Cureus
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Open Access Original Article

Effectiveness of Low-Cost Vacuum-Assisted Closure Using Locally Available Materials for Wound Healing: A Prospective Interventional Case Series From a Public-Sector Tertiary Care Hospital

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Review began 09/22/2026
Review ended 10/26/2026
Published 11/02/2026

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DOI: 10.7759/cureus.119015

Abstract

Background: Impaired wound healing is associated with delayed granulation, infection, repeated dressings, prolonged hospital stay, and increased treatment costs. Commercial vacuum-assisted closure (VAC) systems are effective but often unaffordable in public-sector and resource-limited settings. This study evaluated wound healing outcomes, safety, and direct dressing-material expenditure associated with a low-cost VAC system using locally available materials.

Methods: This prospective, single-arm, interventional case series was conducted at a public-sector tertiary care hospital in Chennai, India, over one month, from 16 July 2026 to 15 August 2026. Fifteen adult patients requiring wound bed preparation for delayed or impaired wound healing, including non-healing wounds and large ulcers, were included after obtaining written informed consent. Low-cost VAC therapy was administered using a sterilised sponge, suction tubing or Ryle's tube, an airtight adhesive drape, and wall or portable suction, maintaining negative pressure of −100 to −125 mmHg. Wound area was estimated by multiplying the maximum length and width. Outcomes included granulation tissue formation, estimated percentage wound-area reduction, final wound management, complications, and dressing-material expenditure.

Results: The mean age was 40.60 ± 10.87 years, and 10 patients (66.7%) were male. Post-operative wounds were the most common, occurring in seven patients (46.7%). Comorbidities were present in 10 patients (66.7%), with type 2 diabetes mellitus being the most common. Baseline bacterial growth was observed in 10 patients (66.7%). Healthy granulation tissue developed within three to four days in 14 patients (93.3%). Mean estimated wound-area reduction was 35.33 ± 6.67% by Day 7 and 72.67 ± 12.08% by Day 14. Seven patients (46.7%) became suitable for skin grafting or secondary suturing. No major complications were reported. Direct dressing-material expenditure was approximately ₱50 per dressing, comprising ₱20 for the sterilised sponge and ₱30 for gauze; suction tubing and adhesive drapes were supplied without direct charge by the government hospital. The estimated dressing-material expenditure per patient was ₱150-₱200 for three to four dressing changes, compared with an estimated ₱6,000-₱20,000 for commercial VAC dressings.

Conclusion: Low-cost VAC therapy is a feasible, safe, effective, and economical option for managing non-healing wounds in resource-limited hospital settings.

Categories: Trauma, General Surgery, Infectious Disease
Keywords: chronic wounds, granulation tissue, low-cost npwt, low-cost vac, negative pressure wound therapy, negative wound pressure therapy (nwpt), non-healing wounds, vacuum-assisted closure, vacuum-assisted closure (vac), wound healing

Introduction

Chronic wounds are wounds that fail to progress through the normal phases of healing in an orderly and timely manner. They are commonly associated with diabetes mellitus, vascular insufficiency, trauma, postoperative wound complications, pressure-related tissue injury, and persistent soft tissue infection [1]. These wounds often remain in a prolonged inflammatory state due to bacterial colonization, excessive exudate, tissue edema, impaired perfusion and underlying comorbidities, resulting in delayed granulation, delayed epithelialization and failure of wound closure [1].

Chronic wounds represent a major clinical and economic burden, as they require repeated dressings, prolonged hospital visits or admissions, antibiotic therapy, and additional surgical procedures [2]. They have been described as a silent epidemic globally. Chronic wounds affect nearly one in six people, involving approximately 10.5 million people and costing an estimated 22.5 billion dollars annually [3]. In India, the overall prevalence of chronic wounds is 1.89 per 1000 population [4]. This burden is especially important in

public sector and resource-limited hospitals, where delayed presentation, infection, and limited access to advanced wound care can further prolong healing and increase treatment cost.

