REVIEW

Negative Pressure Wound Therapy Effectiveness in the Care of Diabetic Ulcers Compared to Traditional Methods

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ABSTRACT

Background: Diabetic foot ulcers (DFUs) are associated with substantial morbidity and resource use. Negative-pressure wound therapy (NPWT/VAC) is widely used, but its comparative effectiveness versus conventional local wound care remains under investigation.

Aim: To summarize the effectiveness and safety of NPWT/VAC compared with conventional care in DFUs.

Methods: Data sources included MEDLINE/PubMed and Scopus, with the last search conducted on 01/10/2025 and target publication years ranging from 2018 to 2024. Eligibility criteria comprised comparative studies, including randomized controlled trials and non-randomized studies, involving adults with diabetic foot ulcers (DFUs) that evaluated NPWT/VAC versus conventional care or other dressing modalities. Only studies published in English were included. Study selection and deduplication were performed manually by one reviewer, with duplicate records removed based on title, author, year, DOI, and PMID. Data extraction was also carried out by one reviewer. Risk-of-bias assessment was conducted using RoB 2 for randomized controlled trials and ROBINS-I for non-randomized studies. Due to heterogeneity among studies and the limited number of studies available for each outcome, a narrative synthesis was undertaken, and no meta-analysis was performed.

Results: Overall, 11 studies were included in the review. Randomized controlled trials showed that NPWT may reduce the time required for wound-bed preparation/healing and increase granulation and graft survival, particularly as a bridging strategy before split-thickness skin grafting (STSG). However, final wound closure was not consistently superior to conventional care across all trials. Non-randomized studies supported trends in favor of NPWT, mainly regarding granulation speed. Risks of bias varied, ranging from Low (for example, in rigorously conducted randomized controlled trials) to High (for example, where there were major deviations or missing data). Non-randomized studies were mainly assessed as serious because of confounding and outcome-measurement concerns. Heterogeneity in protocols and outcomes, single-center samples, single-reviewer screening and extraction, and lack of meta-analysis.

Conclusions: NPWT/VAC appears to accelerate wound-bed preparation and granulation and often reduces length of hospital stay in DFUs. However, these conclusions should be interpreted cautiously because of risk of bias and methodological heterogeneity.

Keywords: diabetic foot, DFU, NPWT, VAC, negative pressure, healing

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INTRODUCTION

Diabetes mellitus is a metabolic disorder characterized by elevated blood glucose levels due to impaired insulin secretion, impaired insulin action, or both (Galtier 2010). Since 2022, the American Diabetes Association (ADA) has classified diabetes into four main types based on distinct underlying causes: type 1 diabetes, type 2 diabetes, specific types caused by other factors such as monogenic diabetes syndromes, pancreatic diseases, or drug-induced diabetes, and gestational diabetes. Type 2 diabetes accounts for most cases, representing 90-95% of all cases (American Diabetes Association 2022).

Type 2 diabetes mellitus (T2DM), also referred to as non-insulin-dependent diabetes mellitus, is one of the most prevalent metabolic disorders worldwide. It is mainly attributed to two key factors: reduced insulin secretion by pancreatic beta cells and reduced responsiveness of insulin-sensitive tissues to insulin (Roden & Shulman 2019). It is influenced by a combination of genetic predisposition, lifestyle choices, and the patient's overall health status (Janssen 2021; Wong et al. 2016; Schellenberg et al. 2013; Galicia-Garcia et al., 2020).

Epidemiological data present a concerning picture, particularly for T2DM (Galicia-Garcia et al. 2020). According to the most recent data from the International Diabetes Federation (IDF), the global prevalence of diabetes in 2021 reached 537 million people, with more than 75% of cases occurring in low- and middle-income countries. This number is projected to rise to 643 million by 2030 and to 783 million by 2045. People with diabetes face increased risks of complications, including various cancers such as gastrointestinal, pancreatic, and ovarian cancer; dementia, including Alzheimer's disease; and increased susceptibility to infections, particularly foot, respiratory, urinary tract, and postoperative infections (Tomic & Shaw 2022).

Diabetic foot ulcers (DFUs) are among the most serious complications experienced by patients with diabetes. They are ulcers associated with neuropathy or peripheral arterial disease in patients with diabetes, are common and widespread, and affect 4-10% of people with diabetes, especially older adults (Lauterbach et al. 2010). Worldwide, the annual incidence of diabetic foot ulcers ranges from 9.1 to 26.1 million, while 15-25% of patients with diabetes develop ulcers during their lifetime (Armstrong et al. 2017). Moreover, 85% of lower-limb amputations in patients with diabetes are caused by DFUs (Shojaiefard et al., 2018). DFUs are also among the main causes of morbidity and mortality in patients with diabetes, with a global prevalence of approximately 1.8-6.3% (Zhang et al., 2020).

Diabetic foot ulcers are frequent complications in people with poorly controlled diabetes mellitus. They are often caused by factors such as inadequate glycemic control, neuropathy, peripheral vascular disease, or suboptimal foot-care practices. These ulcers usually develop in areas of the foot exposed to repeated pressure and trauma. Staphylococcal infections often complicate these ulcers (Singer et al., 2018), which typically present as chronic conditions requiring a collaborative interprofessional approach for optimal management (Alexiadou & Doupis 2012). Although most foot ulcers, approximately 60-80%, heal, a substantial proportion, around 10-15%, remain active, and 5-24% may require limb amputation within 6-18 months. Neuropathic ulcers tend to heal within 20 weeks, whereas neuroischemic ulcers require more time and are more prone to amputation (Katsilambros et al. 2010).

Because the treatment of DFUs is complex, ulcers may often remain unhealed for prolonged periods and therefore burden health-care resources through prolonged hospitalization, rehabilitation, and home nursing care (Singer et al. 2018; Alvarez et al. 2015). In addition, diabetic foot ulcer has a negative impact on patients' health-related quality of life, including physical, social, and psychological dimensions. Patients with DFUs often experience mobility limitations that may lead to pain, discomfort, and sleep disturbance, ultimately making them dependent on assistive devices or other people for support (Ashford et al. 2000). Patients also frequently worry about their current ulcers, the risk of developing new ulcers, and the possibility of lower-limb amputation, which further affects their overall well-being (Kontodimopoulos et al. 2016). At present, most clinical treatments are not considered sufficiently effective to guarantee adequate ulcer healing, prompting researchers to develop new therapeutic approaches (Alvarez et al. 2015).

THE NPWT NEGATIVE-PRESSURE METHOD

Negative-pressure therapy, first introduced by Bier in 1908, has been used for more than a century to treat open wounds. The technique regained attention in the 1990s, particularly when Fleischmann and colleagues successfully applied vacuum suction in clinical settings (Fleischmann, Strecker, Bombelli, & Kinzi 1993). Kinetic Concepts, Inc. (KCI, Texas, USA) patented the method under the name Vacuum Assisted Closure (V.A.C.), while the term Negative Pressure Wound Therapy (NPWT) is commonly used in English. This therapy involves the application of evenly distributed local negative pressure to the wound surface. The open wound is covered with a special dressing, either polyurethane or polyvinyl alcohol, and sealed with an airtight film. A set of suction tubes connects the dressing to a control unit, which regulates the primary negative pressure on the wound surface, usually maintaining it between 80 and 125 mmHg, either continuously or intermittently. Fluid extracted from the wound is collected in a canister within the control unit. Treatment duration ranges from a few days to several months, depending on the treatment goals and the nature of the wound (Vikatmaa et al. 2008).

