Enhancing diabetic foot ulcer management in WOCARE Indonesia: Impact of nano-colloidal silver-zinc cream on infection control and healing

Citation: Mokti SA, Gitarja WS, Bahri (2025) Enhancing diabetic foot ulcer management in WOCARE Indonesia: Impact of nano-colloidal silver-zinc cream on infection control and healing. *The Diabetic Foot Journal* 28-2: 39-46

Article points

1. Nano-colloidal silver cream is a promising advanced wound care option.
2. This case series describes the clinical outcomes associated with the use of nano-colloidal silver cream in three patients with diabetic foot ulcers.
3. All three cases showed complete wound closure, with a 100% reduction in wound size achieved in 72 to 131 days.

Key words

- Antimicrobial therapy
- Diabetic foot ulcer
- Infection control
- Nano-colloidal silver
- Wound healing

Authors

Shakiroh Abdul Mokti is Family Medicine Specialist, Special Interest in Wound Care in Primary Care, Lunas Health Clinic Kulim District, Kedah, Malaysia. Widasari Sri Gitarja is Senior Wound Care Specialist and Research Fellow in Wound Care Management, WOCARE Indonesia, Nursing Faculty, Lincoln University, Malaysia. Khairul Bahri is Senior Lecturer and Public Health Researcher, Wound, Ostomy and Continence Care Department, WOCARE Indonesia, Padjajaran University, Indonesia.

Shakiroh Abdul Mokti, Widasari Sri Gitarja and Khairul Bahri

Diabetic foot ulcers (DFUs) pose significant challenges in wound management due to their high susceptibility to infection and delayed healing. Nano-colloidal silver cream has emerged as a promising advanced wound dressing. This case series describes the clinical outcomes associated with the use of nano-colloidal silver cream in promoting wound healing and managing infections in patients with DFUs. This case series included three patients with DFUs. All wounds were thoroughly cleansed and debrided, after which nano-colloidal silver cream was applied as the primary dressing. All three cases showed complete wound closure, with a 100% reduction in wound size achieved in 72 to 131 days. The WINNERS scale from 38 to 46 gradually decreased over 12 to 16 weeks. Infection control was evident, as the NERDS score fell from 4 to 0 in all cases. Additionally, two cases demonstrated a reduced WIFI scale from 5 to 0, while one showed improvement from 5 to 1. This case series emphasises the potential of nano-colloidal silver-zinc cream to accelerate wound healing and effectively manage DFU infections. These findings support its clinical use as a primary dressing in DFU treatment, improving outcomes in wound care management.

The global demand for high-quality healthcare continues to rise, driven by increasing educational attainment, improved economic capacity, and expanding access to digital technologies (Vas and Chockalingam, 2023). These factors have heightened public expectations for both private and public healthcare services, especially in developing countries like Indonesia, where the need for accessible and effective medical care is growing. The International Diabetes Federation (2021) estimated that 537 million adults aged 20 to 79 had diabetes worldwide in 2021). In 2019, Indonesia has the seventh highest prevalence of diabetes (Oktora and Butar, 2022). The rising incidence of diabetes is associated with increasing morbidity and mortality rates, particularly in cases involving diabetic foot ulcers (DFUs; Stancu et al, 2022).

Chronic wounds affect approximately 1–2% of the global population and present a significant public health burden due to prolonged healing times, a high risk of complications, and increased healthcare costs (Soeatmadji et al, 2023). People with diabetes often experience complications related to foot issues, such as infections, gangrene, and ulcerations, with DFUs accounting for nearly 90% of the wounds treated in private nursing clinics in Indonesia (Gitarja et al, 2018).

Advanced wound dressings offer substantial therapeutic benefits, including moisture regulation, antimicrobial properties, and accelerated healing, making them essential for managing DFUs (Sahputra et al, 2021).

Wound care quality is a multifaceted concept influenced by clinician expertise, evidence-based decision-making, and systemic factors. In Indonesia, wound care clinicians play a crucial role in optimising patient outcomes by implementing effective wound management strategies, including the use of advanced wound dressings. However, several barriers hinder optimal treatment, such as

financial constraints, regulatory limitations, and unequal access to specialised wound care products, all of which can affect treatment efficacy (Falcone et al, 2021).