Negative pressure wound therapy (NPWT), also known as vacuum-assisted closure (VAC), is an established technique for wound management that applies controlled sub-atmospheric pressure to the wound bed through a sealed dressing system [5]. It promotes healing by removing exudate and infectious material, reducing tissue edema, improving local perfusion, decreasing bacterial burden, and drawing wound edges together [6]. The beneficial effects of NPWT are also mediated through macrodeformation and microdeformation at the wound surface, which stimulate cellular proliferation, angiogenesis, fibroblast activity, collagen synthesis, and healthy granulation tissue formation [7].

A standard NPWT system consists of a porous foam dressing placed over the wound, an adhesive occlusive drape to create an airtight seal, a drainage tube, and a vacuum source that applies controlled negative pressure [8]. Although commercial VAC systems are effective, their high cost, limited availability, and requirement for proprietary components restrict their routine use in low-resource settings. Therefore, the present study was undertaken to evaluate the effectiveness, safety, and cost-effectiveness of a low-cost VAC system using locally available sterile materials for wound healing in a public-sector tertiary care hospital.

Materials And Methods

This was a prospective, single-arm, interventional case series conducted at the Institute of General Surgery, Rajiv Gandhi Government General Hospital, Madras Medical College, Chennai, India, over a period of one month from 16 July 2026 to 15 August 2026. The study was conducted in accordance with the principles of the Declaration of Helsinki. Approval was obtained from the Institutional Ethics Committee, Madras Medical College, Chennai, India (approval number IEC-MMC/Approval/56072026), following the meeting held on 16 July 2026. Written informed consent was obtained from all participants before enrolment.

Consecutive sampling was used. All eligible patients admitted during the study period with wounds requiring wound bed preparation for delayed or impaired wound healing were screened. A total of 15 adult patients aged more than 18 years with non-healing wounds or large ulcers measuring more than 5 cm (2 inches) in diameter were included. Patients with wounds communicating with an organ or body cavity, malignancy in the wound, osteomyelitis, necrotising infection, exposed major vessels, small healthy ulcers, post-burn ulcers, or major cardiorespiratory illness were excluded. No formal sample size calculation was performed because this was a prospective interventional case series conducted over a fixed one-month study period. The sample size was based on the number of eligible patients who fulfilled the inclusion criteria and consented to participate during the study duration.

Baseline demographic details, wound type, wound site, wound duration, comorbidities, wound discharge or slough, wound size, and wound culture findings were recorded using a structured data collection form. Potential confounding factors such as age, diabetes mellitus, systemic hypertension with coronary artery disease, obesity, hypothyroidism, anemia, wound duration, baseline wound size, wound site, wound etiology, and baseline bacterial culture status were recorded. As this was a single-arm case series without a control group, no adjusted comparative analysis was performed.

For the low-cost VAC system, the required equipment included a sterilised sponge, suction tubing or Ryle's tube, an airtight adhesive drape, sterile gauze, antiseptic solution, connecting tubing, and wall suction or portable suction apparatus. After adequate wound cleaning and debridement when required, the sterilised sponge was placed over the wound bed. Suction tubing or a Ryle's tube was positioned within the dressing, and the wound area was sealed with an airtight adhesive drape. The tubing was connected to wall suction or portable suction, and negative pressure of −100 to −125 mmHg was maintained (Figure *1*).



FIGURE 1: Representative image showing the low-cost vacuum-assisted closure dressing assembly using locally available sterile materials, including a sterilised sponge, suction tubing or Ryle's tube, airtight adhesive drape, and suction connection.

Dressings were changed every three to four days depending on wound condition, exudate, seal integrity, and granulation tissue formation. Wound dimensions were measured using the maximum length and maximum width, and wound area was estimated in square centimetres (cm^2) using the formula: Wound area (cm^2) = maximum length (cm) × maximum width (cm). This method provided an approximate wound area rather than an exact measurement, particularly for irregularly shaped wounds. The same measurement method was used at baseline and during follow-up on Days 7 and 14 to assess changes in wound area. Healthy granulation tissue formation was assessed clinically based on the appearance of healthy red granulation tissue over the wound bed, reduction in slough or discharge, and suitability of the wound for further

dressing, skin grafting, or secondary suturing.