The most common synonyms for Negative Pressure Wound Therapy (NPWT) are Vacuum Assisted Closure (V.A.C.), vacuum sealing therapy, and topical negative-pressure therapy (Mendez-Eastman, 2001). VAC negative-pressure therapy (Vacuum Assisted Closure) has revolutionized how clinicians manage chronic wounds (Singh et al. 2020). It involves placing an open-cell foam dressing over the ulcer area and applying controlled subatmospheric pressure (Vuerstaek et al. 2006). More specifically, VAC promotes ulcer healing in several ways. First, the therapy applies

three-dimensional pressure over the entire wound area, also known as macrostrain, which pulls the wound edges inward in a centripetal manner and thereby contracts the wound. The positive effect of mechanical forces on tissue growth is also noted, particularly through stimulation of cellular migration and mitosis. This therapy enhances the removal of bacteria colonizing the wound and supports wound healing. The use of VAC therapy in large wounds avoided the need for daily dressing changes, thereby eliminating the burden of daily wound dressing and cleaning. Studies have shown that this technique optimizes blood flow, reduces local tissue edema, and removes excess fluid from the wound (Cavanagh et al., 2005). Reducing excessive wound fluid also decompresses small blood vessels, restores microcirculation, and increases oxygen and nutrient delivery to the ulcer. All these factors substantially improve the rate of granulation-tissue formation (Dsouza et al. 2017).

Numerous systematic reviews and studies have demonstrated the effectiveness of negative-pressure wound therapy (NPWT) in the treatment of diabetic foot ulcers (DFUs). Liu et al. (2017) and Chen et al. (2021) found that NPWT is more effective, safer, and less costly than conventional methods. Rys et al. (2020) reported a healing rate of 51% and a significantly lower risk of major amputation associated with NPWT, while Alipour et al. (2021) emphasized its cost-effectiveness. In addition, recent studies, including Arora et al. (2023) and Zhang et al. (2024), confirmed that combining NPWT with other treatments, such as platelet-rich plasma, enhances wound healing and reduces amputation risks. Combined interventions in the diabetic foot aim to accelerate granulation and prepare the wound for definitive coverage when basic care is insufficient. A meta-analysis of randomized studies showed that adjunctive therapies increase healing rates and reduce time to healing, with high to moderate certainty for skin substitutes, PRP, HBOT, and NPWT; in some arms, PRP and HBOT were also associated with a lower risk of major amputation (Monami et al., 2025). Adding HBOT to NPWT in chronic wounds improved the healing rate without increasing pain or microbial burden in a multicenter randomized trial, supporting this combination where there is evidence of tissue hypoxia (Riansrithongkham et al., 2025).

NPWT with instillation and dwell time is proposed as an option for infected or biofilm-related ulcers after surgical debridement, with mechanisms involving removal of exudate and improvement of the wound microenvironment (Dalla Paola, 2013). Targeted use of PRP may enhance angiogenesis and extracellular-matrix remodeling, although standardization of dosage and composition is required to limit variability in clinical outcomes (Smith & Rai, 2024). Additional evidence supports individualized NPWT settings or NPWT with instillation in microangiopathy and surgical-site infections (Ioannidis et al., 2025), as well as evidence of benefit for HBOT as an adjunctive approach in DFUs (Sharma et al., 2021). Finally, Sun et al. (2024) reported that low-cost NPWT is not only effective but also reduces the economic burden on patients.

Regarding clinical practice in Greece, despite progress in prevention and treatment, the diabetic foot remains a major problem in the country, creating a need for interdisciplinary structures and standardized care protocols in clinical practice (Papanas & Maltezos, 2009). Greek nursing literature documents that negative pressure is used as an adjunctive method after debridement, if infection and ischemia are controlled, and with clear contraindications when exposed structures or uncontrolled osteomyelitis are present; these conditions guide daily patient selection (Antonakou et al., 2017). More recent Greek reviews highlight the mechanisms of NPWT and the need to individualize settings for each patient, emphasizing combined use with off-loading, infection control, and modern dressings (Petritzikli, 2022). Contemporary Greek clinical reports in patients with microangiopathy demonstrate practical pressure adjustments and the use of systems with instillation as part of a targeted strategy for better granulation and reduced necrosis, which is useful in cases of difficult perfusion (Ioannidis et al., 2025). The domestic scientific community continually highlights issues of organization, prevention, and healing in national conferences, promoting clinical education and common standards of care that facilitate uniform application of NPWT in Greek centers (Hellenic Society for the Study of the Diabetic Foot, 2024).

This systematic review explores the effectiveness of NPWT and VAC negative-pressure therapy in the diabetic foot compared with conventional treatment.

MATERIALS AND METHODS

In this study, a systematic literature review was conducted according to the PRISMA method. To carry out the review, the question was formulated using the PICO framework. The following table (Table 1) presents the PICO elements for the present study.

Table 1. PICO Method

PICO	Analysis
P (Population)	Adults with diabetic foot ulcers (DFUs)
I (Intervention)	NPWT/VAC, alone or combined with other therapeutic methods
C (Comparator)	Conventional local care or other methods
O (Outcome)	healing time, complete closure, granulation tissue, amputation, adverse events, hospital stay, cost

The present systematic review followed the PRISMA 2020 guidelines. The review was not pre-registered in a protocol database such as PROSPERO. An ex-post protocol was prepared before data extraction. Appendix A presents the search strategy, study-selection process, flow diagram, data extraction, risk-of-bias assessment (RoB 2/ROBINS-I), and synthesis plan (narrative synthesis) (Tables 2 and 3).

Table 2. RoB 2 assessment of randomized clinical studies

Study (Year)	D1: Randomization (sequence and concealment)	D2: Deviations from interventions	D3: Missing outcome data	D4: Outcome measurement	D5: Selective reporting	Overall judgement	Documentation
Wu et al., 2023	Low	Some Concerns	Low	Low	Low	**Low**	D1: block randomization and concealment using opaque envelopes/central system. D2: clear protocol/ITT reported, but treatment was not blinded; possible deviations. D3: minimal losses; 50/50 analyzed. D4: outcome assessors blinded (STSG timing/measurement). D5: pre-registration and all outcomes reported.
Seidel et al., 2020	Low	High	High	Low	Low	**High**	D1: central web-based randomization (permuted blocks) and adequate concealment. D2: many deviations/non-adherence events: early discontinuation of NPWT, crossovers (NPWT<->SMWC), infrequent dressing changes (<3/week). D3: high missing data/unconfirmed endpoints, for example absence of closure photographs and early terminations. D4: outcomes measured by blinded assessors (photographic confirmation of closure/measurements). D5: pre-registration and reporting of pre-specified outcomes.
Seidel et al., 2022	Low	High	High	Low	Low	**High**	D1: central web-based randomization, permuted blocks, adequate concealment. D2: many deviations/non-adherence events, including crossovers, early NPWT discontinuations, and care deviations. D3: high missing data/unconfirmed endpoints and extensive exclusions affecting outcomes. D4: outcomes measured by blinded central assessors (photographic confirmation). D5: pre-registered outcomes and complete reporting.
Yadav et al., 2023	Some concerns	Some concerns	Low	Low	Some concerns	**Some concerns**	D1: randomization using a «random table» (Excel), without clear description of concealment. D2: open-label intervention, possible deviations; ITT is not documented. D3: 90 participants ultimately enrolled (5 excluded before enrollment because of COVID); no major missing outcome data reported. D4: outcomes mainly objective (hospital days, number of debridements, cost, healing rate); no blinding, but low risk of measurement bias. D5: no pre-registration/protocol reported; risk of selective reporting.

