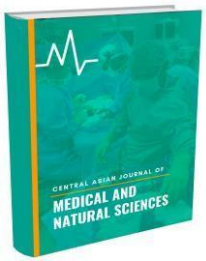

CENTRAL ASIAN JOURNAL OF MEDICAL AND NATURAL SCIENCES
https://cajmns.casjournal.org/index.php/CAJMNS
Volume: 07 Issue: 01 | January 2026 ISSN: 2660-4159

Article

Studying the Microbial Landscape and Antibiotic Effectiveness in Patients with Diabetic Foot Syndrome

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Abstract: The goal of this work was to determine the qualitative and quantitative structure of microbial landscape in purulent-necrotic wounds in patients with diabetic foot syndrome, defining dominant causative agents and efficacy evaluation antibiotic therapy on the basis of detection an antimicrobial resistance. A prospective observational study included 113 patients with diabetic foot syndrome admitted for treatment in the purulent surgery department during one year. Bacteriological culture of wound discharge was done by standard microbiological methods. Isolated microorganisms were identified by standard test systems, and susceptibility to antibiotics was tested by the disk diffusion on a medium of Mueller–Hinton agar. Severe cases were complex treated with intra-arterially infused levofloxacin. The microbial population of purulent-necrotic wounds was diverse. Gram positive organisms, mainly Staphylococcus spp., were the most common organisms identified, and Gram negative bacteria such as Escherichia coli or Pseudomonas aeruginosa were less commonly isolated. High Geometric Mean (>5μg/ml) for Levofloxacin was found for all but few Acinetobacter spp. strains. Faster wound debridement, disappearance of signs of inflammation and an earlier commencement of granulation tissue and epithelialization were found in patients who received intraarterial antibiotic therapy. This investigation offers regional microbiological information on diabetic foot infections and it also reconfirms the high clinical activity of levofloxacin against the prevalent wound pathogens. The results play up the value of routine bacteriological control and selection of antibiotics in patients with diabetic foot syndrome, especially in severe forms that need point antibiotic treatment. The limitations in the study are that it is single center and without long term outcomes. More multi-center studies are needed to evaluate the recent trends of resistant antibiotics and refine treatment strategy.

Keywords: Diabetic Foot, Wound Infection, Microbial Landscape, Antibiotic Therapy, Levofloxacin

Citation: Zikrilla T. Z., Fayzullaevna A. Z. Studying the Microbial Landscape and Antibiotic Effectiveness in Patients with Diabetic Foot Syndrome Central Asian Journal of Medical and Natural Science 2026, 7(1), 503-507.

Received: 30th Nov 2025
Revised: 10th Dec 2025
Accepted: 23th Dec 2025
Published: 09 th Jan 2026

1. Introduction

Diabetes mellitus remains one of the most significant global health challenges, with a steady increase in prevalence worldwide. Among its chronic complications, diabetic foot syndrome occupies a special place due to its high incidence, tendency toward chronicity, and severe socio-economic consequences[1]. Diabetic foot syndrome is a complex pathological condition characterized by neuropathic, ischemic, and infectious components, frequently leading to the formation of chronic trophic ulcers and purulent-necrotic lesions of the lower extremities[2].

From surgical view, the infection is so essential in diabetic foot lesions' deterioration. Hyperglycemia, microangiopathy, macroangiopathy, peripheral neuropathy and develop secondary immunosuppression induce the optimal conditions for microbial colonization and persistence in wound tissue[3]. An impaired local immune response, and decreased tissue perfusion presentations render host defence operations and systemic antibacterial therapy of limited overall efficacy. Therefore, even incipient skin injuries had the potential to develop into extensive purulent-necrotic processes often resulting in amputations of limbs.

The microbiome of DFU is found to be complex and ever-changing. Both Gram-positive and Gram-negative bacteria may be implicated; and it is common that the organisms formed polymicrobial conglomerates and biofilms. Biofilm production is a key contributor in chronic wound infection, as it hinders antibiotic penetration and favours bacterial resistance. Accordingly, the correct identification of pathogens of wounds and antibiotic sensitivity is important in wound therapy[4-5].

The treatment of diabetic foot infections continues to represent a clinical conundrum despite the evolution of antimicrobial therapy. In most instances, patients with CRI are empirically managed without microbiologically documented evidence and this inappropriate use of antibiotics can result in poor pathogen coverage and antibiotic resistance. In such a setting, trials researching local microbial trends and different antibacterial agents are clinically significant.

The objective of the study reveals the need to explore microbial panorama in purulent-necrotic wounds in patients with diabetic foot syndrome and estimate therapeutic efficacy considering also levofloxacin. The results will be used to help rationalize antibiotic use and enhance treatment outcomes in this patient population at high risk [6-7].

2. Methodology

This study included 113 patients diagnosed with diabetic foot syndrome who were treated in the department of purulent surgery of Tashkent State Medical University over a one-year period. All patients presented with purulent-necrotic wounds characterized by foul-smelling discharge, poorly formed granulation tissue, and signs of systemic intoxication, including fever, night pain, muscle weakness, and edema of the lower extremities.

