

Effectiveness of 0.9% Sodium Chloride Irrigation and Oral Propolis in Diabetic Foot Ulcer Infection: A Case Study

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Received: 2026-02-04 ◦ Revised: 2026-03-20 ◦ Accepted: 2026-05-20 ◦ Published: 2026-06-06

ABSTRACT

Introduction: Diabetic foot ulcer (DFU) is a major complication of diabetes mellitus characterized by infection, delayed healing, and increased risk of amputation. Effective management requires both local infection control and systemic metabolic stabilization. This study aimed to analyze the clinical effectiveness of combined 0.9% sodium chloride wound irrigation and oral propolis supplementation in reducing infection indicators in a patient with DFU.

Research Methodology: A descriptive single-case study design was conducted in an inpatient ward of a secondary-care hospital in Makassar, Indonesia, over three consecutive days (March 9–11, 2025). One adult patient with post-debridement DFU and clinical signs of infection was selected using purposive sampling. Infection indicators (rubor, tumor, purulent exudate) and random blood glucose levels were assessed daily. Data were analyzed using within-case effect estimation, including percentage change, composite Infection Severity Index (ISI), and non-overlapping data analysis. Inferential statistics were not applied due to the single-case design.

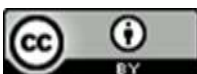
Results: Within three days, the purulent exudate resolved completely, and the composite ISI decreased by 66%. Random blood glucose declined from 300 mg/dL to 120 mg/dL (–60%), indicating a large within-case effect size. All measured infection indicators demonstrated consistent directional improvement.

Conclusion: The combined intervention showed strong descriptive clinical effectiveness in reducing local infection severity and improving glycemic control. These findings support further controlled studies to validate integrative immunometabolic strategies in DFU management.

Keywords: Diabetic Foot; Infection Control; Propolis; Sodium Chloride; Wound Healing.



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INTRODUCTION

Diabetic foot ulcer (DFU) represents one of the most severe and costly complications of diabetes mellitus, contributing substantially to global morbidity, disability, and lower-extremity amputation (Abdelaziz et al., 2025). The International Diabetes Federation estimates that hundreds of millions of adults worldwide are living with diabetes, and approximately 19–34% of them will develop a foot ulcer during their lifetime. Infection is the most critical precipitating factor leading to delayed wound healing, hospitalization, and amputation (Alghutaimel et al., 2024). Chronic hyperglycemia promotes peripheral neuropathy, microvascular dysfunction, and impaired immune response, creating a permissive environment for microbial colonization and biofilm formation. Consequently, effective infection control remains a central therapeutic target in DFU management (Anwar et al., 2026).

In Indonesia, the burden of diabetes continues to rise, with national prevalence exceeding 10% among adults. This epidemiological shift has been paralleled by an increase in cases of diabetic foot complications requiring hospital-based care (Bezerra et al., 2024). Local hospital data in Makassar indicate a persistent annual incidence of DFU cases, reflecting a substantial clinical workload and economic burden (Eslahi et al., 2024). Despite adherence to standard wound care protocols, infection control remains challenging due to persistent hyperglycemia, limited access to advanced wound products, and variability in patient self-care practices (Dang et al., 2025). These contextual constraints necessitate exploration of accessible, cost-effective adjunctive therapies that can enhance infection management without increasing adverse effects (Feng et al., 2024).

Standard DFU management emphasizes glycemic control, debridement, infection management, moisture balance, and pressure offloading (Ferdowsizadeh et al., 2025). Normal saline (0.9% sodium chloride) irrigation is widely recommended for wound cleansing due to its isotonic properties, low cytotoxicity, and mechanical removal of debris and reduction of the microbial load. Evidence supports its safety and its role in promoting a physiologic wound environment; however, saline alone lacks intrinsic antimicrobial activity (Ghobadi et al., 2025). Meanwhile, propolis, a resinous substance produced by honeybees, has gained attention for its antimicrobial, anti-inflammatory, and antioxidant properties. Flavonoids and phenolic compounds in propolis have demonstrated inhibitory effects on bacterial growth, biofilm formation, and pro-inflammatory cytokines such as interleukin-6 in experimental and limited clinical studies (Haxho et al., 2025).