In addition to clinical benefits, high-quality wound care addresses the psychological and emotional aspects of patient care. Chronic wounds can significantly impact a patient's quality of life, resulting in pain, reduced mobility,and social isolation. By utilising advanced wound dressing products such as nano-colloidal silver that promote faster healing and minimise discomfort, clinicians can alleviate these burdens and enhance patients' mental well-being. Integrating such products into private nursing practices aligns with the broader objectives of patient-centred care, emphasising holistic and individualised treatment (Klein et al, 2020).

Nano-colloidal silver cream has emerged as a promising advanced wound dressing, offering broad-spectrum antimicrobial activity while inhibiting biofilm formation. Besides its antibacterial properties, nano-colloidal silver also exhibits anti-inflammatory effects, reducing excessive wound exudate and promoting tissue regeneration.

Aim

This case series aims to describe the clinical outcomes associated with the use of nano-colloidal silver-zinc cream in promoting wound healing by assessing reductions in wound size and changes in the WINNERS scale. Additionally, it describes the clinical outcomes in managing infections related to DFUs by analysing reductions in the NERDS and WIFI scores, which assess limb-threatening diabetic foot disease based on wound status, ischemia, foot infection, tissue loss, and infection severity. Through this case series, we aim to contribute to the evidence base supporting the clinical application of nano-colloidal silver-zinc cream in DFU management, particularly in resource-limited settings.

Methods

This case series included three patients with diabetic foot ulcers (DFUs) who were referred to WOCARE Indonesia between July 2022 and February 2024. Patients were selected based on the documented use of nano-colloidal silver-zinc cream as part of their treatment. Only cases with complete clinical records were included. Wound assessment and management were carried out according to established clinical guidelines and best practices in wound care management.

Wound assessment

Wound evaluation was performed using the TIMES framework (Colwell et al, 2017), which considers Tissue management, Infection control, Moisture balance, Edge advancement, and Surrounding skin condition. Additionally, wound progression was monitored using the WINNERS scale, while infection severity was measured with the NERDS and WIFI scores.

The WINNERS scale is a validated tool for assessing wound healing progression. It measures key parameters such as wound size, inflammation, necrosis, exudate levels, regeneration, and the condition of surrounding tissue. The scale provides a quantitative measure of wound improvement over time, allowing for objective comparisons of treatment effectiveness (Gitarja et al, 2017). The NERDS score is a clinical tool used to evaluate superficial wound infections, identify bacterial colonisation, and determine the need for antimicrobial intervention. It assesses factors such as non-healing wounds, exudate levels, redness, debris, and odour, which indicate critical colonisation or local infection (Sibbald et al, 2006). The WIFI (Wound, Ischemia, and Foot Infection) classification system is utilised to stratify limb-threatening diabetic foot conditions. It assesses the severity of wounds, the degree of ischemia (reduced blood supply), and the presence of infection to predict the risk of amputation and inform treatment decisions (Mills et al, 2014).

Wound management protocol

A standardised wound management protocol was implemented, following the procedures known as 3M, a straightforward approach to wound care management:

- M1: Wound Cleansing. The wound was irrigated with 1 litre of wound wash solution and antibacterial soap. After cleansing, it was dried with sterile gauze. Subsequently, ozone and infrared therapies were administered for

Figure 1. Case 1 at presentation (left) and fully healed at day 83 (right).

Figure 2. Case 2 at presentation (left) and fully healed at day 88 (right).

Figure 3. Case 3 at presentation (left) and fully healed at day 131 (right).

15 minutes to enhance circulation and bacterial control.

- M2: Debridement. Slough and necrotic tissue were removed using autolytic and mechanical debridement techniques, with an emphasis on conservative sharp wound debridement (CSWD) (Schultz et al, 2017). This step aimed to promote granulation tissue formation and reduce the bacterial load.
- M3: Dressing Application. An advanced wound dressing protocol was implemented, featuring a primary dressing with colloidal silver cream and alginate to maintain moisture balance and provide antimicrobial protection (Lazaro-Martínez et al, 2019). A secondary dressing of sterile gauze, orthopaedic wool, and crepe bandages was applied to ensure optimal wound coverage and protection.

