who had received systemic antibiotic therapy in the last 7 days before sample collection. This is done to avoid the influence of antibiotics on the results of bacterial culture and antibiotic sensitivity tests; Patients with severe immunosuppression (eg, HIV/AIDS, advanced cancer). Patients with severe immunosuppression have a higher risk of infection and the bacterial pattern causing infection may be different from patients without immunosuppression; Patients with a history of allergies to antibiotics will be tested. This is done to avoid allergic reactions that could harm the patient.

Swab or pus samples from diabetic foot ulcers are taken by a trained doctor or nurse. Before sampling, the ulcer was cleaned with a sterile saline solution to remove debris and contaminants. Samples are taken from the deepest parts of the ulcer or from parts that show signs of active infection. Swab samples are taken by wiping the ulcer area with sterile cotton. Pus samples are taken using a sterile syringe or by aspiration using a sterile needle. After sampling, the ulcer is covered with a sterile dressing. The samples are then immediately sent to the microbiology laboratory for further examination. Swab and pus samples from diabetic foot ulcers were examined at the Microbiology Laboratory of Dr. M. Djamil General Hospital Padang. Samples are grown on appropriate growth media, such as blood agar and MacConkey agar. Blood agar is a general growth medium that can support the growth of various types of bacteria, while MacConkey agar is a selective medium that can differentiate gram-negative bacteria based on their ability to ferment lactose. The growth medium that has been inoculated with the sample is incubated at 37°C for 24-48 hours. This temperature is the optimal temperature for the growth of most pathogenic bacteria. Bacterial colonies growing in the growth medium were taken and Gram-stained. Gram staining is a method for distinguishing bacteria into gram-positive and gram-negative based on differences in the structure of their cell walls. Gram-positive bacteria will be purple, while gram-negative bacteria will be pink. Bacterial identification was carried out using the VITEK 2 automatic microbiology tool. This tool can identify bacteria quickly and accurately based on the biochemical profile of the bacteria. Antibiotic sensitivity testing is carried out to determine the type of antibiotic that is effective against the isolated bacteria. This test is carried out using the Kirby-Bauer method or disc diffusion method. In the Kirby-Bauer method, bacteria are grown on Mueller-Hinton agar media, and then a paper disc containing antibiotics is placed on the surface of the agar. After incubation, the diameter of the inhibition zone is measured to

determine the sensitivity of the bacteria to antibiotics.

Data obtained from microbiological examinations and patient medical records were analyzed descriptively. Descriptive analysis was used to describe patient characteristics, bacterial patterns that cause DFU, and antibiotic sensitivity. Data is presented in the form of tables and narratives. The VITEK 2 automatic microbiology instrument is calibrated periodically to ensure the accuracy of bacterial identification and antibiotic sensitivity test results. Positive and negative controls are used in each microbiological examination to ensure the validity of the results. Data is recorded completely and accurately in the form provided. The data that has been recorded is re-checked by different laboratory personnel to avoid recording errors. This research has received approval from the Research Ethics Committee of Dr. M. Djamil General Hospital Padang. Patient data is kept confidential and is not used for purposes other than this research.

3. Results

In this study, there were 14 female subjects (61%) and 9 male subjects (39%). The average age of the research subjects was ± 58 years. Based on the type of treatment obtained, 16 subjects (69.6%) received insulin therapy and 7 subjects (30.4%) used oral diabetes medication. Seven subjects (30.4%) suffered from DM <10 years and 16 subjects (69.6%) suffered from DM >10 years. The degree of diabetic foot infection was found to be 20 subjects (87%) in grade III and 3 subjects (13%) in grade IV (Table 1). The results of bacterial identification of diabetic foot ulcers using the VITEK 2 automatic tool showed that there were 15 samples of gram-negative bacteria (65%) and 8 samples of gram-positive bacteria (35%). The gram-negative bacteria found in diabetic foot ulcers in order from the most numerous are *Escherichia coli* as many as 7 samples (30%), *Pseudomonas aeruginosoa* 3 samples (13%), *Acinobacter baumanii* 3 samples (13%), *Klebsiella pneumaniae* 1 sample (4.5%) and *Citobacter freundii* 1 sample (4.5%) (Figure 1). In this study, the gram-positive bacteria found in sequence were: *Staphylococcus aureus* as many as 4 samples (18%), *Enterococcus faecium* as many as 2 samples (9%), *Staphylococcus warneri* 1 sample (4.5%) and *Kocuria kristinae* 1 sample (4.5%) (Figure 1).

