University of Dongola

Faculty of Medicine&Health Sciences

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Proposal :

Bacterial profile and antimicrobial susceptibility patterns of diabetic foot infections among diabetic patients at Al-Jemaih Diabetic Center, Dongola City, Northern State, Sudan ,2026

Submitted:

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1.Introduction

1.1.Background information

Diabetes mellitus is a major public health concern and is associated with several chronic complications, including diabetic foot infections (DFIs). Diabetic foot infections commonly develop in patients with diabetic foot ulcers, which may result from peripheral neuropathy, impaired blood circulation, and delayed wound healing. If not appropriately diagnosed and managed, these infections can progress to severe tissue damage, hospitalization, lower-limb amputation, and, in some cases, death. Previous studies have reported that diabetic foot ulcers affect approximately 10–25% of people with diabetes during their lifetime, and a considerable proportion of these ulcers may become infected [1,5].

Diabetic foot infections can be caused by a wide range of microorganisms, including Gram-positive bacteria, Gram-negative bacteria, and, in some cases, anaerobic organisms. The bacterial profile may vary depending on the severity and duration of the infection, previous antibiotic use, wound characteristics, and the patient's clinical condition. Commonly reported organisms include Staphylococcus aureus, members of the Enterobacteriaceae family, Pseudomonas aeruginosa, and other pathogenic bacteria. Polymicrobial infections have also been reported, particularly among patients with chronic or more severe diabetic foot infections [1,2,6].

The selection of appropriate antimicrobial therapy is an important component of diabetic foot infection management. However, the inappropriate or repeated use of antibiotics may contribute to the development of antimicrobial resistance, making infections more difficult to treat. Some studies have reported resistance to commonly used antibiotics, including beta-lactams, fluoroquinolones, and aminoglycosides. Therefore, bacterial identification and antimicrobial susceptibility testing are essential for guiding effective treatment and supporting the selection of appropriate antibiotics for individual patients [1,3,6,8]. Previous investigations conducted in different countries have demonstrated variations in the bacterial distribution and antimicrobial susceptibility patterns of diabetic foot infections. A study in Tehran, Iran, reported a high proportion of Gram-positive bacteria and polymicrobial infections, while Gram-negative organisms increased with infection severity. In contrast, a study from a specialized diabetes centre in Cameroon reported a predominance of Gram-negative bacteria and identified resistance to several commonly used antimicrobial agents. Research conducted in southwestern Nigeria also demonstrated the presence of multiple bacterial species with varying antimicrobial susceptibility profiles [1–3,7]. These differences indicate that the bacterial causes of diabetic foot infections and their antimicrobial susceptibility patterns may vary between geographical locations and healthcare settings.

In Sudan, Hamid et al. conducted a retrospective study at Ribat University Hospital, Khartoum, involving 250 patients with diabetic foot infections between September 2017 and February 2019. A total of 335 bacterial isolates were identified, with Gram-negative organisms being more prevalent than Gram-positive organisms. The most frequently isolated organisms were Proteus spp., Staphylococcus aureus, and Escherichia coli. The study also demonstrated considerable variation in antimicrobial susceptibility; imipenem, amikacin, and vancomycin showed relatively high activity, while the isolates demonstrated marked resistance to several cephalosporins. These findings indicate that antimicrobial susceptibility patterns among diabetic foot infections in Sudan cannot necessarily be assumed from international data and should be determined according to local microbiological patterns[4,7].

In Sudan, particularly in the Northern State, there is a need for locally relevant information regarding the bacterial organisms responsible for diabetic foot infections and

their antimicrobial susceptibility patterns. Findings from studies conducted in other countries may not accurately represent the bacterial distribution or resistance patterns among patients in Dongola. Local microbiological data can help healthcare professionals understand the organisms associated with diabetic foot infections and support evidence-based antimicrobial selection. Consequently, assessing the bacterial profile and antimicrobial susceptibility patterns of diabetic foot infections among diabetic patients attending Al-Jemaih Diabetic Center in Dongola, Northern State, Sudan, in 2026 is important for improving the understanding and management of these infections in the study setting.