Wound healing progression was monitored through systematic documentation and photographic records to evaluate changes in wound size, tissue quality, and exudate levels over time. Dressing changes were conducted at various

Table 1. Wound reduction.

Case	Initial wound area (cm^2)	Final wound area (cm^2)	Percentage of wound reduction (%)
1	104.0 cm^2	0.0	100%
2	3.0 cm^2	0.0	100%
3	98.0 cm^2	0.0	100%

Table 2. WINNERS scale

Case	Baseline	1 week	4 weeks	8 weeks	12 weeks	16 weeks
1	46	40	32	22	18	2 (healed)
2	38	28	20	16	12	2 (healed)
3	39	31	28	22	20	12

Table 3. Expected wound healing versus actual wound healing

Case	Expected wound healing by WINNERS scale	Actual wound healing
1	10.0 weeks	11.9 weeks (83 days)
2	8.29 weeks	12.5 weeks (88 days)
3	8.5 weeks	18.7 weeks (131 days)

intervals – every other day, every 3–4 days, or weekly – based on individual wound characteristics, including exudate volume, necrotic tissue, infection status, and overall wound bed condition. The frequency of dressing changes was adjusted to maintain an optimal healing environment, prevent excessive moisture accumulation, and minimise the risk of infection, while ensuring patient comfort and adherence to the treatment protocol.

Cases

Case 1 is a 50-year-old man with a history of diabetes. His presentation was consistent with a DFU (*Figure 1*). At presentation, his wound measured 13 × 8 × 1 cm and it was fully healed by day 83.

Case 2 is a 68-year-old man with comorbidities including diabetes and gout. This patient demonstrates a more complex clinical scenario, where both diabetes and gout contribute to the progression of DFU (*Figure 2*). Gout may exacerbate joint deformities and impair mobility, further complicating ulcer healing. Additionally, the patient's advanced age increases the susceptibility to complications and impedes the overall healing process of the foot ulcer. At presentation, the wound measured 1 × 1 × 3 cm, and full healing was achieved by day 88.

Case 3 is a 50-year-old man with diabetes, presenting with DFU measuring 14 × 7 × 1 cm (*Figure 3*). As with the first case, the presence of diabetes is a significant risk factor, and careful management is necessary to address both glycaemic control and local wound care. This patient's case highlights the importance of early intervention to prevent infection and promote wound healing. This ulcer was fully healed by day 131.

Results

Wound healing is a complex biological process influenced by various factors, including infection control, inflammation regulation, and tissue regeneration. Prolonged inflammation, bacterial colonisation, and poor microcirculation often exacerbate impaired healing in DFUs (Colwell et al, 2017). Effective management strategies must address these challenges to promote faster tissue repair and prevent complications.

This study evaluates the impact of nano-colloidal silver-zinc cream on wound healing, emphasising reduction in wound size, tissue regeneration, and infection control. Analysing the WIFI scale and changes in the NERDS score provides insights into colloidal silver's role in modulating the healing environment. The results highlight the potential of this intervention to improve wound bed preparation, reduce bacterial load, and expedite epithelialisation.

Table 1 shows that all three patients experienced complete wound closure by the end of the treatment period, achieving a 100% reduction in wound size. This outcome suggests effective wound healing across both small and extensive DFUs following the integrated wound care approach.

The WINNERS Scale provides a longitudinal assessment of wound healing progress over a specified period. As shown in *Table 2*, cases 1 and 2 demonstrated steady healing, reaching complete wound closure (WINNERS scale 2) by week 16. Case 3 showed a slower, partial healing response, ending at a WINNERS score of 12. This variability highlights differences in healing trajectories among patients.

Table 3 compares expected versus actual healing times based on the WINNERS scale. All three

cases experienced longer healing durations than predicted, with delays ranging from 1.9 to 10.2 weeks. These delays may reflect patient-specific factors such as comorbidities, wound severity, or systemic conditions rather than any single treatment component. This underscores the importance of considering individual variability in wound healing trajectories.

