



Effectiveness of Diabetic Foot Ulcer Management Using the Modern Wound Care Approach: A Literature Review

Nurwahyuni¹, Fadil Mula Putra², Adlia Purnawaty Harifuddin³

¹Medical Doctor Professional Education Program, Faculty of Medicine, Universitas Muslim Indonesia, Indonesia

²Department of Orthopaedics, Faculty of Medicine, Universitas Muslim Indonesia, Indonesia

³Department of Surgery, Faculty of Medicine, Universitas Muslim Indonesia, Indonesia

*Corresponding Author: Nurwahyuni

E-mail: nurwahyuni@gmail.com



Article Info

Article history:

Received 12 July 2026

Received in revised form 2

August 2026

Accepted 27 August 2026

Keywords:

Effectiveness

Wound Care

Diabetic Ulcer

Modern Wound Care

Moist Wound Healing

Abstract

Diabetic ulcers are a complication of diabetes mellitus that can lead to vascular disorders, neuropathy, infection, and an increased risk of amputation. Wound care is an essential component of the management of diabetic ulcers. Modern wound care methods such as advanced dressings, moist wound healing, Negative Pressure Wound Therapy (NPWT), and ultrasound-assisted wound debridement are considered more effective than conventional methods because they create an optimal wound environment, accelerate healing, reduce the risk of infection, and improve clinical outcomes in patients with diabetic ulcers. This study employed a literature review method using a systematic literature search approach through the Google Scholar, PubMed, and ScienceDirect databases. The literature search was conducted in May 2026 using keywords related to modern wound care, diabetic foot ulcers, moist wound healing, and wound healing. The analyzed articles consisted of studies investigating the effectiveness of modern wound care approaches for diabetic ulcers. Data were analyzed descriptively and narratively based on the findings of each study. The review findings indicated that modern wound care approaches including modern dressings, moist wound healing, Negative Pressure Wound Therapy (NPWT), and ultrasound-assisted wound debridement are effective in accelerating the healing of diabetic ulcers. These methods help maintain wound moisture, promote granulation tissue formation, reduce infection, and lower the risk of amputation. A multidisciplinary approach also contributes to improved clinical outcomes in patients. Modern wound care approaches are more effective than conventional wound care in accelerating the healing of diabetic ulcers. The effectiveness of treatment depends on the type of intervention, the patient's condition, and the wound care approach used.

Introduction

Diabetic ulcers are a chronic complication of diabetes mellitus characterized by tissue damage ranging from the skin to deeper tissues due to the interaction of various pathophysiological factors, particularly peripheral neuropathy, peripheral arterial disease (PAD), and infection. Chronic hyperglycemia causes peripheral neuropathy, leading to the loss of protective sensation, accompanied by impaired motor and autonomic function, thereby increasing the risk of wound formation. Additionally, diabetic angiopathy which includes microvascular and

macrovascular disorders causes reduced tissue perfusion (vascular insufficiency), thereby hindering the wound healing process. If not managed optimally, diabetic ulcers can progress to deep tissue infections, osteomyelitis, gangrene, and even increase the risk of lower extremity amputation (Trisnawati et al., 2023). One approach to managing diabetic ulcers is treatment . To address infections, appropriate treatment is necessary, including the use of antibiotics (Yuliana et al., 2024; Jeffcoate et al., 2024; Maity et al., 2024; Armstrong et al., 2023; Husain & Agrawal, 2023).

Wound care is an important component of diabetic ulcer management. Conventional wound care methods, which involve keeping the wound dry, are considered less effective in accelerating the healing process (Kolimi et al., 2022; Saifullah & Sharma, 2024). With advances in science and healthcare technology, modern wound care approaches are becoming increasingly common because they are considered more effective at creating an optimal wound environment for tissue regeneration. These approaches include the use of modern dressings, moist wound healing, Negative Pressure Wound Therapy (NPWT), ultrasound-assisted wound debridement, and other bioengineered therapies (Liu et al., 2024; Sun et al., 2026; Begeno et al., 2026).

Modern wound care is a method that emphasizes maintaining wound moisture to ensure a faster and more optimal healing process. A moist wound environment can enhance granulation tissue formation, accelerate epithelialization, reduce trauma during dressing changes, and lower the risk of infection. Additionally, technological advancements such as NPWT and ultrasound-assisted debridement have also yielded significant results in helping to accelerate the healing of diabetic ulcers and reduce the risk of amputation (Seidel & Lefering, 2022; Mei et al., 2026; Flores-Escobar et al., 2022; Dayya et al., 2022; Lazarus et al., 2024).

Various studies indicate that modern wound care approaches yield better outcomes than conventional methods. The use of modern dressings and moist wound healing has been shown to accelerate wound healing and improve patient comfort (Su et al., 2023; Orlińska et al., 2023; Gürsoy et al., 2025). Furthermore, a multidisciplinary approach through integrated wound care and diabetic foot clinics has also proven effective in improving clinical outcomes for patients with diabetic ulcers. However, the effectiveness of various modern wound care methods still requires further evaluation through a comprehensive literature review to determine the most effective methods for healing diabetic ulcers (Karokaro et al., 2025; Arkhad et al., 2024; Jiang et al., 2023; Mirhaj et al., 2022).

Based on the above discussion, it is important to conduct a literature review on the effectiveness of wound care for diabetic ulcers using modern wound care approaches. This review is expected to serve as a source of scientific information on the effectiveness of various modern wound care methods in enhancing the healing process of diabetic wounds and to provide a foundation for the development of more optimal nursing practices and health care services. Therefore, the researcher is interested in conducting a study titled “The Effectiveness of Wound Care for Diabetic Ulcers Using a Modern Wound Care Approach: A Literature Review.”