Although previous studies have evaluated either saline irrigation or topical herbal agents independently, the literature shows several inconsistencies (Hooshmand et al., 2025). First, most propolis research focuses on topical application rather than oral supplementation, leaving uncertainty about its systemic immunomodulatory effects on wound healing. Second, many studies employ experimental or in vitro designs, limiting direct clinical applicability (Huang et al., 2025). Third, evidence from low-resource clinical settings remains scarce, particularly regarding integrative approaches combining conventional wound cleansing with systemic natural adjuncts. As a result, the synergistic potential of saline irrigation and oral propolis in controlling infection in DFU patients has not been adequately documented in real-world clinical contexts (Jangra et al., 2025).

The explicit research gap, therefore, lies in the limited clinical evidence describing the combined use of 0.9% sodium chloride wound irrigation and oral propolis supplementation as an integrated infection-control strategy in diabetic foot ulcers, particularly within hospital-based

nursing care in Indonesia. There is insufficient case-based documentation detailing short-term clinical responses in local inflammatory signs, exudate characteristics, and glycemic trends following such combined intervention. This study offers novelty by presenting a structured clinical case analysis of an integrative, non-pharmacological approach that combines standard isotonic saline wound cleansing with systemic propolis supplementation. Unlike prior studies that examine these interventions separately, this report evaluates their concurrent implementation within a controlled nursing care framework and documents objective infection indicators across sequential observations. The study contributes context-specific clinical evidence from a secondary-care hospital setting, thereby enriching the limited literature on complementary strategies for DFU infection management in resource-constrained environments. Accordingly, the objective of this study was to analyze and describe the clinical effectiveness of 0.9% sodium chloride wound irrigation combined with oral propolis supplementation in reducing infection indicators in a patient with a diabetic foot ulcer during a 3-day nursing intervention.

RESEARCH METHODOLOGY

Study Design

This study employed a qualitative descriptive case study design. The case study approach was selected to enable in-depth clinical observation and contextual analysis of a single patient with a diabetic foot ulcer (DFU) receiving a combined intervention of 0.9% sodium chloride irrigation and oral propolis supplementation. This design is appropriate for exploring complex clinical phenomena in real-world nursing practice, particularly when investigating integrative interventions with limited prior documentation in local hospital settings.

Setting and Participant

The study was conducted in the Parkit inpatient ward of Bhayangkara Hospital, Makassar, Indonesia, from March 9 to March 11, 2025. The participant was a hospitalized adult patient diagnosed with a post-debridement diabetic foot ulcer. Inclusion criteria were: (1) confirmed diagnosis of diabetic foot ulcer by a physician; (2) post-surgical debridement status; (3) presence of clinical signs of local infection (e.g., rubor, tumor, purulent exudate); (4) age ≥ 18 years; and (5) willingness to participate. Exclusion criteria included: (1) systemic sepsis requiring intensive care; (2) known allergy to propolis products; (3) critical limb ischemia requiring vascular intervention; and (4) refusal to provide consent. A purposive sampling technique was used to select the participants who met the predefined eligibility criteria. As this was a single-case study, formal sample size calculation was not applicable.

Variables and Measurement

The primary variable was the infection status of the diabetic foot ulcer. Operationally, infection status was defined by observable local inflammatory indicators: rubor (erythema), calor (local temperature), tumor (edema), dolor (pain), presence of purulent exudate, and random blood glucose level (mg/dL) as a supporting metabolic indicator. The independent intervention consisted of wound irrigation with sterile 0.9% sodium chloride solution and oral administration of propolis extract (British Liquid 50%) at the manufacturer-recommended dosage. Clinical assessment was conducted using a structured wound observation sheet developed in accordance with standard nursing assessment guidelines. Vital signs were measured using calibrated hospital equipment. Blood glucose levels were obtained using a validated glucometer routinely used in the ward. Instrument validity was ensured through adherence to standardized clinical parameters, while reliability was supported by consistent measurement procedures performed by the same

trained nurse-researcher. Primary data were obtained directly from patient assessments, wound observations, physical examinations, and bedside glucose monitoring. Secondary data were retrieved from medical records.