Table 4 summarises the changes in NERDS and WIFI scores before and after treatment. All three patients showed a reduction in NERDS scores from 4 to 0, indicating resolution of local infection. WIFI scores improved from 5 to 0 or 1, suggesting a decreased risk of amputation following the integrated treatment approach. These findings reflect the effectiveness of the intervention in both infection control and limb preservation.

Initially, all three cases showed a gradual reduction in WINNERS scale (*Figure 4*). Case 1 (blue line) started with the highest value and steadily decreases over time. Case 2 (orange) began at a slightly lower value and follows a similar trend, but with a more rapid decline in the early weeks, especially up to the fourth week. Case 3 (grey) showed a moderate decline. By the 12th week, all three cases converge toward similar WINNERS scale, indicating significant healing. However, cases 1 and 2 achieved complete wound closure by the 16th week, while case 3 retained a slightly larger residual WINNERS scale at this final stage.

The comparison between the expected and actual wound healing times reveals that while case 1 experienced minimal deviations from the anticipated healing timelines, cases 2 and 3 exhibited significant delays. These delays highlight the complexities of treating DFUs, where individual patient factors, such as comorbidities, infections, and overall health, can significantly influence the healing rate. The findings suggest that while the WINNERS scale is an effective tool for predicting wound healing, it is crucial to consider the individual characteristics of each patient when developing treatment strategies. Further research is essential to explore the factors contributing to healing delays and optimise care for patients with challenging wound healing profiles.

The notable reductions in the NERDS and WIFI scores across all three cases demonstrate the effectiveness of the intervention in addressing infection and reducing the risk of amputation for diabetic foot ulcer patients. The reduction of the NERDS score to zero indicates successful infection control, while the significant decrease in WIFI scores highlights the treatment's positive impact on patients' limb salvage potential. These results underscore the importance of timely and comprehensive interventions in improving outcomes for DFU patients and minimising the risk of severe complications, such as infection and amputation.

Chronic wound care for DFUs poses a significant financial burden. As shown in Table 6, the three patients required between 24 and 33 outpatient visits over treatment durations ranging from 11.9 to 18.7 weeks (*Table 5*). The total cost per patient ranged from US$864–1,188, with an average per-visit cost of US$36. These values reflect the direct financial impact of managing DFUs in an outpatient setting.

Table 4. NERDS score and WIFI score

Case	Initial NERDS score	Post intervention NERDS score	Initial WIFI score	Post intervention WIFI score
1	4	0	5	1
2	4	0	5	0
3	4	0	5	0

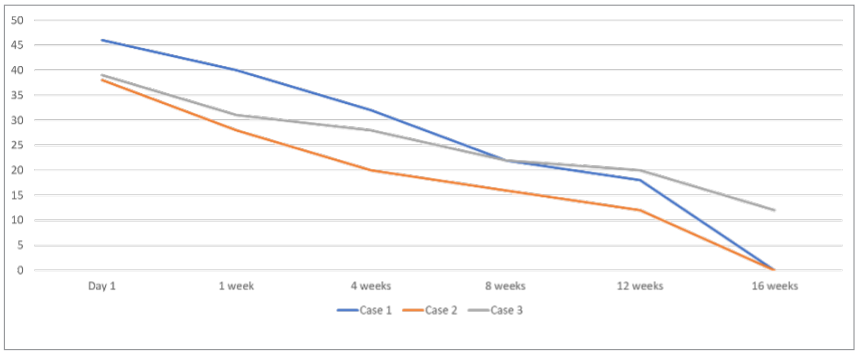

Figure 4. The wound healing rate over 16 weeks in the cases. The y-axis represents the WINNERS scale, while the x-axis indicates the progression of time from day 1 to 16 weeks.

Discussion

DFU is a common and debilitating complication of diabetes, often leading to significant morbidity, including the risk of leg amputation (Jeffcoate and Harding, 2003). Early and effective treatment is crucial for preventing further complications, such as amputation. Chronic wounds such as DFUs are characterised by a slow healing process, with microbial infection being a major factor that

Table 5. Cost of wound management.					
Case	**Wound size**	**Prediction**	**Actual wound healing**	**Number of visits**	**Price**
1	104.0 cm^2	10.0 weeks	11.9 weeks (83 days)	24	US$864
2	3.0 cm^2	8.29 weeks	12.5 weeks (88 days)	25	US$900
3	98.0 cm^2	8.5 weeks	18.7 weeks (131 days)	33	US$1,188

contributes to delayed healing (Dowsett, 2004). The results of this study emphasise the effectiveness of colloidal silver cream combined with zinc in managing infections in DFUs, demonstrating promising outcomes in infection control and wound healing.