Methods

The research method used is *a literature review*. A *literature review* is a form of research that involves searching for existing studies and literature. The study was conducted by reviewing the literature to obtain references relevant to the research topic. This method is used to critically examine ideas, findings, and knowledge in order to draw theoretical conclusions that can serve as a reference for future research.

The results of this literature review will be summarized in a descriptive analysis according to the researcher's needs, based on the findings from each identified study. The findings are organized and presented to readers in an easily understandable format.

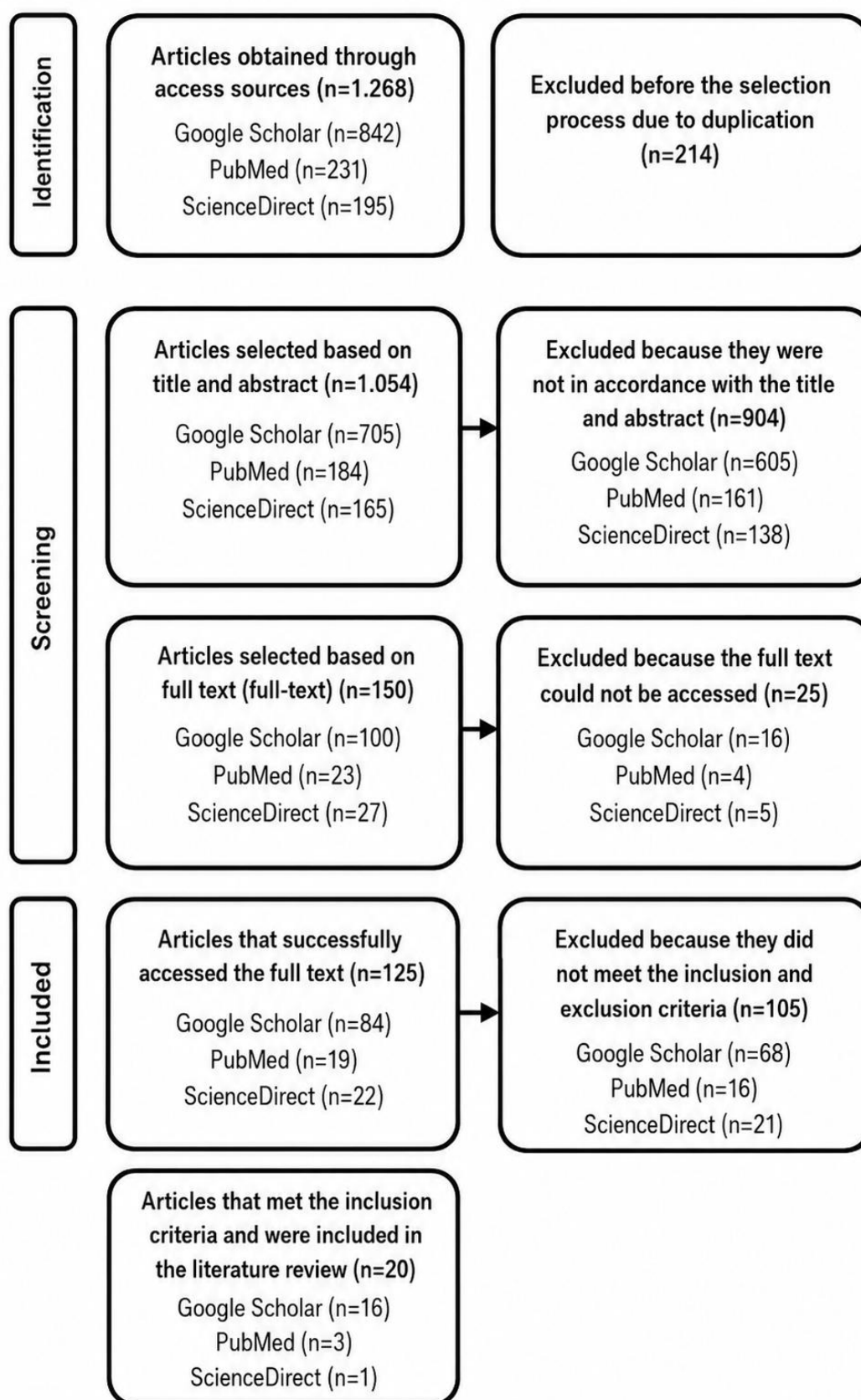


Figure 1. PRISMA Flowchart for the Research Article on the Effectiveness of Wound Care for Diabetic Ulcers Using a Modern Wound Care Approach: Literature Review

The literature search was conducted from May 1–15, 2026, with the last access date on May 15, 2026, using three electronic databases: Google Scholar, PubMed, and ScienceDirect

(Elsevier). The search strategy employed a combination of keywords with Boolean operators (AND and OR), specifically: ("diabetic foot ulcer" OR "diabetic ulcer") AND ("wound care" OR "modern wound care" OR "moist wound healing" OR "negative pressure wound therapy" OR "ultrasound-assisted wound debridement") AND ("effectiveness" OR "efektivitas"), and was limited to articles in Indonesian and English published within the last 5 years (2020–2026).

The initial search yielded 1,268 articles, comprising Google Scholar (n=842), PubMed (n=231), and ScienceDirect (n=195). After removing duplicate articles, 214 articles were eliminated, leaving 1,054 articles for screening based on titles and abstracts. During the title and abstract screening stage, 904 articles were excluded because they did not align with the research focus, leaving 150 articles for eligibility assessment based on the full text.

Next, during the full-text assessment stage, 130 articles were excluded because they did not meet the inclusion and exclusion criteria; for example, they did not discuss the effectiveness of modern wound care methods for diabetic foot ulcers, were not original research articles or systematic reviews, did not have full-text versions available, or had inappropriate research outcomes. Consequently, 20 articles met all inclusion criteria and were ultimately included in the synthesis process for this literature review.