Pre-antibiotic wound exudates were obtained under aseptic conditions. Primary isolation was carried out by standard bacteriological techniques on 5% blood agar and selective media (Endo ager, egg yolk-salt mannitol agar, Sabouraud's dextrose agar). Bacterial contamination levels were quantified according to the table of Ryabinsky–Rodoman.

Microorganism identification was performed using Erba Lachema (Czech Republic) diagnostics test systems. Antimicrobial susceptibility was tested with the disk diffusion technique on Mueller–Hinton agar, according to international recommendations. Tested antibiotics comprised fluoroquinolones, cephalosporins, aminoglycosides and other clinically relevant antibacterial drugs.

In cases of severe clinical course, purulent-necrotic changes in the lungs and 19 (17) patients intra-arterial administration levofloxacin at a dose of 500 mg once was used. The clinical response was evaluated according to the improvement of systemic inflammatory signs, wound aspect and timing of granulation tissue formation and epithelialization.

3. Results

The bacteriological examination revealed a heterogeneous microbial composition in purulent-necrotic wounds. A total of 64 microbial strains were isolated from the wound exudates of 113 patients[8].

Table 1 presents the distribution of isolated microorganisms according to their taxonomic groups.

Table 1. Distribution of microorganisms isolated from diabetic foot wounds[9].

Microorganism	Number of isolates (n)	Percentage (%)
Staphylococcus aureus	3	4.8
Staphylococcus epidermidis	1	1.4
Staphylococcus haemolyticus	1	1.2
Streptococcus pyogenes	3	4.0
Enterococcus spp.	1	1.4
Escherichia coli	2	2.5
Pseudomonas aeruginosa	13	20.0
Acinetobacter spp.	2	3.2
Klebsiella pneumoniae	2	3.2
Microbial associations	2	3.2
Candida spp.	1	2.0

A total of 64 microbial strains were isolated from purulent-necrotic wounds. Absolute numbers were calculated based on the percentages reported in the study.

The most frequently isolated pathogens were Gram-positive bacteria, predominantly Staphylococcus spp., including Staphylococcus aureus, Staphylococcus epidermidis, and Staphylococcus haemolyticus. Among Gram-negative microorganisms, Escherichia coli and Pseudomonas aeruginosa were the most common. In 3.2% of cases, polymicrobial associations were identified. Fungal growth of Candida spp. was detected in 2% of samples.

Antibiotic susceptibility testing demonstrated high sensitivity of the majority of isolated strains to levofloxacin. Resistance was observed only in two strains of Acinetobacter spp. The results of antibiotic effectiveness are summarized in Table 2.

Table 2. Antibiotic susceptibility of isolated microorganisms to levofloxacin[10].

Microorganism	Sensitivity to levofloxacin
Staphylococcus spp.	Sensitive
Streptococcus pyogenes	Sensitive
Enterococcus spp.	Sensitive
Escherichia coli	Sensitive
Pseudomonas aeruginosa	Sensitive
Acinetobacter spp.	Resistant in isolated cases
Candida spp.	Not applicable

In patients receiving intra-arterial levofloxacin therapy, clinical improvement was observed within the first week of treatment. The appearance of initial granulation tissue

occurred on days 5–7, while significant wound improvement was achieved by days 8–10. No local or systemic adverse reactions related to levofloxacin administration were recorded[11-12].

4. Discussion

It The results of this study confirm that the microbial landscape of diabetic foot infections is complex and dominated by Gram-positive cocci, particularly staphylococci. This finding is consistent with data reported in the literature and reflects the role of skin flora in wound contamination. The presence of Gram-negative bacteria, including Pseudomonas aeruginosa, underscores the severity and chronicity of infections in diabetic patients[13].

High susceptibility of the isolates to levofloxacin indicates its usefulness in the treatment of diabetic foot infection[14-15]. The pharmacokinetics of levofloxacin, and particularly its excellent tissue penetration and long elimination half-life also contribute to the clinical efficacy. Intra-arterial substance application enables the rapidization of high local drug concentrations which is advantageous above all in ischemic tissue.

The observed clinical improvements, including accelerated wound cleansing and earlier epithelialization, emphasize the importance of targeted antibiotic therapy guided by microbiological data. These findings support the incorporation of routine bacteriological monitoring into the standard management of diabetic foot syndrome.

5. Conclusion

The microbial landscape of purulent-necrotic wounds in patients with diabetic foot syndrome is characterized by heterogeneity, with a predominance of Gram-positive microorganisms, mainly Staphylococcus spp., and a significant contribution of Gram-negative pathogens such as Escherichia coli and Pseudomonas aeruginosa. Most isolated strains demonstrated high sensitivity to levofloxacin, confirming its effectiveness as a key component of antibacterial therapy.

The use of intra-arterial levofloxacin in severe cases was associated with favorable clinical outcomes, including rapid reduction of inflammatory signs, effective wound cleansing, and stimulation of reparative processes. These results underscore the necessity of microbiological assessment and rational antibiotic selection in the management of diabetic foot infections.

Further multicenter studies with extended follow-up are required to evaluate long-term outcomes and monitor emerging antibiotic resistance patterns.

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