The findings from this study align with the 2023 International Working Group on the Diabetic Foot (IWGDF) guidelines for diagnosing and treating diabetes-related foot infections, which classify all patients as having moderate DFU infections with no systemic manifestation (Senneville et al, 2024). Hallmark features such as local swelling, local tenderness, increased local warmth, and erythema extending ≥2 cm from the wound margin were observed at baseline in these cases.

Silver-based dressings are commonly used for managing DFU infections due to their ability to combat a broad range of pathogens (Dowsett, 2004). This study demonstrated that nano-colloidal silver-zinc cream significantly enhanced healing by preventing infection and creating an environment conducive to wound healing.

Zinc, recognised for its well-documented anti-inflammatory and antimicrobial properties, also positively impacts the healing process. As a topical treatment, zinc achieves more effective results than oral supplementation by consistently releasing zinc ions, enhancing local defences, promoting tissue repair, and reducing the risk of infection (Lansdown et al, 2007; Ahmed et al, 2018). In these cases, the combination of zinc cream with nano-colloidal silver dressing represents an ideal strategy for managing DFU infections, as it targets microbial and inflammatory wound healing aspects.

The study results demonstrated a 100% reduction in wound size over 19 to 131 days for all patients, signifying the effectiveness of the nano-colloidal silver-zinc cream in promoting wound closure. This outcome aligns with previous research that found silver-based dressings significantly accelerate healing by eliminating infection, promoting granulation tissue formation, reducing pain, and decreasing wound size (Frykberg and Banks, 2015). Furthermore, the reduction in wound size, as assessed by the WINNERS scale, supports the treatment's efficacy. The actual healing times were longer than the expected healing times based on the WINNERS scale. The primary factor contributing to this delay appears to be wound infection, which hindered the healing process despite the effective treatment with nano-colloidal silver-zinc cream.

Regarding infection management, the NERDS score, which assesses clinical signs of local wound infection, showed significant reduction following the intervention. All three patients had an initial NERDS score of 4, indicating moderate infection based on the presence of exudate, debris, and odour (Sibbald et al, 2006). After treatment with nano-colloidal silver-zinc cream, all patients' NERDS scores decreased to 0, suggesting successful infection control and contributing to overall wound healing. While the PEDIS and IWGDF classification systems are widely recognised as the current standard for evaluating diabetic foot infections (Senneville et al, 2024), this retrospective case series relied on existing clinical records that used the NERDS and WIFI scoring systems (Williams et al, 2022). Nonetheless, these tools provided meaningful insight into local infection severity and limb-threat risk. We acknowledge this limitation and recommend that future prospective studies adopt the PEDIS/IWGDF frameworks to ensure improved standardisation, comparability, and global alignment in DFU assessment.

The efficacy of nano-colloidal silver cream was further evaluated using the WIFI classification system, a prognostic tool for assessing the severity of diabetic foot complications (Williams et al, 2022). Initially, three patients had a WIFI score of 5, indicating high severity and a 50% risk of major amputation within one year. Following treatment, there was a significant reduction in WIFI scores, with two patients achieving a score of 0 (indicative of minimal risk of amputation) and one achieving a score of 1. This significant improvement highlights the potential of nano-colloidal silver-zinc cream

in controlling infection and reducing the risk of amputation, emphasising its therapeutic value in DFU management.

While these cases showed promising results with tnano-colloidal silver-zinc , it is essential to note that comparative research on the specific formulation used here is limited. Nonetheless, the findings align with studies involving single silver-based dressings for managing diabetic foot ulcer (DFU) infections (Tsang et al, 2017; Yi et al, 2025). These studies also reported favourable outcomes in infection control and wound healing, reinforcing the potential role of silver-based treatments in DFU management. Conversely, the survey by Lafontaine et al. (2023), which found no significant difference between silver and non-silver dressings, highlights variability in patient responses to treatment and suggests further investigation into the optimal use of silver-based dressings in wound care.