Result and Discussion

No.	Author(s), Year	Study Design	Intervention/Focus	Main Findings
1	Sarwoto et al. (2025)	Clinical/intervention study	Modern wound care techniques	Modern wound care significantly improved the condition and stage of diabetic ulcers.
2	Mei et al. (2026)	Systematic review and meta-analysis of RCTs	Ultrasound-Assisted Wound Debridement (UAWD)	UAWD increased complete healing rates, reduced wound area, and shortened healing time compared with conventional debridement.
3	Santoso et al. (2026)	Prospective study	Integrated wound care protocol	The protocol achieved a 69.8% complete healing rate within 12 weeks and significantly reduced wound area, BWAT scores, pain, and infection.
4	Gong et al. (2025)	Systematic review and network meta-analysis	Non-pharmacological nursing interventions	Modern non-pharmacological interventions produced favorable healing outcomes in patients with

				diabetic foot ulcers.
5	Flores-Escobar et al. (2022)	Systematic review and meta-analysis	Ultrasound-Assisted Wound Debridement	UAWD showed a positive trend toward improved healing and wound-area reduction, although not all outcomes were statistically significant.
6	Du et al. (2026)	Meta-analysis	Negative Pressure Wound Therapy (NPWT)	NPWT significantly improved wound healing rates (OR = 4.48), accelerated wound-size reduction, and reduced the risk of amputation.
7	Villalba-Aguilar et al. (2025)	Systematic review and meta-analysis	NPWT versus conventional treatment	NPWT produced better healing outcomes than conventional treatment, including improved wound closure and reduced wound area.
8	Koonalinthip et al. (2021)	Clinical evaluation study	Diabetic Foot Clinic	Diabetic Foot Clinic services accelerated ulcer healing and helped prevent the development of pre-ulcerative lesions.
9	Guan et al. (2026)	Systematic review and meta-analysis	NPWT, stem cells, ESWT, and bioengineered treatments	Advanced therapeutic modalities generally improved diabetic foot-ulcer healing, with NPWT demonstrating favorable clinical effectiveness.

10	Normalia et al. (2025)	Intervention study	Home-care moist wound healing	Modern dressings combined with home-care-based moist wound healing significantly improved PUSH Tool 3.0 wound-healing scores.
11	Yogita and Sutanto (2022)	Systematic review	NPWT effectiveness and complications	NPWT accelerated healing, reduced wound size and pain, and decreased antibiotic and analgesic use.
12	Deng et al. (2025)	Meta-analysis	Effectiveness and safety of NPWT	NPWT improved diabetic foot-ulcer healing without significantly increasing adverse effects.
13	Lavery et al. (2020)	Randomized clinical trial	NPWT with irrigation versus standard NPWT	Adding polyhexanide-betaine irrigation did not significantly improve healing time, healing rate, reinfection rate, or hospital stay.
14	Theodorakopoulos and Armstrong (2025)	Synthesis of international randomized evidence	NPWT	Evidence from randomized studies supported NPWT for improving granulation tissue formation, wound closure, and overall healing.
15	Angulo et al. (2025)	Comparative study	NPWT versus standard treatment	NPWT resulted in better wound-healing outcomes than standard treatment for diabetic foot ulcers.
16	Sanjiwani and Murti (2023)	Meta-analysis	Use of NPWT	NPWT improved granulation tissue formation, wound

				closure, and ulcer-area reduction compared with conventional care.
17	Gu et al. (2025)	Comparative study	NPWT versus Advanced Moist Wound Therapy	Complete wound closure was higher with NPWT than with advanced moist wound therapy (87% versus 29%; $p < 0.001$), with fewer infections, recurrences, and amputations.
18	Apriani et al. (2023)	Literature review	Use of NPWT for diabetic foot ulcers	NPWT supported granulation tissue formation, reduced wound size, and promoted the healing of diabetic foot ulcers.
19	Widigdo et al. (2024)	Literature review	Effectiveness of NPWT	NPWT consistently improved healing, granulation tissue formation, and wound closure while reducing complications.
20	Sun et al. (2025)	Comparative clinical study	NPWT with Kangfuxin Liquid irrigation	Kangfuxin Liquid irrigation increased healing rates, accelerated granulation, reduced inflammatory markers, increased growth factors, and shortened hospital stay compared with normal saline irrigation.

These articles serve as the basis for a synthesis comparing the effectiveness of various modern wound care approaches in enhancing the healing process of diabetic foot ulcers.

Based on a synthesis of 20 research articles, the majority of the evidence indicates that various modern wound care interventions have a positive impact on the healing of diabetic foot ulcers

(DFUs). The interventions reviewed include modern dressings, Moist Wound Healing (MWH), Ultrasound-Assisted Wound Debridement (UAWD), Negative Pressure Wound Therapy (NPWT), integrated wound care protocols, and services provided by Diabetic Foot Clinics. The majority of studies employed designs with a high level of evidence, particularly systematic reviews, meta-analyses, and randomized controlled trials, thereby yielding strong scientific evidence regarding the effectiveness of these therapies.

Negative Pressure Wound Therapy (NPWT) is the most extensively studied intervention and has consistently shown the best outcomes compared to conventional care. Various studies report that NPWT improves wound closure rates, accelerates granulation tissue formation, reduces wound area, lowers the risk of infection and amputation, and shortens healing time without significantly increasing side effects. Some studies also suggest that NPWT has the potential to reduce treatment costs by accelerating the healing process and shortening the length of hospital stays.