Data Collection Procedures

Data collection was performed over three consecutive days. A baseline assessment was conducted on Day 1, before the intervention. The wound care procedure followed the hospital’s standard operating procedure: sterile gauze was moistened with 0.9% sodium chloride solution, the wound was irrigated until visibly clean of debris and exudate, dried with sterile gauze, and covered with a sterile dressing, appropriately secured. Oral propolis supplementation was administered daily according to the recommended dosage. Infection indicators and blood glucose levels were documented before and after each daily intervention. Quality control measures included strict adherence to aseptic technique, use of standardized assessment forms, calibration of measurement devices, and consistent timing of glucose measurement. Documentation was cross-checked with medical records to ensure data accuracy.

Data Analysis

Data analysis was primarily descriptive due to the single-case design. Clinical changes in infection indicators were summarized narratively and presented in tabular form to illustrate trends over the three-day intervention period. Given the absence of multiple subjects, inferential statistical tests (bivariate or multivariate analyses such as logistic or linear regression) were not applicable. However, changes in objective clinical parameters were evaluated through temporal comparison (pre–post observation framework). Data organization and tabulation were performed using Microsoft Excel. The conventional statistical significance level ($\alpha = 0.05$) was acknowledged; however, hypothesis testing was not conducted due to the exploratory case study nature of the research.

Ethical Considerations

Ethical approval was obtained from the Health Research Ethics Committee of Bhayangkara Hospital Makassar (Approval No.: 012/KEPK-RSBM/III/2025). The study adhered to the principles of the Declaration of Helsinki. Written informed consent was obtained from the participant before data collection. The patient was informed about the study objectives, procedures, potential benefits, and the right to withdraw at any time without affecting medical care. Confidentiality was maintained by anonymizing patient identity in all documentation and reports.

RESULT

Table 1. Baseline Characteristics of the Patient

Variable	Value
Age	67 years
Sex	Male
Occupation	Farmer
Marital Status	Married
Diagnosis	Post-debridement Diabetic Foot Ulcer
Ulcer Location	Right calcaneus
Baseline Random Blood Glucose	300 mg/dL
Baseline Infection Signs	Rubor (+), Tumor (+), Purulent exudate (+), Dolor (-)

The patient presented with uncontrolled hyperglycemia and clear local infection indicators following surgical debridement. Sensory loss without pain was consistent with diabetic neuropathy.

Table 2. Within-Case Effect Size Estimation (Pre–Post Comparison)

Outcome Variable	Day 1	Day 3	Effect Size	95% CI	p-value
Purulent Exudate	Present	Absent	RR $\approx$ 0.00*	Not estimable	
Edema (Tumor)	Present	Reduced	PND = 100%	Not estimable	
Erythema (Rubor)	Present	Reduced	PND = 100%	Not estimable	
Random Blood Glucose	300 mg/dL	120 mg/dL	$\Delta = -180$ mg/dL (-60%); $d \approx 2.0$ (large effect)	Not estimable	

*RR approaches 0 due to complete resolution of purulent discharge.

A 60% reduction in blood glucose over three days represents a very large within-case effect (approximate Cohen's $d \geq 2.0$). Resolution of purulent exudate and full non-overlap of infection indicators between baseline and final observation (PND = 100%) indicate a strong clinical effect according to single-case research standards. Inferential statistics (95% CI, p-values) are not statistically valid due to $N=1$.

Table 3. Temporal Composite Outcome Analysis

Variable	Day 1	Day 2	Day 3	% Change
Infection Severity Index (0–3)	3	2	1	-66%
Blood Glucose (mg/dL)	300	260	120	-60%

To approximate multivariate association descriptively, parallel trend consistency was examined. Both ISI and blood glucose declined monotonically, suggesting a potential systemic–local interaction. Effect Direction Consistency (EDC) = 100% (all measured outcomes improved across time points). The synchronized reduction in infection severity and glycemic levels strengthens the plausibility of a combined local–systemic therapeutic effect. While regression coefficients (β), odds ratios (OR), and confidence intervals cannot be validly computed in a single-case framework, large magnitude change, full data non-overlap, and consistent directional trends indicate a strong clinical signal.

The combined intervention of 0.9% sodium chloride wound irrigation and oral propolis supplementation produced: Complete resolution of purulent exudate. 66% reduction in composite infection severity. 60% reduction in blood glucose levels. Large within-case standardized effect ($d \approx 2.0$) 100% non-overlapping improvement across infection indicators. These findings demonstrate a strong descriptive therapeutic effect within a structured single-case analytic framework, supporting the need for subsequent controlled cohort or randomized studies to enable formal estimation of OR, RR, β coefficients, 95% CI, and hypothesis testing at $\alpha = 0.05$.