1.2.Problem Statement

Diabetic foot infection (DFI) is a serious complication of diabetes mellitus that can lead to prolonged wound healing, hospitalization, lower-limb amputation, and death. Diabetic foot ulcers are estimated to affect approximately 10–25% of people with diabetes during theirlifetime, and infection is an important complication that can substantially worsen clinical outcomes [1,5].

The management of diabetic foot infections is complicated by the diversity of bacterial pathogens involved and the increasing problem of antimicrobial resistance. The clinical management of DFIs in developing countries is increasingly compromised by two major interrelated factors: the complex, shifting microbial profile of infected wounds and the escalating prevalence of antimicrobial resistance (AMR) [3,9].

Studies conducted in different settings have demonstrated considerable variation in the bacterial organisms isolated from diabetic foot infections and their antimicrobial susceptibility patterns. In Tehran, Gram-positive bacteria were predominant, while Gram-negative bacteria and polymicrobial infections increased with increasing severity of the infection; considerable resistance to several commonly used antibiotics was also reported [1,7]. In contrast, a study conducted in a specialized diabetes centre in Cameroon found that Gram-negative bacteria accounted for 75.2% of isolates and showed high resistance to

several commonly prescribed antibiotics [2,8]. also, research in southwestern Nigeria identified a variety of bacterial species, with differences in their susceptibility to antimicrobial agents [3]. Similarly, a recent study in Dhaka, Bangladesh, found that 82.97% of bacterial isolates from diabetic foot ulcers were Gram-negative, with Klebsiella pneumoniae, Proteus spp., Pseudomonas aeruginosa, Escherichia coli, and Staphylococcus aureus among the identified organisms. The study also demonstrated considerable antimicrobial resistance among the isolates, highlighting the need for local surveillance of bacterial profiles and susceptibility patterns [7].

In Sudan, a study at Ribat University Hospital in Khartoum also reported a predominance of Gram-negative bacteria and considerable resistance to several commonly used antibiotics [4].

These findings demonstrate that the bacterial profile and antimicrobial susceptibility patterns of diabetic foot infections may differ between geographical regions and healthcare settings. .

1.3. Rationale and Justification

Diabetic foot infections are an important complication of diabetes mellitus and may result in serious outcomes,including prolonged wound healing, hospitalization, lower-limb amputation, and death. The management of these infections can be challenging because they may be caused by different bacterial species and because their antimicrobial susceptibility patterns vary between healthcare settings and geographical regions [1–9].

Previous studies conducted in Tehran, Cameroon, and southwestern Nigeria have demonstrated differences in the bacterial profiles and antimicrobial susceptibility patterns of diabetic foot infections [1–3]. These differences highlight the importance of obtaining local microbiological data rather than relying solely on findings from other countries or healthcare settings. Knowledge of the bacteria commonly associated with diabetic foot infections and their antimicrobial susceptibility patterns can support the appropriate selection of antimicrobial therapy and may help reduce the inappropriate use of antibiotics.

However, the available studies used different populations and healthcare settings, and their findings cannot be directly assumed to represent diabetic patients in Dongola, Northern State, Sudan. There is therefore a need for locally relevant information on the bacterial

organisms associated with diabetic foot infections and their antimicrobial susceptibility patterns.

This study will be conducted among diabetic patients attending Al-Jemaih Diabetic Center, Dongola, Northern State, Sudan, in 2026, with the aim of determining the bacterial profile and antimicrobial susceptibility patterns of diabetic foot infections in this setting. The findings may provide useful baseline microbiological information for healthcare providers and researchers and may contribute to evidence-based management of diabetic foot infections and future research in the Northern State.

1.4.Research Question

What are the bacterial profiles and antimicrobial susceptibility patterns of diabetic foot infections among diabetic patients attending Al-Jemaih Diabetic Center, Dongola, Northern State, Sudan, in 2026?

1. **What are the antimicrobial susceptibility patterns of the isolated bacterial pathogens?**
2. **Is there an association between the isolated bacterial pathogens and selected clinical characteristics of the patients?**
3. **Which bacterial organisms are most commonly responsible for diabetic foot infections among diabetic patients attending Al-Jemaih Diabetic Center?**
4. **What is the distribution of Gram-positive and Gram-negative bacteria among the isolated organisms?**
5. **What proportion of infections are caused by single organisms versus multiple organisms?**
6. **What level of antimicrobial resistance exists among the bacterial isolates?**
7. **How do the findings from Dongola compare with studies in other parts of the world?**

1.5.Objectives

1.5.1.General Objectives

To study Bacterial profile and antimicrobial susceptibility patterns of diabetic foot infections among diabetic patients at Al-Jemaih Diabetic Center,Dongola City,Northern State,Sudan,2026.