In addition to NPWT, ultrasound-assisted debridement (UAWD) has also shown promising effectiveness. A recent meta-analysis reported that UAWD improves the likelihood of wound healing and accelerates the healing process compared to conventional debridement. Although some previous studies have not found statistically significant differences, the trend in results still indicates positive clinical benefits, suggesting that this technology has the potential to serve as an alternative therapy for patients with diabetic foot ulcers.

Other approaches, such as modern dressings based on Moist Wound Healing, integrated wound care protocols, and Diabetic Foot Clinic services, have also yielded good results. These three approaches have been shown to accelerate wound healing, improve tissue condition, lower wound severity scores, and reduce infections. These findings indicate that the success of DFU management depends not only on a single therapeutic method but also on the implementation of comprehensive, continuous care tailored to the patient's clinical condition.

Overall, this literature review shows that modern wound care interventions are more effective than conventional therapies in accelerating the healing of diabetic foot ulcers. Of all the methods reviewed, NPWT has the strongest and most consistent scientific evidence and is therefore recommended as one of the primary therapies, especially for complex ulcers. Nevertheless, the choice of intervention must still take into account the condition of the wound, healthcare facilities, the competence of healthcare personnel, and the characteristics of each patient to ensure optimal therapeutic outcomes.

Based on a synthesis of 20 articles that met the inclusion criteria, it was found that the majority of studies demonstrated the effectiveness of modern wound care in accelerating the healing of diabetic foot ulcers. The study designs analyzed included systematic reviews and meta-analyses, randomized controlled trials (RCTs), prospective cohort studies, quasi-experimental studies, retrospective comparative studies, and literature reviews. Most studies had a high level of evidence (Level I), providing strong evidence regarding the effectiveness of various modern wound care methods.

The most widely studied wound care method is Negative Pressure Wound Therapy (NPWT). A total of 10 out of 20 articles evaluated the effectiveness of NPWT, both in comparison with conventional wound care and with advanced moist wound therapy methods. In general, all studies indicate that NPWT improves wound healing rates, accelerates granulation tissue formation, speeds up wound closure, reduces ulcer size, and lowers the risk of infection and amputation. Meta-analyses by Du et al. (2026), Deng et al. (2025), Theodorakopoulos & Armstrong (2025), Angulo et al. (2025), Yogita & Sutanto (2022), and Sanjiwani & Murti (2023) consistently show that NPWT is more effective than conventional therapy in promoting the healing of diabetic foot ulcers.

Similar results were also found in a study by Gu et al. (2025) comparing NPWT with Advanced Moist Wound Therapy (AMWT). That study showed that the rate of complete wound closure in the NPWT group reached 87%, while in the AMWT group it was only 29% ($p < 0.001$). In addition, the NPWT group showed a greater reduction in wound area, as well as lower rates of infection, ulcer recurrence, and amputation compared to the AMWT group.

Research on modern dressings and moist wound healing has also shown positive results. A study by Sarwoto et al. (2025) reported a significant improvement in ulcer stage following the application of modern wound care techniques. Meanwhile, a study by Normalia et al. (2025) demonstrated that modern dressings combined with a home-care-based moist wound healing method resulted in significantly improved wound healing, as measured by the PUSH Tool 3.0 score, compared to the control group.

In addition to the use of modern dressings, two studies on ultrasound-assisted wound debridement (UAWD) showed that this method offers benefits for the healing of diabetic ulcers. A meta-analysis by Mei et al. (2026) reported that UAWD increases the rate of complete healing, accelerates healing time, and enhances wound area reduction compared to conventional debridement. The study by Flores-Escobar et al. (2022) also showed a trend toward improved wound healing and reduced wound area in the UAWD group, although not all outcomes reached statistical significance.

Research findings on integrated wound care and Diabetic Foot Clinic services also indicate good effectiveness. Santoso et al. (2026) reported that the implementation of an integrated wound care protocol resulted in a complete healing rate of 69.8% within 12 weeks, accompanied by significant reductions in wound area, BWAT scores, pain, and infection. A study by Koonalinthip et al. (2021) showed that Diabetic Foot Clinic services can accelerate ulcer healing and prevent the development of pre-ulcer lesions in patients with diabetes.

Several studies have also evaluated combination NPWT therapies. A study by Lavery et al. (2020) showed that adding an irrigation system to NPWT did not provide additional clinical benefits compared to standard NPWT in terms of wound healing or other clinical outcomes. In contrast, a study by Sun et al. (2025) reported that NPWT with *Periplaneta americana* irrigation (*Kangfuxin Liquid*) resulted in higher healing rates, shorter healing times, reduced inflammatory markers, and increased growth factors compared to NPWT with normal saline irrigation.

The results of the synthesis indicate that modern wound care methods yield better clinical outcomes than conventional care in patients with diabetic foot ulcers. Various interventions—such as modern dressings, moist wound healing, Negative Pressure Wound Therapy (NPWT), ultrasound-assisted wound debridement (UAWD), and integrated wound care approaches—have consistently been reported to improve wound healing, accelerate granulation tissue formation, reduce the risk of infection, and minimize complications such as amputation.

Diabetic ulcers are one of the chronic complications of diabetes mellitus that often lead to infection, mobility impairment, and even amputation if not managed optimally. The wound healing process in diabetic patients proceeds more slowly due to a combination of peripheral neuropathy, peripheral arterial disease, microcirculatory disorders, chronic hyperglycemia, and a diminished immune response—all of which inhibit granulation tissue formation and epithelialization. These conditions make wounds difficult to heal and increase the risk of infection and amputation, necessitating effective wound care strategies to accelerate the healing process and prevent further complications.

Based on the analysis of twenty studies, the majority indicate that modern wound care approaches are more effective than conventional wound care in promoting the healing of diabetic foot ulcers. Methods such as modern dressings, moist wound healing, ultrasound-assisted wound debridement (UAWD), Negative Pressure Wound Therapy (NPWT), and a

multidisciplinary approach consistently yield better clinical outcomes, including increased granulation tissue formation, accelerated wound closure, reduced wound size, and a lower risk of infection and amputation.