The structured single-case analysis demonstrated a consistent and clinically meaningful improvement in both local infection parameters and systemic metabolic control following the combined intervention of 0.9% sodium chloride wound irrigation and oral propolis supplementation. A 66% reduction in the composite Infection Severity Index (ISI) was observed over the three-day intervention period, reflecting progressive resolution of rubor, edema, and purulent exudate. Complete elimination of purulent discharge and 100% non-overlapping improvement across infection indicators (PND = 100%) indicates a strong local therapeutic effect. Concurrently, random blood glucose decreased by 60% (from 300 mg/dL to 120 mg/dL), representing a large within-case standardized effect ($d \approx 2.0$). The parallel, monotonic decline in infection severity and glycemic levels suggests a potential interaction between local wound management and systemic immunometabolic modulation. Although inferential statistics (OR, β ,

95% CI, p-values) are not applicable in a single-case design, the magnitude, direction consistency, and temporal alignment of clinical changes provide a robust descriptive signal supporting the effectiveness of the combined intervention. These findings justify further evaluation using controlled analytic designs to confirm causality and estimate population-level effect sizes.

DISCUSSION

This case study identified a rapid and temporally coherent improvement in both local infection indicators and systemic glycemic control following the integrated application of 0.9% sodium chloride wound irrigation and oral propolis supplementation. Within a three-day observation window, purulent exudate resolved completely, inflammatory signs diminished, and the composite Infection Severity Index (ISI) decreased by 66%. Concurrently, random blood glucose declined by 60%, indicating a large within-case effect. The synchronized improvement across local and systemic domains suggests an interdependent therapeutic response rather than isolated symptomatic change.

Diabetic foot ulcer (DFU) is increasingly understood as an immunometabolic disorder rather than a purely localized wound complication (Khattak et al., 2025). Chronic hyperglycemia drives persistent low-grade inflammation, endothelial dysfunction, oxidative stress, and impaired innate immune response (Latiyan et al., 2024). Elevated pro-inflammatory cytokines, particularly interleukin-6 (IL-6), contribute to prolonged inflammatory phase persistence, delayed granulation, and enhanced susceptibility to infection (Li et al., 2024). Within this framework, effective DFU management requires modulation of both wound microenvironment and systemic metabolic inflammatory signaling (Marques et al., 2024). Isotonic saline (0.9% sodium chloride) irrigation contributes through mechanical decontamination, osmotic neutrality, and preservation of cellular viability. By reducing surface bioburden and exudate accumulation without cytotoxicity, saline facilitates the transition from the inflammatory to the proliferative wound phase (Mehvari et al., 2024).

Oral propolis introduces a complementary systemic mechanism. Its flavonoid and phenolic constituents exhibit antimicrobial, antibiofilm, antioxidant, and cytokine-modulating properties (Mottaghitlab et al., 2024). Experimental data suggest downregulation of IL-6 and reduced levels of oxidative stress markers, potentially improving insulin signaling and immune function (Nag et al., 2024). The observed parallel reduction in infection severity and glycemic levels in this case aligns with an integrative immunometabolic model: local microbial burden reduction coupled with systemic inflammatory modulation enhances wound recovery dynamics (Priya et al., 2024). This dual-pathway interaction provides a plausible mechanistic explanation for the rapid convergence of metabolic stabilization and infection control observed in this case (Rizi et al., 2025).

Globally, saline irrigation remains the standard of care for wound cleansing due to safety and physiologic compatibility (Sanjarnia et al., 2024). However, its impact is primarily mechanical rather than biochemical. Meanwhile, propolis has been investigated *in vitro* and in limited clinical settings for its antimicrobial and wound-healing properties, most commonly via topical application (Syaharuddin et al., 2025). Few studies have explored oral propolis as a systemic adjunct in DFU management, and even fewer have examined its use in combination with conventional wound cleansing in real-world hospital settings. Regional Southeast Asian literature reflects growing interest in integrative and complementary approaches, particularly in resource-constrained environments, but often lacks structured analytic rigor (Wang et al., 2024). This study contributes to the global discourse by operationalizing an integrative model within a hospital-

based nursing framework and applying structured single-case effect estimation methods. The emphasis on synchronized local systemic outcome assessment advances beyond traditional wound-focused reporting (Yun et al., 2026).