The economic impact of chronic wound management at WOCARE Centre highlights the substantial burden that diabetic foot ulcer (DFU) care places on both healthcare systems and patients. A cost analysis at WOCARE Centre revealed that DFU cases required an average of 24 to 33 outpatient visits over 11.9 to 18.7 weeks, with total treatment costs of US$864–1,188 per patient. The mean cost per visit was US$36, highlighting the financial strain of prolonged healing.

These findings emphasise the economic implications of delayed or suboptimal wound care. While this case series did not evaluate cost-effectiveness, we recognise that strategies such as early screening and home-based care may help reduce healthcare costs. For instance, early detection of DFUs through community foot screening could allow for earlier intervention and prevent complications that extend healing time. Likewise, home-based care programs could reduce the frequency of clinic visits by supporting wound care adherence and monitoring in the patient's own environment. Although such interventions have shown promise in some community models, they remain under-studied and unproven in many regions, including ours.

Therefore, we propose these as potential approaches for future investigation. Rigorous economic evaluations, including randomised trials or implementation studies, are needed to determine whether early screening or decentralised care models can reduce costs and improve outcomes in DFU management, particularly in resource-limited settings.

Limitations

This case series has several limitations. First, the small sample size of only three patients limits the generalisability of the findings. Second, the absence of a control group prevents definitive conclusions regarding treatment effectiveness. Third, the use of multiple assessment tools, TIMES for wound bed assessment, WINNERS for wound healing progress, NERDS for local infection, and WIFI for limb threat and amputation risk may appear excessive for a small cohort. However, each tool addressed a different aspect of wound care and contributed to a more comprehensive understanding of the healing trajectory. We acknowledge that this approach may be more appropriate for studies with larger sample sizes and have noted it as a limitation.

Additionally, the concurrent use of infrared therapy, ozone and coordinated wound care makes it difficult to isolate the specific impact of nano-colloidal silver-zinc cream on healing outcomes. It is also not possible to determine whether the observed healing rates were influenced by patients' baseline healing trajectories prior to treatment. Given the setting of a specialised wound care centre, the benefits observed may be reflective of the comprehensive care protocol rather than the topical agent alone. Future studies should incorporate a controlled design with baseline healing velocity data to differentiate the individual contributions of each intervention. Standardised tools should also be applied across larger populations to improve consistency and interpretability.

Conclusion

This case series describes the clinical outcomes associated with the use of nano-colloidal silver-zinc cream in promoting wound healing and managing infections in patients with diabetic foot ulcers (DFUs), as part of a multimodal wound care protocol that also included debridement, ozone and infrared therapy. The treatment led to a 100% reduction in wound size in all three cases within 83 to 131 days, indicating a strong potential to expedite wound closure. Furthermore, the decrease in

WINNERS scale scores, ranging from 38 to 46 over 12 to 16 weeks, supports the positive trajectory of healing. The noted reduction in the NERDS score from 4 to 0 in all patients emphasises successful infection resolution, while improvements in the WIFI scale from 5 to 0 in two cases and from 5 to 1 in another case suggest a reduced risk of amputation and improved limb preservation.

While the findings are promising, we acknowledge that the multimodal nature of the treatment protocol limits the ability to attribute outcomes solely to the nano-colloidal silver-zinc cream. The results should therefore be interpreted as reflective of the integrated protocol rather than any single intervention. This case series contributes to the growing body of evidence supporting the role of silver-based dressings within a comprehensive DFU management strategy, particularly in resource-limited settings. Future research involving larger clinical trials and comparative designs is essential to confirm these findings and isolate the effects of individual interventions. ■

Acknowledgment

Shakiroh Abdul Mokti thanks everyone who contributed to the successful completion of this work, particularly Widasari Sri Gitarja and Khairul Bahri for their invaluable guidance and support. Thank you to WOCARE Indonesia for providing the necessary resources and opportunities. Your contributions have been truly invaluable.