Modern wound care, which employs the principle of moist wound healing, has been proven to maintain optimal moisture at the wound bed, thereby supporting the physiological healing process. A moist wound environment facilitates keratinocyte migration, enhances fibroblast proliferation, stimulates angiogenesis, maintains growth factor activity, and reduces tissue damage during dressing changes. Additionally, these conditions also aid the process of autolytic debridement, allowing necrotic tissue to be shed more easily and naturally. A study by Sarwoto et al. (2025) showed that modern wound care techniques significantly improved the stage of diabetic ulcers, while a study by Normalia et al. (2025) demonstrated that modern dressings based on moist wound healing, when used in a home care program, improved wound healing scores according to the PUSH Tool 3.0 compared to the control group.

Nevertheless, the results of the synthesis indicate that Negative Pressure Wound Therapy (NPWT) is more effective than moist wound healing, particularly for diabetic ulcers with moderate to heavy exudate or complex wounds. Unlike moist wound healing, which functions to maintain wound moisture, NPWT works by applying controlled negative pressure (typically -80 to -125 mmHg) using a closed system consisting of a foam dressing, a drainage tube, and a vacuum pump. This negative pressure induces macrodeformation—pulling the wound edges together to reduce wound size—as well as microdeformation at the cellular level, which stimulates fibroblast proliferation, collagen synthesis, angiogenesis, and the formation of new granulation tissue. In addition, the NPWT system continuously absorbs exudate, thereby reducing interstitial edema, decreasing the bacterial load, improving tissue perfusion, enhancing local oxygenation, and maintaining an optimal wound environment. The combination of these mechanisms accelerates the healing process compared to moist wound healing, which merely maintains wound moisture without providing mechanical stimulation or actively removing exudate.

These benefits are supported by numerous studies with a high level of evidence. A meta-analysis by Hai Du et al. (2026) showed that NPWT significantly improves wound healing rates ($OR=4.48$), accelerates wound size reduction, and reduces the risk of amputation compared to conventional therapy. Similar results were reported by Villalba-Aguilar et al. (2025), who found that NPWT accelerates healing, reduces wound size, alleviates pain, and decreases the use of antibiotics and analgesics. Yogita & Sutanto (2022), Deng et al. (2025), Theodorakopoulos & Armstrong (2025), Angulo et al. (2025), Sanjiwani & Murti (2023), Apriani et al. (2023), and Widigdo et al. (2024) also reported consistent findings that NPWT enhances granulation tissue formation, accelerates wound closure, reduces ulcer area, and decreases complications without significantly increasing the incidence of side effects. Even the study by Gu et al. (2025), which directly compared NPWT with Advanced Moist Wound Therapy, showed a significantly higher rate of complete wound closure in the NPWT group (87% versus 29%), accompanied by a significant reduction in the rates of infection, ulcer recurrence, and amputation.

However, modifications to NPWT do not always provide additional benefits. A study by Lavery et al. (2020) showed that adding a polyhexanide-betaine irrigation system to NPWT did not result in any significant differences in healing time, healing rates, reinfection rates, or length of hospital stay compared to standard NPWT. Conversely, a study by Sun et al. (2025) found that the use of Kangfuxin Liquid as an irrigation solution in NPWT was able to increase the healing rate, accelerate granulation tissue formation, reduce inflammatory markers (ESR, CRP, PCT), increase growth factors (VEGF, EGF, and bFGF), and reduce the length of hospital stay compared to normal saline irrigation. These findings suggest that the effectiveness of NPWT may be influenced by the type of irrigation fluid used.

In addition to NPWT, Ultrasound-Assisted Wound Debridement (UAWD) technology also shows great potential for accelerating the healing of diabetic foot ulcers. Unlike conventional debridement, which relies on surgical instruments, UAWD utilizes low-frequency ultrasonic waves to produce cavitation and microstreaming effects capable of selectively removing necrotic tissue, biofilm, and debris without damaging the surrounding healthy tissue. This mechanism helps reduce the bacterial load, decrease inflammation, improve tissue perfusion, and stimulate fibroblast activity and angiogenesis, thereby accelerating granulation tissue formation. A meta-analysis by Mei et al. (2026) showed that UAWD increased the rate of complete healing, accelerated healing time by approximately 4.84 weeks, and resulted in a greater reduction in wound area compared to conventional debridement. Flores-Escobar et al. (2022) also reported a trend toward higher healing rates and greater wound area reduction in the UAWD group, although this did not reach statistical significance; therefore, clinical trials with larger sample sizes are still needed.

The results of the synthesis also indicate that the success of modern therapy is influenced not only by the type of intervention but also by the implementation of a multidisciplinary approach. A study by Santoso et al. (2026) demonstrated that an integrated wound care protocol was able to increase the complete healing rate to nearly 70% within 12 weeks while significantly reducing infections and wound scores. A study by Koonalinthip et al. (2021) also demonstrated that the Diabetic Foot Clinic delivers favorable outcomes through multidisciplinary collaboration among physicians, nurses, surgeons, dietitians, and other healthcare professionals. This approach enables integrated management of blood glucose control, adequate debridement, off-loading, infection control, patient education, and the selection of appropriate wound therapies, thereby improving healing success.