Table 1. Characteristics of research subjects.

Characteristics	n	Percentage (%)
Gender		
Male	9	39 %
Female	14	61 %
Age		
Average	± 58 years	
DM type		
Insulin-dependent	16	69,6 %
Non-insulin-dependent	7	30,4 %
Long suffered from DM		
<10 years	7	30,4%
>10 years	16	69,6%
Sample culture results		
Gram-positive	8	34,8 %
Gram-negative	15	65,2 %
Degree of infection in diabetic foot		
III (moderate)	20	87 %
IV (severe)	3	13 %

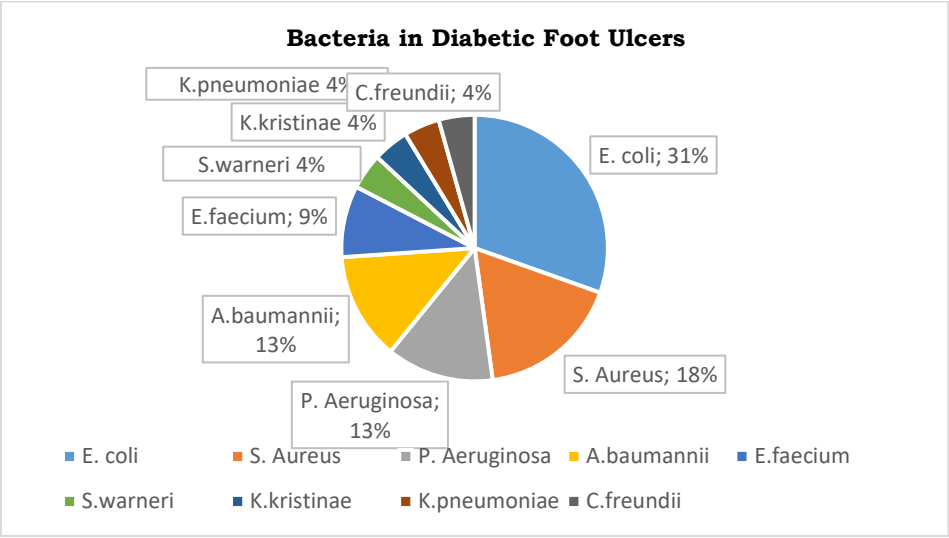

Figure 1. Bacteria in diabetic foot ulcers.

Table 2. Antibiotic sensitivity test results with gram-negative bacterial patterns.

Bacteria names	**AM**		**AN**		**AMS**		**CRO**		**CAZ**		**CZ**		**CIP**		**GM**		**MEM**		**PC**		**SMT**	
	R	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**
Escherichia coli	7	-	6	1	3	4	7	-	3	4			5	2	6	1	-	7			1	6
Pseudomonas aeroginosa	2	1		-3	1	2	2	1	2	1			2	1	-	3	2	1	1			
Acinobacter baumanii			3	-	1	2	3	-	2	1			1	2	3	-	-	3			3	-
Klebsiella pneumoniae	1	-	1	-	1	-	1	-	1	-	1	-	-	1	-	1	-	1			-	1
Citibacter freundii	1	-	-	1	1	-	-	1	-	1	1	-	-	1	-	1	-	1			-	1

Information: Ampicillim (AM), Amikacin (AN), Ampicillin Sulbactam (AMS), Ceftriaxone (CRO), Ceftazidime (CAZ), Cefazolin (CZ), Ciprofloxacin (CIP), Gentamicin (GM), Meropenem (MEM), Piperacillin (PC), Sulfamethoxazole trimetrhoprin (SMT), Resistant (R), Sensitive (S).

Table 3. Antibiotic sensitivity test results with gram-positive bacterial patterns.