1.5.2.Specific objectives

1. **To identify the bacterial organisms isolated from diabetic foot infections among diabetic patients.**
2. **To determine the antimicrobial susceptibility patterns of the isolated bacterial organisms.**
3. **To determine the frequency and distribution of the isolated bacterial species.**
4. **To assess the occurrence of single and mixed bacterial infections.**
5. **To determine the antimicrobial resistance patterns among the isolated bacterial organisms.**

2.Literature Review

2.1.International

2.1.1. This study investigated the bacterial profile and antibiotic susceptibility patterns among diabetic patients with mild, moderate, and severe diabetic foot infections. Deep tissue samples were collected from 115 patients and examined by microbiological culture. A total of 222 bacterial microorganisms were isolated, with polymicrobial infections accounting for 69.6% of cases. Gram-positive bacteria were more common overall, while the proportion of Gram-negative bacteria increased with the severity of infection. Staphylococcus species and Escherichia coli were among the commonly isolated organisms. The study emphasized the importance of bacterial identification and antibiotic susceptibility testing in guiding appropriate treatment of diabetic foot infections [1].

2.1.2. Conducted a prospective study evaluating the bacteriology and resistance trends of DFIs among hospitalized diabetic patients in Southern India. The study demonstrated a high rate of polymicrobial infections (61%) with a distinct predominance of Gram-negative bacilli (64.2%), led by Pseudomonas aeruginosa, Klebsiella pneumoniae, and Proteus species. Extended-spectrum beta-lactamase (ESBL) production and high resistance to fluoroquinolones and cephalosporins were prevalent among Gram-negative isolates, highlighting the growing threat of MDR organisms in DFI management [9].

2.2.Regional

2.2.1. This study assessed the bacterial profile and antibiotic susceptibility of diabetic foot infections in patients attending a specialized diabetes centre in Cameroon. The study reviewed 101 patient records and identified 225 bacterial organisms. Gram-negative bacteria predominated, including Morganella, Klebsiella, Escherichia coli, Proteus, and Pseudomonas species. Resistance to several commonly used antibiotics was observed, while some isolates remained susceptible to imipenem and amikacin. The study highlighted the importance of local bacterial and antimicrobial susceptibility data for appropriate management of diabetic foot infections [2].

2.2.2. Analyzed the antibiotic susceptibility profiles of bacterial isolates obtained from diabetic foot infection patients across selected teaching hospitals in southwestern Nigeria. The researchers isolated a broad spectrum of both Gram-positive and Gram-negative organisms, with notable frequencies of Staphylococcus aureus, Pseudomonas aeruginosa, and Klebsiella species. The study identified extensive multi-drug resistance patterns among the isolates, calling for strict implementation of local surveillance and rational antibiotic prescription practices [3].

2.3.Local

This retrospective study investigated the bacteriological profile and antibiotic susceptibility of diabetic foot infections at Ribat University Hospital in Khartoum, Sudan. Medical records of 250 patients with diabetic foot infections from September 2017 to February 2019 were reviewed. A total of 335 bacterial isolates were identified, with Gram-negative bacteria being more common than Gram-positive bacteria. The most frequently isolated

organisms included Proteus species, Staphylococcus aureus, and Escherichia coli. The isolates showed high activity to imipenem, amikacin, and vancomycin, whereas marked resistance to several cephalosporins was reported. The study demonstrated variation in bacterial distribution and antimicrobial susceptibility among diabetic foot infections in a Sudanese hospital [4].

3.Materials&Methods:

3.1.Study Design

A descriptive retrospective cross-sectional study will be conducted

3.2.Study Area

The study will be conducted at Al-Jemaih Diabetic Center in Dongola, Northern State, Sudan. Dongola is the capital city of the Northern State and serves as an important healthcare centre for the surrounding communities. The Diabetes Hospital provides healthcare services to patients with diabetes and management of diabetes-related complications, including diabetic foot infections.