Overall, the results of the synthesis indicate that modern wound care is more effective than conventional methods in accelerating the healing of diabetic foot ulcers. Among the various interventions studied, Negative Pressure Wound Therapy (NPWT) is the therapy with the most consistent scientific evidence for improving healing rates, accelerating granulation tissue formation, reducing wound size, lowering infection rates, shortening hospital stays, and reducing the risk of amputation. Meanwhile, Ultrasound-Assisted Wound Debridement (UAWD) plays a crucial role in optimizing the debridement process by selectively removing necrotic tissue and biofilm, thereby accelerating tissue regeneration. Therefore, the implementation of modern technologies such as NPWT and UAWD, supported by a multidisciplinary approach, should be considered as part of the standard of care for diabetic foot ulcers to improve clinical outcomes and patients' quality of life.

Conclusion

Based on the results of a literature review on the effectiveness of wound care for diabetic ulcers using modern wound care approaches, it can be concluded that various modern wound care methods such as modern dressings, moist wound healing, Negative Pressure Wound Therapy (NPWT), ultrasound-assisted wound debridement, and bioengineered therapy have been proven effective in accelerating the healing process of diabetic ulcers. The moist wound healing approach maintains wound moisture, thereby supporting granulation tissue formation, accelerating the epithelialization process, and reducing the risk of tissue damage. Additionally, the use of NPWT demonstrates more optimal results compared to conventional therapy because it enhances wound healing and reduces the risk of amputation. The ultrasound-assisted wound debridement method is also effective in reducing necrotic tissue, lowering the risk of infection, and accelerating tissue regeneration in diabetic foot ulcers. Furthermore, the implementation of integrated wound care and multidisciplinary diabetic foot clinics has a positive impact on patients' clinical outcomes through more comprehensive management. Overall, modern wound care is more effective than conventional methods in enhancing the healing process of diabetic ulcers and preventing complications.

Based on these conclusions, it is recommended that healthcare professionals adopt modern wound care methods as part of the standard of care for diabetic ulcers to improve wound healing outcomes. The management of diabetic ulcers should also be conducted in a multidisciplinary manner through collaboration among physicians, nurses, dietitians, and other healthcare professionals to achieve optimal patient outcomes. In addition, patients with diabetes need to be educated about diabetic foot care, blood sugar control, and the importance of adherence to therapy to prevent complications. The use of technologies, such as NPWT and ultrasound-assisted wound debridement, can be considered as adjunctive therapies in the management of diabetic foot ulcers. Furthermore, research with a stronger experimental design and a larger sample size is needed to evaluate the effectiveness of various modern wound care methods in greater depth.

References

- Angulo, A. R., Caballero-Alvarado, J., Sarmiento-Falen, J., & Zavaleta-Corvera, C. (2025). Comparative Assessment of Negative Pressure Wound Therapy Versus Standard Treatment in Diabetic Foot Ulcers. *Journal of Wound, Ostomy & Continence Nursing*, 52(3), 227–238. <https://doi.org/10.1097/WON.0000000000001164>
- Apriani, R., Dahlia, D., & Kurnia, D. A. (2023). Penggunaan Negative Pressure Wound Therapy (NPWT) terhadap Diabetic Foot Ulcer. *Journal of Telenursing (JOTING)*, 5(1), 1040–1049. <https://doi.org/10.31539/joting.v5i1.6184>
- Arkhad, A. E., Tuhfa, S., Dalina, Z., Loina, K. L., Manisa, E., & Baheerah, A. B. (2024). Literature Review on the Effectiveness of Modern Dressing in the Wound Care Process on Diabetic Wound Healing. *Journal of Wound Research and Technology*, 1(2), 48-53. <https://doi.org/10.70196/jwrt.v1i2.25>
- Armstrong, D. G., Tan, T. W., Boulton, A. J., & Bus, S. A. (2023). Diabetic foot ulcers: a review. *Jama*, 330(1), 62-75. <https://doi.org/10.1001/jama.2023.10578>
- Begeno, T. A., Kassa, T. S., Bahru, T. B., Shuhuan, C., Jialei, S., Liu, Y., ... & Du, Z. (2026). Green-Synthesized Bio-ZnO Nanoparticle-Integrated PVA-Chitosan-PMMA Nanofibers Enhanced Antimicrobial and Tissue-Regenerative Diabetic Wound Healing. *Macromolecular Bioscience*, 26(3), e70172. <https://doi.org/10.1002/mabi.70172>
- Dayya, D., O'Neill, O. J., Huedo-Medina, T. B., Habib, N., Moore, J., & Iyer, K. (2022). Debridement of diabetic foot ulcers. *Advances in wound care*, 11(12), 666-686. <https://doi.org/10.1089/wound.2021.0016>
- Deng, Y.-X., Wang, X.-C., Xia, Z.-Y., Wan, M.-Y., & Jiang, D.-Y. (2025). Efficacy and Safety of Negative Pressure Wound Therapy for The Treatment of Diabetic Foot Ulcers: A Meta-Analysis. *World Journal of Diabetes*, 16(6). <https://doi.org/10.4239/wjd.v16.i6.103520>
- Du, H., Jiang, T., Mao, R., Yang, X., & Chen, Z. (2026). The Role of Negative Pressure Therapy in Diabetic Foot Ulcer: A Meta-Analysis. *Journal of Diabetes*, 18(4). <https://doi.org/10.1111/1753-0407.70226>
- Flores-Escobar, S., Alvaro-Afonso, F. J., Garcia-Alvarez, Y., Lopez-Moral, M., Lazaro-Martinez, J. L., & Garcia-Morales, E. (2022). Ultrasound-assisted wound (UAW) debridement in the treatment of diabetic foot ulcer: a systematic review and meta-analysis. *Journal of Clinical Medicine*, 11(7), 1911. <https://doi.org/10.3390/jcm11071911>
- Flores-Escobar, S., Álvaro-Afonso, F. J., García-Álvarez, Y., López-Moral, M., Lázaro-Martínez, J. L., & García-Morales, E. (2022). Ultrasound-Assisted Wound (UAW)