Bacteria names	**AM**		**AMX**		**BZX**		**CIP**		**CC**		**CRO**		**CFO**		**ERT**		**GM**		**LEV**		**MOX**		**SMT**		**TE**		**TGC**		**VA**	
	R	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**
Staphylococcus aureus	1	3			4	-	1	3		2					-	4	-	4	1	3	4	-	1	3	3	1			-	4
Tapylococcus warneri					1	-	1	-	1	-					1	-	-	1	1	-	1	-	-	1	-	1			-	1
Enterococcus faecium	2	-			2	-	2	-							2	-			2	-					2	-		1	1	1
Korucia Kristine	1	-	-	1			1	-			1	-	1	-	1	-	1	-					1	-	1	-	-	1		

Information: Ampicillin (AM), Amoxicillin (AMX), Benzypenicillin (BZX), Ciprofloxacin (CIP), Clindamycin (CC), Ceftriaxone (CRO), Ceferazon (CFO), Erytromicin (ERT), Gentamicin (GM), Levofloxacin (LEV), Moxiflokxacin (MOX), Sulfamethoxazole trimetrhoprin (SMT), Tetracycline (TE), Tigecycline (TGC), Vancomycin (VA), Resistant (R), Sensitive (S).

Sensitivity test results against *Escherichia coli* in a sample of diabetic foot ulcer patients at Dr. M. Djamil General Hospital Padang for the period January to June 2023 found that most of these germs were resistant to ampicillin and *ceftriaxone*. *Escherichia coli* are sensitive to meropenem. Most gram-negative bacteria are sensitive to meropenem (Table. 2). Sensitivity test results against *Staphylococcus aureus* in a sample of diabetic foot ulcer patients at Dr. M. Djamil Generall Hospital Padang for the period January to June 2023 found that most of these germs were resistant to benzylpenicillin and moxifloxacin. *Staphylococcus aureus was* sensitive to vancomycin. Most gram-positive bacteria are sensitive to vancomycin (Table 3).

4. Discussion

The findings of this study indicate that gram-negative bacteria are the main cause of diabetic foot ulcer (DFU) infection at Dr. M. Djamil General Hospital Padang during the study period, with a prevalence reaching 65%. More specifically, *Escherichia coli* dominates as the most common pathogen, followed by *Pseudomonas aeruginosa* and *Acinetobacter baumanii*. These results are consistent with global trends showing an increasing proportion of gram-negative infections in DFU, replacing the traditional predominance of gram-positive bacteria. Type 2 diabetes mellitus (T2DM) can change the composition of the skin microbiota, reducing the population of gram-positive bacteria that are usually protective and increasing the colonization of gram-negative bacteria. These changes are thought to be related to impaired skin barrier function, increased skin pH, and decreased production of antimicrobial peptides. The hospital environment is a potential reservoir of gram-negative bacteria, including *E. coli*, *P. aeruginosa*, and *A. baumani*. Contamination can occur through direct contact with contaminated surfaces, medical equipment, or the hands of healthcare workers. T2DM patients with DFU, who often have compromised immune systems, are more susceptible to nosocomial infections caused by gram-negative bacteria. Irrational use of antibiotics, both in terms of type, dose and duration, can disrupt the balance of normal microbiota and increase the selection of resistant bacteria. Overuse of broad-spectrum antibiotics, especially those targeting gram-positive bacteria, can suppress the growth of gram-positive bacteria and provide space for gram-negative bacteria to multiply. T2DM patients with DFU often have multiple comorbidities, such as chronic kidney disease, coronary heart disease, and obesity, which can worsen the clinical condition and increase the risk of infection. In addition, diabetic neuropathy can reduce the sensation of pain in the feet, so patients are late in realizing wounds and infections.[9-11]

Knowledge about the pattern of bacteria that cause DFU in a region can help clinicians choose more appropriate empiric antibiotic therapy. In the case of Dr. M. Djamil General Hospital Padang, initial empiric therapy may include antibiotics that are effective against gram-negative bacteria, such as third-generation cephalosporins, quinolones, or aminoglycosides. Considering the high prevalence of antibiotic resistance in gram-negative bacteria, antibiotic sensitivity testing is very important. Sensitivity test results can help clinicians adjust antibiotic therapy to make it more effective and prevent further development of resistance. Prevention of infection in DFU is crucial. Prevention strategies include optimal blood sugar control, good wound care, debridement of necrotic tissue, pressure offloading, and patient education regarding diabetic foot care. Regular monitoring of antibiotic resistance patterns is essential to identify resistance trends and evaluate the effectiveness of infection control programs. This information can be used to optimize antibiotic use and prevent the spread of resistant bacteria.[12,13]