Maranna et al., 2021	Some concerns	Some concerns	Low	Some concerns	Low	**Some concerns**	D1: simple randomization using computer-generated numbers and sealed-envelope allocation, without clear description of opaque/serially numbered envelopes; possible uncertainty in concealment. D2: non-blinded intervention; ITT not explicitly documented; possible deviations/adherence issues. D3: n=45 (22/23); no substantial missing data reported for main outcomes (14 days/3 months). D4: outcome measurement without blinding; some outcomes subjective, such as percentage granulation, although objective measures were also used (area, hospital days). D5: declared pre-registration and reporting of planned outcomes.
James et al., 2019	Low	Some concerns	Some concerns	Some concerns	Some concerns	**Some concerns**	D1: stratified block randomization (blocks of 4/6) with serially numbered opaque sealed envelopes for concealment. D2: open-label intervention; ITT not explicitly documented; possible deviations/adherence issues. D3: 30 and 27 analyzed per group (approximately 10% losses per arm), without full clarity on handling missing data. D4: non-blinded measurement for some subjective endpoints, such as granulation score and VAS, although objective measures were also included. D5: no pre-registration/protocol reported; possible risk of selective reporting.
Anjum et al., 2022	Some concerns	Some concerns	Low	High	Some concerns	**High**	D1: randomization using «random tables», without clear description of concealment. D2: open-label intervention; ITT not documented; possible deviations/adherence issues. D3: 20/20 randomized and analyzed in each group, essentially without missing data. D4: the primary outcome, appearance of granulation at 2 weeks, is partly subjective, and assessor blinding is not reported. D5: no pre-registration/protocol reported; risk of selective reporting.
Mousa et al., 2020	Some concerns	Some concerns	Low	Some concerns	Some concerns	**Some concerns**	D1: «randomly classified» without details on method/ concealment. D2: open-label intervention; ITT not documented; possible deviations. D3: no substantial missing data/losses reported by outcome. D4: non-blinded measurement; outcomes include time to granulation and number of debridements. D5: no pre-registration/protocol reported; risk of selective reporting.

Table 3. ROBINS-I assessment of non-randomized comparative studies

Study (Year)	D1: Confounding	D2: Selection of participants	D3: Classification of interventions	D4: Deviations from interventions	D5: Missing data	D6: Outcome measurement	D7: Selective reporting	Overall judgement	Documentation
Sukur et al., 2018	Serious	Moderate	Low	Low	Moderate	Moderate	Moderate	**Serious**	Confounding: non-randomized, possible confounding (Wagner grade, ischemia/infection, off-loading, glycemic control) without adjustment. Selection: clear inclusion criteria, but non-randomized allocation to groups. Classification of interventions: VAC versus moist dressings clearly defined. Deviations from intended interventions: no major deviations described. Missing data: losses/handling not documented in detail. Measurement of outcomes: no blinding; the outcome of "90% granulation" is potentially subjective. Selective reporting: no pre-registration; possible selective reporting.
Kotennavar et al., 2022	Serious	Moderate	Low	Moderate	Moderate	Serious	Moderate	**Serious**	Confounding: alternating allocation to four groups (NPWT/collagen/off-loading/conventional), without adjustment for key confounders such as Wagner grade, ischemia/infection, off-loading, and glycemic control. Selection of participants: prospective inclusion of all DFU grades 1-3 in one center; alternating allocation permits possible selection according to case flow. Classification of interventions: interventions are clearly defined and applied as distinct groups. Deviations from intended interventions: common co-interventions such as insulin therapy, antibiotics, and debridement, but adherence/standardization by group is not documented. Missing data: loss/handling of data during follow-up is not explicitly described; completeness is unclear. Measurement of outcomes: open-label study without blinding; outcomes such as percentage granulation/»good outcome» are partly subjective. Selective reporting: no pre-registration/protocol reported; risk of selective reporting.

Hu et al., 2018	Serious	Moderate	Low	Moderate	Moderate	Moderate	Moderate	**Serious**	Confounding: non-randomized comparison, possible baseline differences (Wagner grade, size, infection/ischemia, glycemic control), without adjustment. Selection: single-center study, clear inclusion criteria but no randomization. Classification: interventions clearly defined (VAC versus VAC plus photon therapy). Deviations: open-label care; co-interventions such as debridement/ antibiotics not fully standardized by group. Missing data: losses and their handling are not documented in detail. Measurement: no blinding; some endpoints potentially subjective, such as VAS and frequency of dressing changes. Selective reporting: no pre-registration/ protocol reported.

Protocol finalization date: 01/10/2025.

Deviations from the protocol are documented in the same Appendix and highlighted in the text where applicable. More specifically:

1. Alignment of the population with DFUs, excluding non-DFU studies such as abdominal or other surgical wounds.
2. Search time frame: from [01/01/2018] to [31/12/2024].
3. Combined interventions, such as NPWT plus PRP or phototherapy, were pre-specified for subgroup analysis.

The search was conducted in valid databases, specifically PubMed and Scopus. The inclusion criteria for the studies were as follows:

1) Articles published from 1/1/2018 to 31/12/2024.
2) Studies published in English.
3) Studies examining NPWT and/or VAC in relation to conventional methods for the treatment of diabetic foot.

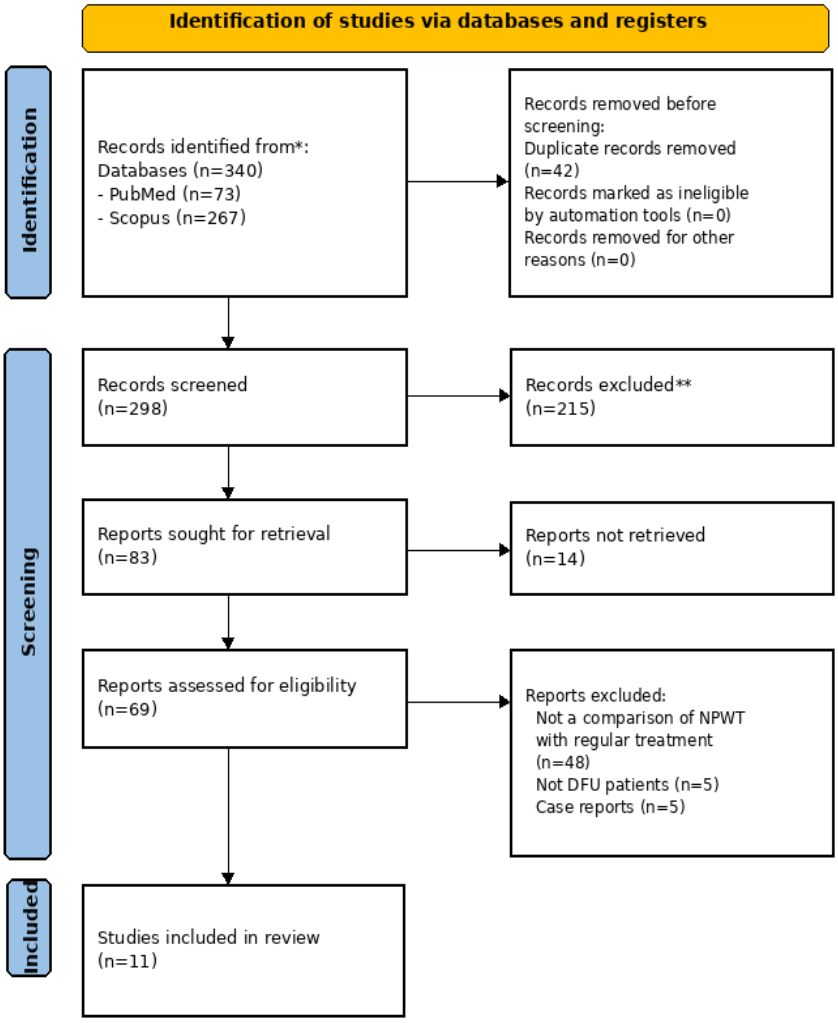
The period 2018-2024 was selected to focus on contemporary applications of NPWT in DFUs after the widespread dissemination of commercially available systems and the standardization of basic care practices. Studies conducted before 2018 may have used older generations of devices or protocols and may not reflect current clinical practice.