The main outcome measures were healthy granulation tissue formation, percentage reduction in wound size by Day 7 and Day 14, final wound management outcome, complications during therapy, and estimated treatment cost. Final wound management outcome was recorded as continuation of dressing, skin grafting, or secondary suturing. Complications such as pain, maceration, air leak, bleeding, worsening infection, or any serious adverse event were documented. Data were entered in Microsoft Excel (Microsoft Corp., Redmond, WA, USA) and analyzed using IBM SPSS Statistics for Windows, Version 27.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean with standard deviation. Categorical variables were expressed as frequency and percentage.

Results

A total of 15 patients were included in the study. The mean age of the study participants was 40.60 ± 10.87 years, with an age range of 23 to 58 years (Table *1*).

Age Group	Frequency (n)	Percentage (%)
≤30 years	2	13.3
31–40 years	6	40.0
41–50 years	4	26.7
>50 years	3	20.0

TABLE 1: Age-wise distribution of the study participants

Out of 15 participants, 10 were male (66.7%) and five were female (33.3%) (Figure *2*). Among the patients, the most common wound type was a post-operative wound, which was seen in seven patients (46.7%). This was followed by post-traumatic wounds and post-debridement wounds, each seen in four patients (26.7%). The most common wound sites were the right leg and abdomen, each accounting for four patients (26.7%), followed by the left foot in three patients (20.0%). The mean wound duration was 6.40 ± 2.24 weeks, with most wounds having a duration of six weeks (40.0%) (Table *2*).

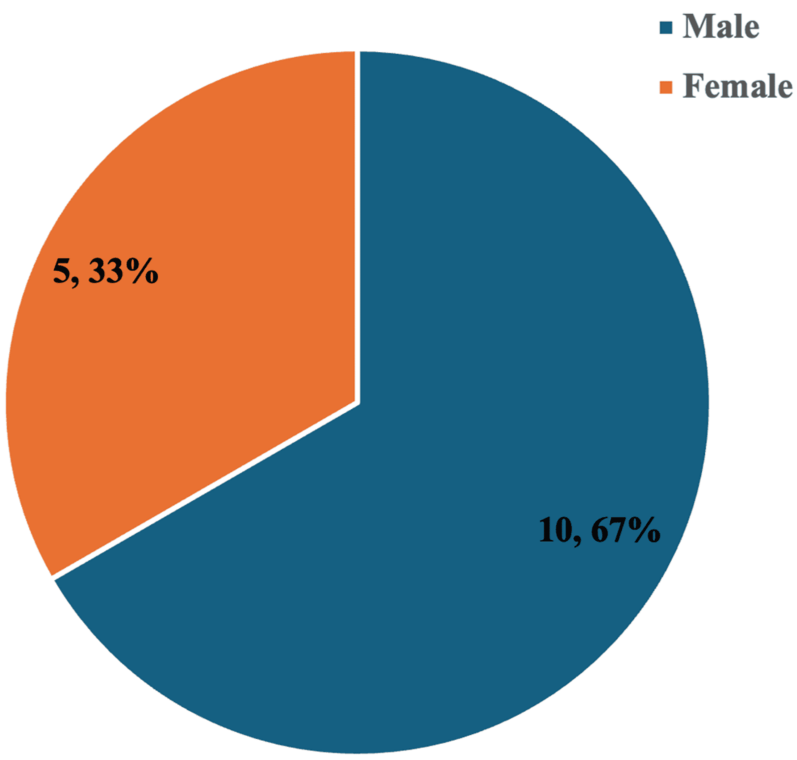


FIGURE 2: Gender-wise distribution of the study group

Clinical Variable		Frequency (n)	Percentage (%)
Wound type	Post-operative wound	7	46.7
	Post-traumatic wound	4	26.7
	Post-debridement wound	4	26.7
Site of the wound	Abdomen	4	26.7
	Right hip/post-hindquarter region	1	6.7
	Right thigh	1	6.7
	Left thigh	1	6.7
	Right leg	4	26.7
	Left leg	1	6.7
	Left foot	3	20
Duration of the wound	4 weeks	4	26.7
	6 weeks	6	40
	8 weeks	4	26.7
	12 weeks	1	6.7