- Debridement in the Treatment of Diabetic Foot Ulcer: A Systematic Review and Meta-Analysis. *Journal of Clinical Medicine*, 11(7), 1911. <https://doi.org/10.3390/jcm11071911>
- Gong, J., Sun, X., Fu, H., Zhang, Y., & Gao, T. (2025). Comparative Efficacy and Safety of Non-Pharmacological Nursing Interventions for Diabetic Foot Ulcers: A Systematic Review and Network Meta-Analysis. *BMC Nursing*, 24(1), 1445. <https://doi.org/10.1186/s12912-025-04065-x>
- Gu, H., Zhao, X., Sun, Y., Ding, Y., & Ouyang, R. (2025). Negative-Pressure Wound Therapy Compared with Advanced Moist Wound Therapy: A Comparative Study on Healing Efficacy in Diabetic Foot Ulcers. *Surgery*, 180, 109098. <https://doi.org/10.1016/j.surg.2024.109098>
- Guan, X., Zhu, G., Jiang, H., Wang, B., & Cheng, J. (2026). Comparative Efficacy of Advanced Therapeutic Modalities for Diabetic Foot Ulcers: A Systematic Review and Meta-Analysis Including NPWT, Stem Cells, ESWT, and Bioengineered Treatments. *Frontiers in Bioengineering and Biotechnology*, 14. <https://doi.org/10.3389/fbioe.2026.1792670>
- Gürsoy, E. N., Sener, K., Külahci, M. B., Balabanli, K. B., & Cevher, Ş. C. (2025). Modern strategies in wound healing: The rise of bacterial cellulose dressings. *Advanced Therapeutics*, 8(7), e00072. <https://doi.org/10.1002/adtp.202500072>
- Husain, M., & Agrawal, Y. O. (2023). Antimicrobial remedies and emerging strategies for the treatment of diabetic foot ulcers. *Current Diabetes Reviews*, 19(5), 5-17. <https://doi.org/10.2174/1573399818666220228161608>
- Jeffcoate, W., Boyko, E. J., Game, F., Cowled, P., Senneville, E., & Fitridge, R. (2024). Causes, prevention, and management of diabetes-related foot ulcers. *The Lancet Diabetes & Endocrinology*, 12(7), 472-482. [https://doi.org/10.1016/s2213-8587\(24\)00110-4](https://doi.org/10.1016/s2213-8587(24)00110-4)
- Jiang, P., Li, Q., Luo, Y., Luo, F., Che, Q., Lu, Z., ... & Cai, Y. (2023). Current status and progress in research on dressing management for diabetic foot ulcer. *Frontiers in endocrinology*, 14, 1221705. <https://doi.org/10.3389/fendo.2023.1221705>
- Karokaro, T. M., Sitepu, A. L., Tarigan, F. K., & Pandiangan, D. K. (2025). The Effect of Modern Dressing Moist Wound Healing Technique on the Wound Healing Process in Diabetic Ulcer Patients. *Jurnal Keperawatan Dan Fisioterapi (JKF)*, 7(2), 245–251. <https://doi.org/10.35451/jkf.v7i2.2646>
- Kolimi, P., Narala, S., Nyavanandi, D., Youssef, A. A. A., & Dudhipala, N. (2022). Innovative treatment strategies to accelerate wound healing: trajectory and recent advancements. *Cells*, 11(15), 2439. <https://doi.org/10.3390/cells11152439>
- Koonalinthip, N., Siwabanpakul, P., & Jaroenarpornwatana, A. (2021). The effectiveness of Diabetic Foot Clinic in Prevention and Healing of Diabetic Foot Ulcers. *The Foot*, 48, 101836. <https://doi.org/10.1016/j.foot.2021.101836>
- Lavery, L. A., Davis, K. E., La Fontaine, J., Farrar, J. D., Bhavan, K., Oz, O. K., & Crisologo, P. A. (2020). Does Negative Pressure Wound Therapy with Irrigation Improve Clinical Outcomes? A Randomized Clinical Trial in Patients with Diabetic Foot Infections. *The American Journal of Surgery*, 220(4), 1076–1082. <https://doi.org/10.1016/j.amjsurg.2020.02.044>
- Lazarus, E., Barnum, L., Ramesh, S., Quint, J., Samandari, M., Laflamme, S., ... & Rivero, I. V. (2024). Engineering tools for stimulating wound healing. *Applied Physics Reviews*, 11(2).