The exclusion criteria applied were as follows:

1) Studies concerning non-diabetic foot ulcers, such as abdominal wounds or wounds at other sites.
2) Case reports or case series without a comparison group.
3) Pediatric studies.
4) Studies conducted before 2018.
5) Studies published in a language other than English.

Detailed information on the search strategy followed is provided in Appendix A. The search yielded 73 results in PubMed and 267 in Scopus. The flow diagram shows in detail how the 11 studies included in the review were selected.

PRISMA 2020 Flow Diagram



RESULTS

Comparison of NPWT (VAC) Alone Versus Conventional Methods

Table 4 presents the seven studies that compared the negative-pressure VAC method alone with conventional methods for the treatment of diabetic foot.

The study by Sukur et al. (2018) aimed to compare the effectiveness of negative-pressure wound therapy (NPWT) with conventional moist wound dressings in the treatment of diabetic ulcers following partial foot amputation. Based on the results, the researchers concluded that VAC appears to be an effective treatment for patients with diabetic foot who had previously undergone partial foot amputation (Sukur et al. 2018).

James et al. (2019) conducted a randomized controlled trial that included patients with Wagner grade 1 and 2 diabetic foot ulcers. Patients were divided into two groups according to ulcer size, DFU <10 cm and DFU >=10 cm, and then randomly received VAC therapy or conventional dressing. Healing time, granulation-tissue formation, and complications were compared between the two groups. The researchers concluded that VAC therapy significantly reduces ulcer healing time, accelerates granulation-tissue formation, and reduces ulcer area compared with conventional dressing, while no complications were observed in the VAC treatment group (James et al. 2019).

The study by Maranna et al. (2021) aimed to compare negative-pressure therapy with conventional saline dressings in the healing of diabetic foot ulcers. Granulation-tissue formation, reduction in ulcer size, length of hospitalization, and time to complete wound healing were assessed. The researchers concluded that ulcer size was reduced, more granulation tissue was formed, hospitalization was shorter, and complete ulcer healing was achieved (Maranna et al. 2021).

The study by Anjum et al. (2022) aimed to compare the outcomes of VAC with conventional wound dressing in the treatment of diabetic foot ulcers. A randomized controlled trial was conducted in the Department of Surgery at Services Hospital, Lahore, over six months. Forty patients with diabetic foot ulcers were included and randomly allocated to two groups. Group A received VAC dressing using adhesive material to create an airtight seal, while the conventional group received daily saline-soaked gauze dressing. Patients were followed for two weeks to assess the appearance of granulation tissue, the primary outcome measure. The VAC group showed a significantly shorter mean wound-healing duration (7.50 +/- 2.82 days) compared with the conventional group (10.60 +/- 5.55 days) ($p<0.05$). All 20 patients (100%) in the VAC group achieved treatment success, whereas only 13 patients (65%) in the conventional group achieved complete healing within two weeks and 7 patients (35%) did not. This difference was statistically significant ($p<0.05$). VAC therapy proved more effective in promoting granulation-tissue formation and accelerating wound healing in patients with diabetic foot ulcers compared with conventional dressing methods, indicating its potential as a superior therapeutic option (Anjum et al. 2022).

In the multicenter study by Seidel, Lefering, and the DiaFu study group (2022), conducted between 23 December 2011 and 21 October 2014, 368 adults with diabetic foot ulcers were randomly assigned to receive either NPWT or conventional therapy. The evaluation focused on direct resource use, including treatment times in hospitals and outpatient clinics, staff time, and materials used for wound care over 16 weeks. Resource analysis primarily involved the per-protocol population (NPWT 44, SMWC 110). The results showed that NPWT significantly reduced treatment duration by an average of 16 days compared with SMWC, while outpatient treatment was also 14.9 days shorter with NPWT (mean (SD) 68.3 (31.1) days versus 83.2 (29.7) days). Although the number of dressing changes per participant tended to be lower with NPWT, the time per dressing change was significantly shorter with SMWC. In addition, NPWT reduced the time spent on surgical procedures per participant by 23.3 minutes compared with SMWC. NPWT demonstrated lower resource use than SMWC, suggesting that it could be an effective treatment option for diabetic foot wounds. However, further cost analyses are required to fully assess its economic benefits (Seidel & Lefering 2022).

The randomized controlled trial by Wu et al. (2023), conducted between September 2022 and March 2023 at Nanjing First Hospital and PLA 454 Hospital, compared negative-pressure wound therapy (NPWT) with alginate dressings for wound-bed preparation before split-thickness skin graft (STSG) surgery in patients with chronic diabetic foot ulcers. The study included 100 patients divided into two groups: NPWT (n=50) and alginate dressings (n=50). The results showed that the NPWT group reached the stage for STSG surgery faster than the control group. In addition, patients receiving NPWT showed higher skin-graft survival rates, increased wound perfusion, and reduced formation of neutrophil extracellular traps (NETs). Furthermore, macrophages in DFU wounds shifted from the pro-inflammatory M1 phenotype to the anti-inflammatory M2 phenotype in the NPWT group. These findings indicated that NPWT is more effective than conventional moist dressings in preparing the wound bed for STSG surgery in patients with chronic DFUs (Wu et al. 2023).

Table 4. Review results - studies on the effectiveness of NPWT versus conventional methods

Author - Year - Country	Type of study - Sample - Methodology	Results	Conclusions	Limitations
James et al. 2019, South India	RCT (n=60) Study duration: 2 years Wagner grade 1 and 2 DFUs, grouped according to DFU size <10 cm and >=10 cm. Treatment with VAC or conventional dressing.	Mean healing time was shorter in the VAC group (22.52 versus 3.85, P < 0.0001). Mean time to 75%-100% coverage by granulation tissue was shorter (23.33 VAC versus 32.15; P < 0.0001), with a better rate of formation (2.91 cm2/day versus 2.16 cm2/day; P = 0.0306). No complications. VAC was associated with significantly less pain in week 3 (scale 3 versus 4; P = 0.004).	VAC heals ulcers more quickly, accelerates granulation-tissue formation, and reduces ulcer surface area.	Small sample; cost, quality-of-life factors, and patient satisfaction should be evaluated.
Sukur et al. 2018 Turkey	RCT (n=65) Comparison of VAC effectiveness with conventional moist dressings for treating diabetic foot ulcers in patients who had previously undergone partial foot amputation. Group A: (n=31) Group B: (n=32) Study duration: 3 months	The mean time to achieve 90% granulation tissue was significantly lower in group A (7.8 +/- 1.2 weeks versus 11.1 +/- 1.2, p < 0.001). There was no significant difference in reoperation requirements: 38.7% (n=12) in group A and 41.2% (n=14) in group B (p = 0.839).	VAC is an effective treatment for patients who had previously undergone partial foot amputation.	Lack of weekly granulation data. Patients' gait pattern was not analyzed.
Maranna et al. 2021 India	Prospective RCT (n=45) Comparison of VAC effectiveness with conventional saline dressings for treating diabetic foot ulcers. Study duration: 3 months	Granulation-tissue formation (91.14 versus 52.61%, p < 0.001) and ulcer-size reduction (40.78 versus 21.18%, p = 0.008) at 14 days were greater in group A. Hospital stay was 15.68 versus 29.00 days (p < 0.001), and time to 100% healing with granulation tissue was 14.82 +/- 7.30 versus 44.57 +/- 7.11 days (p < 0.001), lower in group A. Complete wound healing at 3 months occurred in 20 patients (90.9%) in group A and in 6 patients (26.1%) in group B (p = 0.006).	Early reduction in ulcer size, granulation-tissue formation, shorter hospitalization, and complete ulcer healing.	Not all factors affecting diabetic-foot ulcer treatment were examined.
Seidel et al. (2020a) Germany	Controlled clinical superiority trial with blinded outcome assessment 368 patients and 345 intention-to-treat participants Comparison of NPWT with standard wound care	Wound-healing rate (difference: n=4; 2.5% (95% CI -4.7% to 9.7%); p=0.53) and time to wound healing (p=0.244) differed significantly between treatment arms.	NPWT was not more effective than conventional care in German practice. The wound-healing rate was low.	Insufficient documentation and deviations from treatment guidelines negatively affected the wound-closure outcome.