TABLE 2: Clinical profile of the study participants

Comorbidities were present in 10 patients (66.7%), while five patients (33.3%) had no comorbidity. The most

common comorbidity was type 2 diabetes mellitus, seen in four patients (26.7%) (Figure 3).

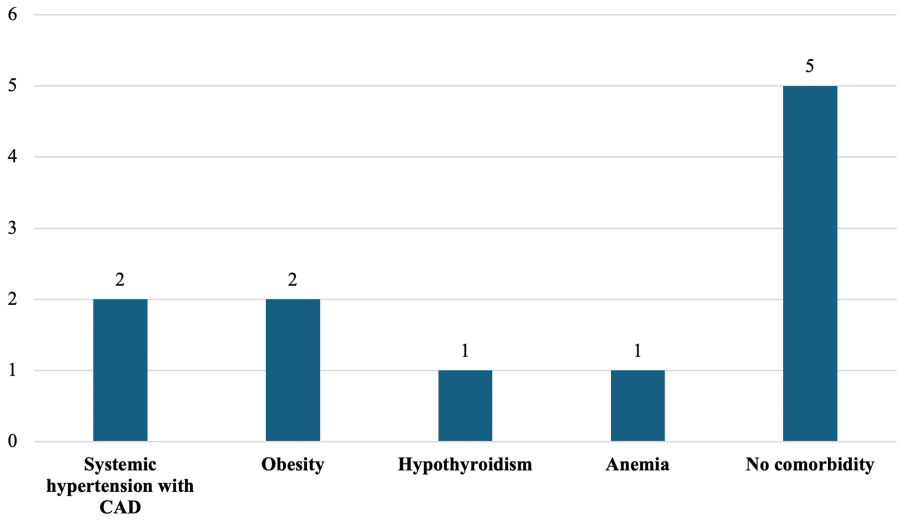


FIGURE 3: Distribution of comorbidities among the study participants

CAD: coronary artery disease

At baseline, the wound area ranged from 25 cm² to 600 cm², with a mean wound area of 117.73 ± 142.18 cm². Most wounds showed discharge at presentation, seen in 12 patients (80.0%), while slough was present in three patients (20.0%). Baseline wound culture showed bacterial growth in 10 patients (66.7%), while no growth was observed in five patients (33.3%). The most common organism isolated was *Klebsiella pneumoniae*, seen in four patients (26.7%), followed by *Klebsiella oxytoca*, *Pseudomonas aeruginosa*, and *Acinetobacter* species, each seen in two patients (13.3%) (Table 3).

Baseline Culture	Frequency (n)	Percentage (%)
Klebsiella pneumoniae	4	26.7
Klebsiella oxytoca	2	13.3
Pseudomonas aeruginosa	2	13.3
Acinetobacter species	2	13.3
No growth	5	33.3
Total	**15**	**100.0**

TABLE 3: Baseline wound culture profile of the study participants

Following low-cost VAC therapy, early wound improvement was observed in most patients. Healthy granulation tissue formation was achieved within three to four days in 14 patients (93.3%), while one patient (6.7%) required seven days. The mean wound size reduction was 35.33 ± 6.67% by Day 7 and improved further to 72.67 ± 12.08% by Day 14. Following low-cost VAC therapy, eight patients (53.3%) continued with dressing, while four patients (26.7%) underwent skin grafting and three patients (20.0%) underwent secondary suturing (Figure 4).