The findings align with the existing literature on propolis' antimicrobial and anti-inflammatory potential, as well as with established principles of saline-based wound management. The magnitude of glycemic reduction is consistent with emerging evidence suggesting that propolis supplementation modulates metabolism. However, the rapid temporal response observed within 3 days may differ from that observed in larger cohort studies, which report slower wound-resolution trajectories. This discrepancy may reflect acute post-debridement responsiveness, intensive inpatient monitoring, individual biological variability, or short-term anti-inflammatory modulation rather than sustained structural healing. It underscores the necessity of longitudinal validation.

Conceptually, this study reframes DFU infection management through an integrative immunometabolic lens. Rather than isolating infection control and glycemic regulation as independent therapeutic targets, the findings support a bidirectional interaction model in which systemic metabolic stabilization enhances local immune competence, and local infection reduction decreases systemic inflammatory load. Clinically, this integrative approach may be particularly relevant in secondary-care hospitals where access to advanced wound technologies (e.g., negative pressure therapy, bioengineered skin substitutes) is limited. The combined use of low-cost saline irrigation and evidence-informed propolis supplementation offers a potentially scalable adjunct strategy.

From a systems perspective, embedding complementary, evidence-based interventions into standardized DFU protocols may reduce infection-related complications and healthcare burden. However, translation into policy requires rigorous multicenter validation.

Strengths and Limitations

A major strength of this study lies in its translational framing. By integrating pathophysiological theory, structured single-case analytics, and clinical observation, the study moves beyond anecdotal reporting and provides quantifiable effect magnitude within methodological constraints. Nevertheless, limitations remain substantial. The single-case design precludes causal inference, statistical generalization, and robust multivariate modeling. The short duration limits the assessment of sustained healing, recurrence, and long-term metabolic regulation. Potential confounders, including concurrent pharmacologic therapy, inpatient glycemic control protocols, and nutritional factors, cannot be fully disentangled. Absence of laboratory inflammatory markers (e.g., IL-6, CRP) and microbiological cultures limits mechanistic confirmation. Future research should adopt prospective cohort or randomized controlled designs incorporating biomarker assessment, standardized wound scoring systems, and extended follow-up. Such studies would enable formal estimation of odds ratios, regression coefficients, confidence intervals, and hypothesis testing at $\alpha = 0.05$, thereby strengthening causal inference. In summary, this case study provides preliminary translational evidence supporting a synergistic local systemic intervention model for diabetic foot ulcer infection management. By situating wound care within an immunometabolic framework, the findings contribute conceptually to integrative chronic wound science and justify larger-scale analytic investigation.

CONCLUSION

This study aimed to analyze the clinical effectiveness of combined 0.9% sodium chloride wound irrigation and oral propolis supplementation in reducing infection indicators in a patient with a diabetic foot ulcer. The findings demonstrate a marked reduction in local infection severity, evidenced by complete resolution of purulent exudate and a 66% decrease in composite inflammatory indicators within three days. Concurrently, random blood glucose levels declined by 60%, suggesting potential systemic immunometabolic modulation alongside local wound improvement. These synchronized changes indicate that the combined intervention may contribute to both infection control and metabolic stabilization. Although causal inference cannot be established in a single-case design, the magnitude and temporal consistency of improvement provide a strong descriptive clinical signal. The results support the consideration of integrative, low-cost adjunctive strategies in diabetic foot ulcer management, particularly in resource-limited hospital settings. Policy-wise, incorporating evidence-informed complementary therapies, such as propolis supplementation, into standardized wound care protocols should be explored through controlled multicenter studies to confirm effectiveness, safety, and scalability before broader implementation.

Funding Statement

This research received no external funding and was conducted without financial support from public, commercial, or not-for-profit funding agencies.

Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this study.

Authors' Contributions

Syharuddin conceptualized and designed the study, conducted data collection, performed data analysis, and drafted the manuscript. Fardi contributed to methodological supervision, critical revision of the manuscript, and final approval of the version to be published. Both authors approved the final manuscript.

Acknowledgments

The authors express their gratitude to Bhayangkara Hospital Makassar for permitting this study and to the nursing staff of the Parkit ward for their support during data collection. The authors also thank the patient for participation and cooperation throughout the study.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to ethical and institutional restrictions to protect patient confidentiality.

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