Anjum et al. 2022 Pakistan	RCT (n=40) Comparison of NPWT with conventional dressing therapy in diabetic foot ulcers based on granulation-tissue healing in two randomized patient groups. Study duration: 6 months	In the NPWT group, mean healing duration was 7.50 +/- 2.82 days. In the conventional group it was 10.60 +/- 5.55 days ($p<0.05$). In the VAC group, 100% healed. In the conventional group, 13 healed, whereas the remaining patients did not achieve complete healing within 2 weeks ($p<0.05$).	NPWT-VAC was more effective for tissue granulation compared with conventional dressing.	Not reported.
Seidel, Lefering & DiaFu 2022 Germany	Multicenter study 368 adults randomly allocated to NPWT and conventional therapy. Assessment of treatment time and materials over 16 weeks.	Treatment was 16 days shorter with NPWT (mean (SD) 82.8 (31.6), SMWC 98.8 (24.6), U test, $p = 0.001$). Fewer dressings per participant were used with NPWT (mean (SD) 35.1 (18.6), SMWC 42.9 (21.4), U test, $p = 0.067$). Time per dressing change differed significantly between SMWC (mean (SD) 19.7 (12.8)) and NPWT (16.5 (8.2) minutes; U test, $p < 0.0001$).	Resource use was lower for NPWT, which may be an effective alternative treatment to SMWC for diabetic foot wounds, to be confirmed in subsequent cost analyses.	Not reported.
Wu et al. (2023) China	Randomized controlled trial. Patients were divided into two groups: NPWT (n=50) and a control group treated with alginate dressings (n=50). When the DFU was filled with healthy granulation tissue, STSG surgery was performed.	The NPWT group required less time to reach STSG surgery than the control group. The NPWT group had markedly increased skin-graft survival rates, increased wound perfusion, and reduced NET formation compared with the control group. Macrophages in DFUs changed from the M1 phenotype to the M2 phenotype in the NPWT group.	VAC is superior to conventional moist dressings for wound-bed preparation before STSG surgery in patients with chronic DFUs.	Not reported.

Comparison of Combined Methods

Table 5 presents the four studies that either compare therapies combining NPWT and VAC or compare a third method together with VAC and conventional therapy.

The study by Mousa et al. (2020) compared the outcomes of VAC, hyperbaric oxygen therapy (HBOT), and traditional moist dressings in improving the healing of chronic diabetic foot infection. Ulcers were assessed weekly for six weeks for size, time to formation of healthy granulation tissue, complications, and number of debridement sessions. VAC therapy was presented as safer and more effective, with fewer complications than the other two methods, and it may be used concurrently with HBOT (Mousa et al. 2020).

The study by Hu et al. (2020) was conducted to investigate the effectiveness of VAC therapy combined with phototherapy for the management of DFUs. Both VAC therapy and the combination of VAC with phototherapy were effective and safe in the treatment of DFUs, while the combined therapy may have accelerated wound healing without affecting long-term effectiveness (Hu et al. 2020).

The study by Kotennavar et al. (2022) aimed to compare the effectiveness of vacuum-assisted NPWT, collagen granules, and off-loading techniques with conventional moist gauze dressings in the treatment of DFUs. It examined demographic characteristics, types of foot lesions, and treatment outcomes across different dressing methods. Patients were allocated alternately to one of four groups, with 50 cases in each group. The results showed a gradual increase in granulation-tissue development in all groups, with the collagen-dressing group showing the most significant improvement from the first week. Early recovery was more pronounced in the NPWT, collagen, and off-loading groups compared with the conventional method. Mean recovery time was lowest in the collagen-dressing group. Positive outcomes were observed in 90% of the NPWT group, 92% of the off-loading group, and 96% of the collagen group, whereas only 64% of the conventional group had favorable outcomes. The differences were statistically significant. The study found that collagen dressing was superior for treating diabetic foot ulcers, followed by off-loading techniques and NPWT. Conventional moist gauze dressings led to less favorable and slower outcomes (Kotennavar et al. 2022).

In the study by Yadav et al. (2023), the effectiveness of conventional dressings, foam dressings, and negative-pressure therapy (VAC) in the management of diabetic foot ulcers was evaluated. Treatment duration, number of debridements, need for another intervention, treatment cost, and length of hospital stay were compared between groups. The researchers concluded that VAC is the best treatment for faster healing and shorter hospital stay. Foam dressing provides an economically viable option with better outcomes than conventional dressing (Yadav et al. 2023).

Table 5. Review results - studies on the effectiveness of NPWT combined with other therapeutic interventions versus conventional methods

Author - Year - Country	Type of study - Sample - Methodology	Results	Conclusions	Limitations
Hu et al. 2018 China	RCT (n=69) Comparison of VAC combined with phototherapy in DFUs among patients at Wagner stage 2 or 3, divided into two groups: the VAC group (n=35) and the combined group, in which patients received VAC and phototherapy (n=34). Study duration: 2 years	Treatment duration and dressing-change times were shorter in the combined group compared with the VAC group ($P < 0.05$). The reduction in ulcer surface area did not show a significant difference between the two groups.	VAC and VAC combined with phototherapy were effective and safe; the combination may have accelerated wound healing and did not affect long-term effectiveness.	Not reported.
Mousa et al. 2020 Egypt	Prospective randomized study (n=75) Comparison of outcomes of VAC, HBOT, and traditional moist dressings in healing chronic diabetic-foot infection. Group A (n=25): VAC Group B (n=25): HBOT Group C (n=25): conventional moist dressings Study duration: 6 weeks	Ulcer-size reduction averaged 70.25% in group A, 62.65% in group B, and 32.46% in group C. Onset of healthy granulation-tissue formation was faster in group A, with a mean of 6.5 days, compared with 7 days in group B and 14 days in group C. Debridement sessions and complications were fewer with VAC.	VAC is safe and more effective, with fewer complications than the other two methods, and it may be used concurrently with HBOT when indicated.	Not reported.

Kotennavar et al. (2022) India	Comparison of vacuum-assisted NPWT, collagen granules, and off-loading techniques with conventional dressings. Four patient groups with 50 cases in each group.	Gradual increase in granulation-tissue development in all groups, with the collagen-dressing group showing the most significant improvement from the first week. Early recovery was more pronounced in the NPWT, collagen, and off-loading groups compared with the conventional method. Mean recovery time was lower in the collagen-dressing group. Positive outcomes were observed in 90% of the NPWT group, 92% of the off-loading group, and 96% of the collagen group, whereas only 64% of the conventional group had favorable outcomes. The differences were statistically significant.	Collagen dressing is superior for treating diabetic foot ulcers, followed by off-loading techniques and NPWT. Conventional moist gauze dressings led to less favorable and slower outcomes.	Not reported.
Yadav et al. (2023) India	RCT (n=90) Search for the optimal treatment for diabetic foot ulcers. Group 1: conventional dressing (n=30) Group 2: foam dressing (n=30) Group 3: VAC (n=30) Study duration: 3 years	Mean number of debridements: group 1, 2.37; group 2, 2.43; group 3, 1.60. Mean hospital stay: group 1, 31.17 days; group 2, 24.13 days; group 3, 15.17 days.	VAC is the recommended treatment for faster ulcer healing. Foam dressing is a more economical treatment with better outcomes than conventional dressing.	Not reported.