Ahmed R, Tariq M, Ali I et al (2018) Novel electrospun chitosan/polyvinyl alcohol/zinc oxide nanofibrous mats with antibacterial and antioxidant properties for diabetic wound healing. *Int J Biol Macromol* 120(Pt A): 385–93

Colwell JC, McNichol L, Boarini J (2017) North America wound, ostomy, and continence and enterostomal therapy nurses current ostomy care practice related to peristomal skin issues. *J Wound Ostomy Continence Nurs* 44(3): 257–261

Dowsett C (2004) The use of silver-based dressings in wound care. *Nurs Standard* 19(7): 56–60

Falcone M, De Angelis B, Pea F et al (2021) Challenges in the management of chronic wound infections. *J Glob Antimicrob Resist* 26: 140–7

Frykberg RG, Banks J (2015) Challenges in the treatment of chronic wounds. *Adv Wound Care* 4(9): 560–82

Gitarja WS, Jamaluddin A, Wibisono AH et al (2018) Wound care management in Indonesia: issues and challenges in diabetic foot ulceration. *Wounds Asia* 1(2): 13–7

International Diabetes Federation (2021) *IDF Diabetes Atlas*, 10th edn. Brussels, Belgium.

Jeffcoate WJ, Harding KG (2003) Diabetic foot ulcers. *Lancet* 361(9368): 1545–51

Klein TM, Andrees V, Kirsten N et al (2021) Social participation of people with chronic wounds: a systematic review. *Int Wound J* 18(3): 287–311

Lafontaine N, Jolley J, Kyi M et al (2023) Prospective randomised placebo-controlled trial assessing the efficacy of silver dressings to enhance healing of acute diabetes-related foot ulcers. *Diabetologia* 66(4): 768–76

Lansdown AB, Mirastschijski U, Stubbs N et al (2007) Zinc in wound healing: theoretical, experimental, and clinical aspects. *Wound Repair Regen* 15(1): 2–16

Lázaro-Martínez JL, Álvaro-Afonso FJ, Sevillano-Fernández D et al (2019) Clinical and antimicrobial efficacy of a silver foam dressing with silicone adhesive in diabetic foot ulcers with mild infection. *Int J Low Extrem Wounds* 18(3): 269–78

Oktora SI, Butar DB (2022) Determinants of Diabetes Mellitus Prevalence in Indonesia. *J Kesehatan Masyarakat* 18(2): 266–73

Sahputra D, Lumbantobing P, Tuppal CP (2021) Assessment of the quality of independent nursing practice in Indonesia based on total quality management indicators. *Belitung Nurs J* 7(4): 294–303

Senneville É, Albalawi Z, van Asten SA et al (2024) IWGDF/IDSA guidelines on the diagnosis and treatment of diabetes-related foot infections (IWGDF/IDSA 2023). *Diabetes Metab Res Rev* 40(3): e3687

Sibbald RG, Woo K, Ayello EA (2006) Increased bacterial burden and infection: the story of NERDS and STONES. *Adv Skin Wound Care* 19(8): 443–7

Soeatmadji DW, Rosandi R, Saraswati MR et al (2023) Clinicodemographic profile and outcomes of type 2 diabetes mellitus in the Indonesian cohort of DISCOVER: a 3-year prospective cohort study. *J ASEAN Fed Endocr Soc* 38(1): 68–74

Stancu B, Ilyés T, Farcas M et al (2022) Diabetic foot complications: a retrospective cohort study. *Int J Environ Res Public Health* 20(1): 187

Tsang KK, Kwong EW, To TS et al (2017) A Pilot randomized, controlled study of nanocrystalline silver, manuka honey, and conventional dressing in healing diabetic foot ulcer. *Evid Based Complement Alternat Med* 2017: 5294890

Vas P, Chockalingam N (2023) Improving physical, physiological, and psychological health outcomes in patients with diabetic foot ulcers – state of the art. *Clin Cosmet Investig Dermatol* 16: 3547–60

Williams P, Bakewell Z, Akinlade B, Russell DA (2022) WIfI scoring : a reliable tool for risk stratification in the diabetic foot clinic. *J Vasc Soc GB Irel* 1(3): 71–6

Yi Q, Huang Z, Tang B (2025) Impact of silver dressings on wound healing rate in patients with lower extremity ulcers: a systematic review and meta-analysis of randomized controlled trials. *Med Princ Pract* 34(1): 13–24