Escherichia coli is the most common gram-negative bacteria found in DFU at Dr. M. Djamil General Hospital Padang. This bacterium is part of the normal human intestinal flora but can cause opportunistic infections in individuals with compromised immune systems or skin integrity. *E. coli*, virulence factors such as pili, fimbriae, and toxins, allow them to adhere to

host tissue, invade cells, and cause tissue damage. Resistance to *E. coli* to ampicillin and ceftriaxone is an alarming finding. This resistance can be caused by the production of the extended-spectrum beta-lactamase (ESBL) enzyme, which can hydrolyze various types of beta-lactam antibiotics. Resistance to antibiotics can increase morbidity, mortality, and treatment costs in DFU patients.[13,14]

Pseudomonas aeruginosa and *Acinetobacter baumanii* is an opportunistic gram-negative bacterium that is often associated with nosocomial infections. These two bacteria have the ability to survive in dry environments and can form biofilms, making them difficult to eradicate. Infection caused by *P. aeruginosa* and *A. baumani* can be invasive and difficult to treat, especially in immunocompromised patients. *Klebsiella pneumoniae* and *Citrobacter freundii* are gram-negative bacteria that can also cause DFU infections, although their prevalence is lower than *E. coli*, *P. aeruginosa*, and *A. baumani*. These two bacteria can produce the beta-lactamase enzyme and have potential resistance to various types of antibiotics.[14,15]

The results of this research show that *Escherichia coli* isolated from diabetic foot ulcers (DFUs) at Dr. M. Djamil General Hospital Padang in the period January to June 2023 showed high sensitivity to meropenem. Meropenem is a carbapenem class of antibiotics that has a broad spectrum of activity against gram-negative bacteria, including *E. coli*. The mechanism of action of meropenem is by inhibiting bacterial cell wall synthesis, thereby causing bacterial death. The sensitivity of *E. coli* against meropenem in this study is in line with several previous studies that reported a high level of sensitivity of *E. coli* against carbapenems in DFU infections. This indicates that meropenem is still an effective therapeutic option for DFU infections caused by *E. coli*, especially in cases that are resistant to other antibiotics such as ampicillin and ceftriaxone.

However, the use of meropenem must be done wisely to prevent resistance. Excessive or inappropriate use can lead to the selection of bacteria that are resistant to meropenem. Therefore, meropenem should be used as second or third-line therapy for DFU infections that are unresponsive to other narrower-spectrum antibiotics.[15,16]

Besides *E. coli*, this study also found that most of the other gram-negative bacteria isolated from DFU were sensitive to meropenem and amikacin. Amikacin is an aminoglycoside antibiotic with a broad spectrum of activity against gram-negative bacteria. The mechanism of action of amikacin is by inhibiting bacterial protein synthesis. These findings suggest that the combination of meropenem and amikacin may be an effective therapeutic option for DFU infections caused by gram-negative bacteria. This combination can provide a stronger synergistic effect in killing bacteria and reducing the risk of resistance. However, the use of this antibiotic combination must be done with caution in patients with impaired kidney function, because both antibiotics can be nephrotoxic.[16,17]

This research also shows that *Staphylococcus aureus* isolated from DFU was sensitive to vancomycin. Vancomycin is a glycopeptide antibiotic that is effective against gram-positive bacteria, including *S. aureus*. The mechanism of action of vancomycin is by inhibiting bacterial cell wall synthesis. The sensitivity *S. aureus* to vancomycin in this study is consistent with previous studies reporting high levels of sensitivity of *S. aureus* against vancomycin in DFU infections. However, it should be noted that the use of vancomycin should be done with caution due to potential side effects, such as nephrotoxicity and ototoxicity.[17,18]

Previous research shows that *S. aureus* in DFU patients has 100% sensitivity to clindamycin, erythromycin, gentamicin, tetracycline, and vancomycin. Although this study did not test the sensitivity *S. aureus* to these antibiotics, however the finding of sensitivity to vancomycin suggests that vancomycin remains an effective therapeutic option for DFU infections caused by *S. aureus*. Differences in antibiotic sensitivity patterns between this study and previous studies can be caused by several factors, including: Bacterial resistance patterns can change over time due to inappropriate or excessive use of

antibiotics; Patient characteristics, such as age, comorbidities, and history of antibiotic use, may influence bacterial resistance patterns; Differences in sampling methods, bacterial culture, and antibiotic sensitivity testing can influence research results.[16,17]