DISCUSSION

Based on the above results, several important conclusions can be drawn regarding the method and the healing of diabetic foot ulcers. Firstly, the NPWT and VAC negative-pressure methods appear to offer significant advantages across the parameters examined for the diabetic foot. Interestingly, in the studies included in this work, healing time appears to be much shorter than with conventional methods. The same applies to granulation-tissue formation. It is also important to note that, in the intervention group of many studies, faster granulation or wound-bed preparation with NPWT was observed, while complete closure was not consistently superior to conventional care. It is also noteworthy that, in one of these studies, bacteria were absent from most ulcers.

More specifically, in the section of studies included in the research table comparing NPWT with conventional methods, several studies were identified that investigated the effectiveness of NPWT compared with conventional wound dressings in the treatment of diabetic foot ulcers (DFUs). Sukur et al. (2018) focused on patients who had undergone partial foot amputation because of diabetes and concluded that NPWT showed effectiveness in wound healing compared with conventional dressings. Similarly, James et al. (2019) conducted an RCT among patients with Wagner grade 1 and 2 DFUs and found that NPWT significantly reduced wound-healing time, promoted granulation-tissue formation, and reduced ulcer size compared with conventional dressings, without increased complications. In another multicenter study by Seidel, Lefering, and the DiaFu study group (2022), NPWT demonstrated significant reductions in treatment duration, resource use, and surgical procedure time compared with standard moist wound care (SMWC) for diabetic foot wounds, while requiring fewer dressing changes and lower resource use.

NPWT appears consistently effective in accelerating diabetic foot wound healing, promoting granulation-tissue formation, and reducing ulcer size in diabetic foot ulcers compared with conventional dressings. However, it also carries a risk of increased wound-related adverse events, which should be considered in clinical practice. The application of NPWT in diabetic foot ulcers is indicated mainly for postoperative wounds or when optimal basic care is insufficient, with mandatory systematic debridement, off-loading, infection control, and assurance of adequate perfusion or prior revascularization within an interdisciplinary framework (IWGDF, 2023). Pressures of approximately 125 mmHg are recommended, with continuous operation during the first 48-72 hours and intermittent operation during the granulation phase, dressing changes every 48-72 hours, and use of a non-adherent layer to protect vulnerable structures (Solventum). Unresolved osteomyelitis, extensive necrosis without adequate debridement, and direct foam contact with exposed vessels or nerves are contraindications, while monitoring should focus on timely granulation and readiness for skin grafting

where indicated (IWGDF, 2023; Solventum).

Regarding the studies included in the section on combined methods, VAC consistently emerged as an effective therapy for DFUs, promoting faster wound healing, reducing complications, and offering potential advantages over other methods such as HBOT, collagen dressings, and traditional dressings. NPWT also demonstrated significant benefits, particularly in preparing wounds for surgical procedures and improving skin-graft outcomes.

Although VAC and NPWT were often associated with better outcomes, considerations of cost-effectiveness and practicality were evident, with studies such as Yadav et al. (2023) highlighting foam dressings as a viable alternative with favorable outcomes. Combined therapies, such as VAC with phototherapy (Hu et al., 2020), indicated favorable results in enhancing therapeutic effectiveness without compromising patient safety and health. In the theoretical framework, combinations of NPWT with PRP, HBOT, or instillation appear promising for rapid granulation and wound-bed preparation. In the present review, however, the available comparative data on combined approaches are limited, heterogeneous, and often non-randomized, with risk of bias and inconsistent outcomes. Well-designed randomized studies are needed to define clear indications, standardized protocols, and meaningful outcomes so that targeted and truly effective combinations can be identified.

Regarding the economic dimension of treatment in Greece, the orientation toward hospital-based application of NPWT should take into account disease burden, reimbursement mechanisms, and the realistic cost of consumables. Official announcements consistently highlight a high annual number of amputations, underscoring the need for effective interventions and organized care pathways (Ministry of Health, n.d.). Within the existing KEN-DRG framework, the direct hospital cost of admissions for DFUs is captured in Greek analyses and may serve as a reference point for evaluating NPWT programs (University of Athens, n.d.). At the same time, procurement records in Diavgeia provide indicative prices for NPWT systems and consumables, allowing episode-level cost estimates based on actual hospital purchases (Diavgeia, n.d.). From a clinical perspective, resource-use data from a randomized study in DFUs show differences in treatment times and outpatient care in favor of NPWT in some arms, providing a comparative background for economic discussion, even outside the Greek system (Seidel et al., 2022). Overall, systematic documentation of NPWT cost-effectiveness in Greece should be based on KEN-DRG, actual procurement prices, and primary recording of hospitalization days, with clear alignment to EOPYY reimbursement (Government Gazette KEN-DRG; Diavgeia).

In general, with respect to combined methods, NPWT combined with phototherapy appears to perform better in relation to treatment duration and the time required for dressing changes, although not in relation to ulcer surface area. This could therefore justify further clinical studies examining the combination of these two methods. In studies in which a third method was applied in addition to conventional treatment and VAC, such as foam dressing or HBOT, VAC was again considered more effective for faster ulcer healing and fewer complications.

Despite the above, certain limitations should be considered. Although NPWT is not a new wound therapy, more quantitative and qualitative studies are required to fully clarify its scope of action and improve patient tolerance. In summary, the risk-of-bias assessment showed heterogeneous quality among randomized controlled trials: Wu 2023 was assessed as Low risk, several trials such as Maranna 2021, James 2019, Yadav 2023, and Anjum 2022 as Some concerns, and DiaFu (Seidel 2020/2022) as High because of extensive deviations and incomplete data. Non-randomized comparative studies such as Sukur 2018, Kotennavar 2022, and Hu 2018 were mainly classified as Serious, primarily because of confounding and outcome-measurement concerns. This suggests that, although NPWT shows favorable trends compared with conventional care, especially regarding time and wound-bed preparation, findings should be interpreted cautiously because of risk of bias and methodological heterogeneity. In addition, companies and organizations that manufacture related medical devices should improve device size and autonomy so that the devices are more tolerable for patients and do not restrict their daily lives.

CONCLUSIONS

The findings of the present literature review showed that NPWT is an effective and safe treatment for diabetic foot ulcers in affected patients. In addition, this therapy was found to be more effective than conventional dressings and resulted in healthier granulation-tissue formation and reduction of wound extent in all dimensions. All studies examined in the present review followed a comparative research methodology between negative-pressure therapy/VAC and other conventional treatments, such as simple saline-soaked dressings. All 11 studies concluded that NPWT is a more effective and faster treatment for ulcer healing, also helping accelerate granulation-tissue development in the wound and ultimately reducing the length of hospitalization for patients with diabetes.

In conclusion, although negative-pressure therapy remains a first-line treatment for DFUs in patients with diabetes because of its effectiveness and safety, ongoing research aims to optimize treatment strategies by exploring combined therapies and evaluating their long-term benefits and economic implications for clinical practice and patient support.

Hospitals and, more broadly, clinical practices and protocols should consider VAC therapy a core method for managing diabetic foot wounds, while research could focus on examining the effectiveness of combined intervention methods with VAC. Although NPWT shows clear benefits in wound healing, future studies should continue to investigate and mitigate the risk of adverse events associated with NPWT. This includes understanding patient-specific factors that may predispose individuals to complications and developing strategies to minimize

these risks.