- Liu, E., Hu, X., Zhang, W., Xiao, W., Shen, Y., Luo, Y., Zheng, Z., Zhou, P., He, Y., & Que, H. (2024). Efficacy and Safety of Ultrasound-Assisted Wound Debridement in The Treatment of Diabetic Foot Ulcers: A Systematic Review and Meta-Analysis of 11 Randomized Controlled Trials. *Frontiers in Endocrinology*, 15. <https://doi.org/10.3389/fendo.2024.1393251>
- Maity, S., Leton, N., Nayak, N., Jha, A., Anand, N., Thompson, K., ... & Nauhria, S. (2024). A systematic review of diabetic foot infections: pathogenesis, diagnosis, and management strategies. *Frontiers in Clinical Diabetes and Healthcare*, 5, 1393309. <https://doi.org/10.3389/fcdhc.2024.1393309>
- Mei, S., Chen, H., & Dai, J. (2026). Ultrasound-Assisted Wound Debridement for Diabetic Foot Ulcers: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Biomedicines*, 14(4), 846. <https://doi.org/10.3390/biomedicines14040846>
- Mei, S., Chen, H., & Dai, J. (2026). Ultrasound-Assisted Wound Debridement for Diabetic Foot Ulcers: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Biomedicines*, 14(4), 846. <https://doi.org/10.3390/biomedicines14040846>
- Mirhaj, M., Labbaf, S., Tavakoli, M., & Seifalian, A. M. (2022). Emerging treatment strategies in wound care. *International Wound Journal*, 19(7), 1934-1954. <https://doi.org/10.1111/iwj.13786>
- Normalia, N., Ismail, I., Musaidah, M., Palembai, A., & Andrianys, I. (2025). Efektifitas Perawatan Luka Modern Dressing dengan Metode Moist Wound Healing Berbasis Home Care terhadap Penyembuhan Luka pada Klien Ulkus Diabetik. *Jurnal Berita Kesehatan*, 18(2), 238–245. <https://doi.org/10.58294/jbk.v18i2.317>
- Orlińska, K., Komosińska-Vassev, K., Olczyk, K., Glaesel, M., & Olczyk, P. (2023, November). Wound healing—characteristics of the ideal dressing. In *Annales academiae medicae silesiensis* (No. 77, pp. 197-203). Śląski Uniwersytet Medyczny w Katowicach. Wydawnictwo Śląskiego Uniwersytetu Medycznego w Katowicach. <https://doi.org/10.18794/aams/173203>
- Saifullah, Q., & Sharma, A. (2024). Current trends on innovative technologies in topical wound care for advanced healing and management. *Current Drug Research Reviews Formerly: Current Drug Abuse Reviews*, 16(3), 319-332. <https://doi.org/10.2174/0125899775262048230925054922>
- Sanjiwani, N. P. G. R., & Murti, I. P. K. (2023). A Meta-Analysis: The Utilization of Negative Pressure Wound Therapy in Diabetic Foot Ulcers. *Jurnal Rekonstruksi Dan Estetik*, 8(2), 106–116. <https://doi.org/10.20473/jre.v8i2.50290>
- Santoso, D., Muniandy, R. K., & Suwaryo, P. A. W. (2026). Clinical Outcomes of an Integrated Wound Care Protocol for Diabetic Foot Ulcers – A Prospective Study. *European Journal of Clinical and Experimental Medicine*, 24(1), 40–46. <https://doi.org/10.15584/ejcem.2026.1.11>
- Sarwoto, S., Fitria, R., & Putri, D. E. (2025). Effectiveness of Modern Wound Care Techniques in Diabetic Ulcer Patients. *Jurnal Ilmu Kesehatan Dharma Indonesia*, 5(1), 19–24. <https://doi.org/10.56667/JIKDI.V5I1.1746>
- Seidel, D., & Lefering, R. (2022). NPWT Resource Use Compared With Conventional Wound Treatment in Subcutaneous Abdominal Wounds With Healing Impairment After Surgery. *Annals of Surgery*, 275(2), e290–e298.

- Su, L., Jia, Y., Fu, L., Guo, K., & Xie, S. (2023). The emerging progress on wound dressings and their application in clinic wound management. *Heliyon*, 9(12). <https://doi.org/10.1016/j.heliyon.2023.e22520>
- Sun, H., Yang, C., Liu, X., Liang, J., & Geng, H. (2025). Effectiveness of Negative Pressure Wound Therapy of Diabetic Foot Ulcers Using Periplaneta Americana (Kangfuxin Liquid) Irrigation. *The International Journal of Lower Extremity Wounds*, 24(4), 1165–1172. <https://doi.org/10.1177/15347346231176917>
- Sun, R., Nowaczyk, G., Busra, M. F. M., Wu, S., & Wang, W. (2026). Triboelectric Wearable Devices for Wound Healing: Materials, Mechanisms, and Innovative Designs. *Small*, 22(13), e14027. <https://doi.org/10.1002/sml.202514027>
- Theodorakopoulos, G., & Armstrong, D. G. (2025). Negative-Pressure Wound Therapy in Diabetic Foot Management: Synthesis of International Randomized Evidence over Two Decades. *Diabetology*, 6(11), 126. <https://doi.org/10.3390/diabetology6110126>
- Trisnawati, T., Anggraini, R. B., & Nurvinanda, R. (2023). Faktor-faktor yang Berhubungan dengan Terjadinya Ulkus Diabetikum pada Penderita Diabetes Melitus. *Indonesian Journal of Nursing and Health Sciences*, 4(2), 85–94. <https://doi.org/10.37287/IJNHS.V4I2.1563>
- Villalba-Aguilar, C., Laredo-Aguilera, J. A., Villalba-Aguilar, L., Castillo-Hermoso, M. I., López-Fernández-Roldán, Á., & Carmona-Torres, J. M. (2025). Comparative Efficacy of Negative Pressure Wound Therapy and Conventional Treatments in the Management of Diabetic Foot Ulcers: A Systematic Review and Meta-Analysis. *Journal of Clinical Medicine*, 14(22), 8051. <https://doi.org/10.3390/jcm14228051>
- Widigdo, D. A. M., Muttaqien Sofro, Z., Suseani Pangastuti, H., & Dachlan, I. (2024). The Efficacy of Negative Pressure Wound Therapy (NPWT) on Healing of Diabetic Foot Ulcers: A Literature Review. *Current Diabetes Reviews*, 20(8). <https://doi.org/10.2174/0115733998229877230926073555>
- Yogita, S. P., & Sutanto, T. (2022). Negative Pressure Wound Therapy in Treating Diabetic Foot Ulcers: A Systematic Review about Efficacy and Complication. *Intisari Sains Medis*, 13(3), 722–730. <https://doi.org/10.15562/ISM.V13I3.1499>
- Yuliana, D., Hasmi, N., & Lolo, A. M. (2024). Literatur Review: Studi Penggunaan Antibiotik terhadap Pasien Ulkus Diabetikum. *Makassar Pharmaceutical Science Journal (MPSJ)*, 2(1), 146–155. <https://doi.org/10.33096/MPSJ.V2I1.184>