The results of this study have important implications for the selection of antibiotic therapy in DFU patients. The choice of antibiotic should be based on the pattern of the causative bacteria and the results of the antibiotic sensitivity test. In addition, it is important to consider risk factors for antibiotic resistance in each patient, such as a history of previous antibiotic use and the presence of comorbidities. Further research is needed to evaluate the effectiveness of various prevention and treatment strategies for DFU infections, including the use of combination antibiotic therapy and adjuvant therapy such as hyperbaric oxygen therapy. Research is also needed to identify risk factors associated with bacterial patterns and antibiotic resistance in DFU so that appropriate interventions can be carried out to prevent and control DFU infections. Antibiotic resistance found in this study, especially in *E. coli*, has significant implications for the clinical management of DFU patients. Antibiotic resistance can lead to therapy failure, persistent infections, increased risk of complications, and even death. Therefore, it is important for clinicians to consider local antibiotic resistance patterns when selecting antibiotic therapy for DFU patients. In cases of DFU infection caused by *E. coli* resistant to ampicillin and ceftriaxone, alternative antibiotics such as meropenem and amikacin may be an option. However, the use of these broad-spectrum antibiotics must be done with caution to prevent further development of resistance. It is also important to consider risk factors for antibiotic resistance in each patient, such as history of previous antibiotic use, presence of comorbidities, and severity of infection. Patients with high-risk factors for antibiotic resistance may require more aggressive antibiotic therapy or a combination of antibiotics.[15,17]

Controlling antibiotic resistance is a global health problem that requires a multidisciplinary approach. Several strategies that can be used to control antibiotic resistance in DFU infections include: Antibiotics should only be used if absolutely necessary and must be chosen based on the results of antibiotic sensitivity tests. Avoid overuse of broad-spectrum antibiotics; Implement strict infection control procedures in hospitals, including proper hand washing, use of personal protective equipment, and sterilization of medical equipment; Patient education regarding the importance of appropriate antibiotic use and infection prevention can help reduce the risk of antibiotic resistance; Carry out regular monitoring of antibiotic resistance patterns in DFU infections to identify resistance trends and evaluate the effectiveness of resistance control strategies; Research and development of new antibiotics that are effective against resistant bacteria are essential to overcome the problem of antibiotic resistance. Effective management of DFU requires a multidisciplinary approach involving various specialties, including internists, surgeons, wound nurses, nutritionists and physiotherapists. This multidisciplinary team can work together to provide comprehensive care to patients, including control of risk factors, optimal wound care, appropriate antibiotic therapy, and rehabilitation. This multidisciplinary approach can help improve patients' quality of life, prevent complications, and reduce the risk of amputation. In addition, this approach can also help reduce the economic burden associated with DFU, such as treatment costs, hospitalization costs, and loss of productivity.[19,20]

This research provides valuable insight into bacterial patterns and antibiotic sensitivity in DFU at Dr. M. Djamil General Hospital Padang. These findings can be used as a reference in selecting appropriate antibiotic therapy for DFU patients at the hospital. However, further studies with more robust designs and larger sample sizes are needed to confirm these findings and identify risk factors associated with bacterial patterns and antibiotic resistance in DFU. Future research should also focus on developing more effective prevention and treatment strategies for DFU

infections, including the use of combination antibiotic therapy, adjuvant therapy, and other innovative approaches. In this way, it is hoped that morbidity, disability, and death rates due to DFU can be reduced significantly.

5. Conclusion

This research provides an overview of bacterial patterns and antibiotic sensitivity in DFU at Dr. M. Djamil General Hospital Padang. Findings of the predominance of gram-negative bacteria and antibiotic resistance in *E. coli* emphasize the importance of antibiotic sensitivity testing and selecting appropriate antibiotic therapy. A holistic approach to DFU management, including control of risk factors, optimal wound care, and patient education, is essential to prevent complications and improve patient quality of life.

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