Comprehensive cost-effectiveness analyses would also provide valuable information on the economic impact of NPWT compared with conventional dressings. Understanding the long-term economic benefits and health-care resource use associated with NPWT could inform health-care decision-making and reimbursement policies. At the research level, future work could explore personalized-medicine approaches to optimize NPWT outcomes based on individual patient characteristics, such as wound severity, comorbidities, and response to treatment. Tailoring NPWT protocols could potentially enhance treatment effectiveness and reduce complications. Preliminary evidence indicates that NPWT is at least as effective as, if not better than, current topical wound treatments. This also applies to the use of low-cost improvised negative-pressure suction systems. However, the generalizability of cost and effectiveness data is limited by differences in treatment conditions and health-care systems.

REFERENCES

Alexiadou, K., & Doupis, J. (2012). Management of Diabetic Foot Ulcers. Diabetes Therapy, 4.

Alipour, V., Rezapour, A., Ebrahimi, M., & Arabloo, J. (2021). Cost-Utility Analysis of Negative Pressure Wound Therapy Compared With Traditional Wound Care in the Treatment of Diabetic Foot Ulcers in Iran. Wounds, 33 (2): 50-56.

Alvarez, C.A., Lingvay, I., Vuylsteke, V., Koffarnus, R.L. & Mcguire DK. (2015). Cardiovascular Risk in Diabetes Mellitus: Complication of the Disease or of Antihyperglycemic Medications. Clin Pharmacol Ther, 98 (2): 145–161

American Diabetes Association. (2022). Professional Practice Committee. Glycemic Targets: Standards of medical Care in diabetes. Diabetes Care, 45: S83-S96.

Anjum, W., Ali, S., Mumtaz, M., Imran, M., Siddique, H., & Zia, H. (2022). Comparison of Vacuum Assisted Closure (VAC) Therapy Versus Conventional Dressing in the Management of Diabetic Foot Ulcer. PJMHS, 16 (1): 1163-1165

Antonakou, A., Kalemikerakis, I., Charcharidou, M., & Vasilopoulos, G. (2017). Indications and contraindications for the application of negative pressure in the management of diabetic ulcers and pressure ulcers. Perioperative Nursing, 6(2): 96-106.

Armstrong, D., Boulton, A., & Bus, S. (2017). Diabetic foot ulcers and their recurrence. N Engl J Med, pp. 376(24): 2367-2375.

Arora, K., Kapila, R., Chaudhary, P., Singhal, A., Patra, A., & Kapila, S. (2022). Proficiency of Topical Platelet-Rich Plasma with Vacuum-Assisted Closure over Platelet-Rich Plasma Alone in Diabetic oot Ulcers - A clinical, prospective, coparative study. Arch Trauma Res, 11: 37-43.

Cavanagh, P.R., Lipsky, B.A., Bradbury, A.W. & Botek, G. (2005). Treatment for diabetic foot ulcers. Lancet. 366: 1725-35

Chen, L., Zhang, S., Da, J., Wu, W., Ma, F., Tang, C., Li, G., Zhong, D., & Liao, B. (2021). A systematic review and meta-analysis of efficacy and safety of negative pressure wound therapy in the treatment of diabetic foot ulcer. Annals of palliative medicine, 10(10): 10830–10839.

Diavgeia. (n.d.). Procurement records for NPWT systems/consumables.

University of Athens. (n.d.). Study of diabetic-foot hospitalization costs after the implementation of KEN-DRG.

Dsouza, C., Chirag, R., Diaz, E., Rao, Sh. (2017). A randomized controlled trial comparing low-cost vacuum assisted dressings and conventional dressing methods in the management of diabetic foot ulcers. International Surgery Journal, 12: 3858-3865

Galicia-Garcia, U., Benito-Vincente, A., Jebari, S., Larrea-Sebal, A., Siddiqi, H., Uribe, K., . . . Martin, C. (2020). Pathophysiology of Tyoe 2 diabetes Mellitus. Int J Mol. Sci., 21 (17): 6275.

Fleischmann, W., Strecker, W., Bombelli, M., & Kinzi, L. (1993). Vacuum sealing as treatment of soft tissue damage in open fractures . Unfallchirung, 96 (9): 488-492.

Galtier, F. (2010). Definition, epidemiology, risk factors. Diabetes Metab, 36: 628-651.

Government Gazette KEN-DRG. (n.d.). Reimbursement framework for hospitalizations under KEN-DRG.

Hellenic Society for the Study of the Diabetic Foot. (2024). 9th Panhellenic EMEDIP Conference: Programme. Athens.

Hu, X., Lian, W., Zhang, X., Yang, X., Jiang, J. & Li, M., 2018. Efficacy of negative pressure wound therapy using vacuum-assisted closure combined with photon therapy for management of diabetic foot ulcers. Ther Clin Risk Manag., 14: 2113-2118.

Ioannidis, O., Anestiadou, E., Zapsalis, K., et al. (2025). Tailored negative pressure wound therapy with instillation in diabetic, hypertensive, and obese patients. World Journal of Emergency Surgery, 20: 66.

IWGDF. (2023). Guidelines on interventions to enhance healing of foot ulcers in people with diabetes.

James, S.M.D., Sureshkumar, S., Elamurugan, T.P., Debasis, N., Vijayakumar, C., & Palanivel, C., 2019. Comparison of Vacuum-Assisted Closure Therapy and Conventional Dressing on Wound Healing in Patients with Diabetic Foot Ulcer: A Randomized Controlled Trial. Niger J Surg., 25 (1): 14-20.

Janssen, J. (2021). Hyperinsulinemia and Its Pivotal Role in Aging, Obesity, Type 2 Diabetes, Cardiovascular Disease and Cancer. Int J Mol Sci, 22: 7797.

Katsilambros, N., Dounis, E., Makrilakis, T. N., & Tsapogas, P. (2010). Atlas of the diabetic foot. Oxford: Wiley-Blackwell.

Kontodimopoulos, N., Veniou, A., Tentolouris, N. & Niakas, D. (2016). Validity and reliability of the Greek version of Diabetic foot ulcer scale – short form (DFS-SF). HORMONES, 15(3): 394-403

Kotennavar, M., Rajendra, B., Rathod. S, Patil, A., savant, M., Raj, K., . . . Patil, P. (2022). Different Approaches in the management of diabetix foot ulcers- Experience at a tertiary care hospital. Basrah Journal of Surgery, 28 (2): 54-61.

Lauterbach, S., Kostev, K., & Kohlmann, T. (2010). Prevalence of diabetic foot syndrome and its risk factors in the UK. J wound Care, 333-337.

Liu, S., He, C. Z., Cai, Y. T., Xing, Q. P., Guo, Y. Z., Chen, Z. L., Su, J. L., & Yang, L. P. 2017. Evaluation of negative-pressure wound therapy for patients with diabetic foot ulcers: systematic review and meta-analysis. Therapeutics and clinical risk management, 13:533–544.

Maranna, H., Lal, P., Mishra, A., Bains, L., Sawant, G., Bhatia, R., & Beg, M. Y., 2021. Negative pressure wound therapy in grade 1 and 2 diabetic foot ulcers: A randomized controlled study. Diabetes & Metabolic Syndrome: Clinical Research & Reviews, 15 (1): 365–371.

Mendez-Eastman S. (2001). Guidelines for using negative pressure wound therapy. Adv Skin Wound Care, 14 (6): 314-322.

Ministry of Health. (n.d.). Announcements on the burden of amputations due to diabetic foot.