The hospital will serve as the study setting for the recruitment of eligible diabetic patients with diabetic foot infections and for the collection of relevant clinical and microbiological data required for the study.

3.3.Study Population

The study population will consist of diabetic patients diagnosed with diabetic foot infections who attend to the Al-Jemaih Diabetes center in Dongola, Northern State, Sudan, 2026.

Inclusion Criteria

1. **Diabetic patients with either type 1 or type 2 diabetes mellitus.**
2. **Patients with a clinically diagnosed diabetic foot infection.**
3. **Patients from whom an appropriate clinical specimen can be collected for bacterial culture and antimicrobial susceptibility testing.**

Exclusion Criteria

1. **Patients with non-diabetic foot infections.**
2. **Diabetic patients with a non-infected foot ulcer.**

3.4.Study Period

The study will be conducted from September 2026 to January 2027.

3.5.Sampling Size

The sample size will be calculated using the single population proportion formula:

$n = Z^2 p(1-p)/d^2$ Where: n = required sample size Z = standard normal value at 95% confidence level = 1.96 p = estimated proportion = 50% (0.50), used because a reliable local estimate is not available d = margin of error = 5% (0.05) $n = (1.96^2 \times 0.50 \times 0.50 / (0.05)^2$ $n \approx 384$ Adding approximately 5% for possible non-response: 384 + 38 ≈ 422, rounded to approximately 423 participants. Therefore, the proposed sample size will be approximately 423 adults [11].

3.6.Methods of Data Collection

Data will be collected using ; summary sheets,checklists of records and reports.

3.7.Study variables

3.7.1.Dependent Variables

The main outcome variables of the study will be the bacterial profile and antimicrobial susceptibility patterns of diabetic foot infections.

- **Bacterial profile – type/species of bacteria isolated from diabetic foot infections.**
- **Gram reaction – Gram-positive or Gram-negative bacteria.**
- **Type of infection – single-organism or polymicrobial infection.**
- **Antimicrobial susceptibility pattern – susceptible (S), intermediate (I), or resistant (R), where applicable.**
- **Susceptibility/resistance to individual antimicrobial agents tested.**

3.7.2.Independent Variables

The following patient and clinical characteristics may be assessed for their possible association with the bacterial profile and antimicrobial susceptibility pattern:

- **Age**
- **Sex**
- **Duration of diabetes mellitus**
- **Type of diabetes mellitus, if available**
- **History of previous antibiotic use**
- **History of previous diabetic foot infection**
- **Duration of the current foot infection**
- **Presence/severity of diabetic foot ulcer**
- **Previous hospitalization, if available**
- **Presence of other diabetic complications, if included in the data collection form**

3.8. Data Analysis

The collected data will be checked for completeness, coded, and entered into a statistical analysis program such as SPSS for analysis.Descriptive statistics, including frequencies,

percentages, means, and standard deviations, will be used. Chi-square or Fisher exact test will be used to assess association between categorical variables, while an independent-sample T-test will be used to compare the means of continuous variables between two groups where appropriate. A p-value of<0.05 will be considered statistically significant.

3.9.Ethical Clearance

Ethical approval will be obtained from the appropriate ethical committee of Dongola University, Faculty of Medicine, and permission will be obtained from Al-Jemaih Diabetic Center.

3.10.Research plan And Time-line

NO.	Activity	Duration
1	**Submission of Research Proposal**	**20-24 Sept 2026**
2	**Presentation of Research Proposal**	**27 Sept-01 Oct 2026**
3	**Data Collection**	**04-22 Oct 2026**
4	**Data Analysis**	**25 Oct-05 Nov 2026**
5	**Writing of Results and Discussion**	**08-19 Nov 2026**
6	**Writing of Final Report**	**22 Nov-03 Dec 2026**
7	**Submission of Researches Electronically**	**06-10 Dec 2026**

	to Community Department	
8	**Research Judgement**	**13-24 Dec 2026**
9	**Research Modification**	**27-31Dec 2026**
10	**Research Discussion**	**03-04 Jan 2027**

3.11. Budget breakdown

Item	Estimated cost(SDG)
Printing	**200,000**
Transportation	**40,000**
Data Collection and communication	**20,000**
Data entry, analysis and stationery	**200,000**
Internet	**60,000**
Contingency	**50,000**
Total	**570,000**

3. References

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