Mousa, A., Shehata, M., Salem, M., 2020. Comparative Study between treatment by vacuum-assisted Closure (VAC), Treatment by hyperbaric oxygen therapy and Traditional treatment of Diabetic Foot Infection. The Egyptian Journal of Hospital Medicine, 81 (4): 1810-1814

Papanas, N., & Maltezos, E. (2009). The diabetic foot: A global threat and a huge challenge for Greece. Hippokratia, 13(4), 199–204. Rys, P., Borys, S., Hodendorff, J., Zapala, A., Witek, P., Monica, M., . . . Malecki, M. (2020). NPWT in diabetic foot wounds-a systematic review and meta-analysis of observational studies. Endocrine, 68 (1): 44-55.

Petritzikli, A. (2022). Negative pressure treatment devices for wound healing. Perioperative Nursing, 11 (1): 23–30.
Schellenberg, E., Dryden, D., Vandermeer, B., & Korownyk, C. (2013). Lifestyle interventions for patients with and at risk of Type 2 diabetes: A systematic review and meta-analysis. Ann. Inter. Med, 159: 543-551.
Seidel, D., Lefering, R., & DiaFu study group. (2022). NPWT resource use compared with standard moist wound care in diabetic foot wounds: DiaFu randomized clinical trial results. J Foot Ankle Res, 15(1): 72.
Shojaiefard, A., Khorgami, Z. & Larijani, B., 2008. Independent risk factors for amputation in diabetic foot. Int J Diabetes Dev Ctries, 28 (2): 32.
Singer, A., Tassiopoulos, A., & Kirsner, R. (2018). Evaluation and MAnagement of Lower-Extremity Ulcers. N Eng J Med, 378 (3): 302-303.
Singh, D., Chopran, C., Sabino, J., & Brown, E. (2020, 2020 4). Practical Things You Should Know about Wound Healing and Vacuum-Assisted Closure Management. Plastic and Reconstructive Surgery, 839-854.
Solventum. V.A.C. Therapy clinical guidelines.
Sukur, E., Akar, A., Uyar, A. Ç., Cicekli, O., Kochai, A., Turker, M., & Topcu, H. N, 2018. Vacuum-assisted closure versus moist dressings in the treatment of diabetic wound ulcers after partial foot amputation: A retrospective analysis in 65 patients. Journal of Orthopaedic Surgery, 26(3).
Sun, H., Si, S., Liu, X., Geng, H., & Liang, J. (2024). Evaluation of a new low-cost negative pressure wound therapy in the treatment of diabetic foot ulcers. J Wound Care, 1;33.
Tomic, D., & Shaw, J. (2022). The burden and risks of emerging complications of diabetes mellitus. Nat Rev Endocrinol, 18: 525-539.
Vikatmaa, P., Juutilainen, V., Kuukasjarvi, P., & Malmivaara, A. (2008). Negative Pressure Wound Therapy: a Systematic Review on Effectiveness and Safety. European Journal of Vascular and Endovascular Surgery, 36 (4): 438-448.
Vuerstaek, J.D.D., Tryfon, V., Wuite, J., Nelemans, P., Neumann, M.H.A. & Veraart, J.C.J.M., 2006. State-of-the-art treatment of chronic leg ulcers: a randomized controlled trial comparing vacuum-assisted closure (VAC) with modern wound dressings. J Vasc Surg. 44: 1029-38.
Wong, N., Zhao, Y., Patel, R., Patao, C., Malik, S., Bertoni, A., . . . Mukherjee, J. (2016). Risk factos targets and cardiovascular disease event risk in diabetes: A pooling project of the atherosclerosis risk in communities study, Multiethnic study of atherosclerosis and Jackson Heart study. Diabetes Care, 39: 668-676.
Wu, Y., Shen, G., & Hao, C. (2023). Negative pressure wound therapy (NPWT) is superior to conventional moist dressings in wound bed preparation for diabetic foot ulcers: A randomized controlled trial. Saudi Med J., 44(10): 1020-1029.
Yadav, A.K., Mishra, S., Khanna, V., Panchal, S., Modi, N. & Amin, S. 2023. Comparative study of various dressing techniques in diabetic foot ulcers in the Indian population: a single-center experience. Int J Diabetes Dev Ctries, 4: 1-7.
Zhang, Y., Lazzarini, P.A., McPhail, S.M. (2020). Global disability burdens of diabetes- related lower-extremity complications in 1990 and 2016. Diabetes Care, 43 (5): 964-974.
Zhang, N., Liu, Y., Yan, W., & Liu, F. (2024). The effect of negative pressure wound therapy on the outcome of diabetic foot ulcers: A meta-analysis. Int Wound J, 21 (4): 14886.

APPENDIX [A]

Methods: Sources and Search Strategy

The search was conducted in MEDLINE/PubMed and Scopus for the period 1/1/2018-31/12/2024. The final update of the search and study selection was performed on 01/10/2025. The full search strings by database, including fields, Boolean operators, and dates, are provided in the Appendix (PRISMA-S). Combinations of controlled terms (MeSH) and keywords (tiab) were used.

PRISMA-S Searches

PubMed (MEDLINE) - Final execution: 01/10/2025; Limits: 2018-2024; Access filters: Free full text, English, Humans, Exclude preprints, from 2018/1/1 to 2024/12/31

Fields: MeSH + Title/Abstract (tiab)

(("Negative-Pressure Wound Therapy"[MeSH Terms]
OR "Vacuum-Assisted Closure"[All Fields]
OR "negative pressure wound*"[Title/Abstract]
OR "vacuum-assisted"[Title/Abstract]
OR "vacuum assisted"[Title/Abstract]
OR NPWT[Title/Abstract]
OR VAC[Title/Abstract])

AND

("Diabetic Foot"[MeSH Terms]
OR "diabetic foot ulcer*"[Title/Abstract]
OR "diabetic foot"[Title/Abstract]
OR DFU[Title/Abstract]))
AND ("2018/01/01"[Date - Publication] : "2024/12/31"[Date - Publication])
AND (ffrft[Filter])
AND (excludepreprints[Filter])
AND (humans[Filter])
AND (english[Filter])

Scopus - Final execution: 01/10/2025; Years: 2018-2024; Access filters: Range 2018-2024, Article, Final, Journal, English, All open access

Fields: TITLE-ABS-KEY

(TITLE-ABS-KEY("negative pressure wound*" OR "vacuum-assisted" OR "vacuum assisted" OR NPWT OR VAC)
AND TITLE-ABS-KEY("diabetic foot ulcer*" OR "diabetic foot" OR DFU))
AND (PUBYEAR > 2017 AND PUBYEAR < 2025)
AND (LIMIT-TO(LANGUAGE, "English"))
AND (LIMIT-TO(DOCTYPE, "ar"))

Retrieval dates: initial search 12/01/2025; final update 01/10/2025

Selection process:

Screening of titles/abstracts and full texts was performed manually by one reviewer according to predefined criteria. No automation tools were used.

Deduplication:

Records were merged and duplicates were removed manually by matching Title/First author/Year/DOI/PMID. The final number of duplicates is shown in the PRISMA flow diagram below.

Data extraction:

One reviewer extracted data using a standardized form: design, country, n, patient characteristics/ulcer grade, NPWT settings and any combinations, comparator, outcomes, and follow-up.

Risk of bias:

Assessment was performed using RoB 2 for randomized controlled trials and ROBINS-I for non-randomized studies, as shown below.

Effect measures and synthesis:

Dichotomous outcomes were expressed as RR/OR (95% CI) and continuous outcomes as MD/SMD (95% CI). A narrative synthesis was selected because of heterogeneity and the limited number of studies per outcome. No meta-analysis was performed.

Publication bias and certainty:

Publication-bias testing (funnel/Egger) was not performed because there were fewer than 10 studies per outcome and no meta-analysis was conducted.