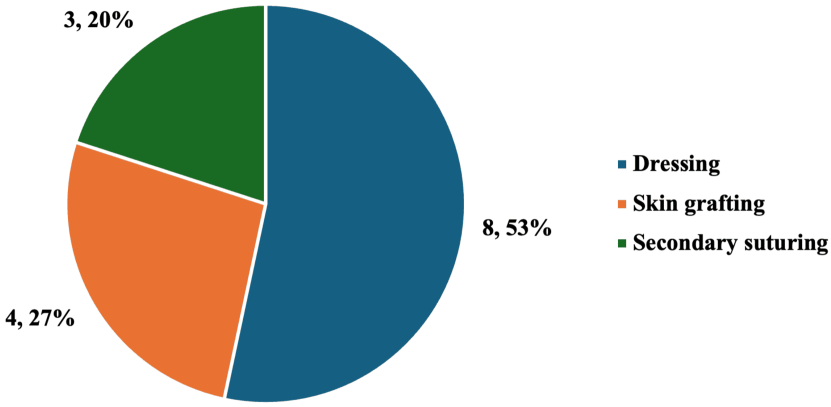


FIGURE 4: Final management outcome after low-cost vacuum-assisted closure therapy

Baseline demographic details, wound characteristics, comorbidities, wound discharge or slough, baseline wound size, wound culture findings, and clinically relevant baseline variables are presented in Table 4.

Variable	Category/Measure	Frequency/Value
Age group	≤30 years	2 (13.3%)
	31–40 years	6 (40.0%)
	41–50 years	4 (26.7%)
	>50 years	3 (20.0%)
Gender	Male	10 (66.7%)
	Female	5 (33.3%)
Wound etiology/type	Post-operative wound	7 (46.7%)
	Post-traumatic wound	4 (26.7%)
	Post-debridement wound	4 (26.7%)
Site of the wound	Abdomen	4 (26.7%)
	Right hip/post-hindquarter region	1 (6.7%)
	Right thigh	1 (6.7%)
	Left thigh	1 (6.7%)
	Right leg	4 (26.7%)
	Left leg	1 (6.7%)
	Left foot	3 (20.0%)
Wound duration	4 weeks	4 (26.7%)
	6 weeks	6 (40.0%)
	8 weeks	4 (26.7%)
	12 weeks	1 (6.7%)
Baseline wound size	Mean wound area ± SD	117.73 ± 142.18 cm²

	Range	25–600 cm²
Wound discharge/slough	Discharge present	12 (80.0%)
	Slough present	3 (20.0%)
Comorbidity status	Comorbidity present	10 (66.7%)
	No comorbidity	5 (33.3%)
Baseline comorbidity	Type 2 diabetes mellitus	4 (26.7%)
	Systemic hypertension with coronary artery disease	2 (13.3%)
	Obesity	2 (13.3%)
	Hypothyroidism	1 (6.7%)
	Anemia	1 (6.7%)
Baseline bacterial culture status	Bacterial growth present	10 (66.7%)
	No growth	5 (33.3%)
Baseline wound culture finding	*Klebsiella pneumoniae*	4 (26.7%)
	Klebsiella oxytoca	2 (13.3%)
	Pseudomonas aeruginosa	2 (13.3%)
	Acinetobacter species	2 (13.3%)
	No growth	5 (33.3%)

TABLE 4: Summary of baseline demographic, clinical, and wound-related variables

Low-cost VAC therapy was well tolerated in most patients. No complications were observed in 13 patients (86.7%). Minor complications were noted in two patients (13.3%), including maceration with pain in one patient (6.7%) and air leak in one patient (6.7%). No major bleeding, worsening infection, or serious adverse event was reported (Table 5).

Complication	Frequency (n)	Percentage (%)
Nil	13	86.7
Maceration With pain	1	6.7
Air leak	1	6.7

TABLE 5: Complications observed during low-cost vacuum-assisted closure therapy

The direct dressing-material expenditure for the low-cost VAC system was ₱50 per dressing, comprising ₱20 for the sterilised sponge and ₱30 for gauze. Suction tubing and adhesive drapes were supplied without direct charge by the government hospital. The low-cost VAC system demonstrated a lower estimated dressing-material cost than commercial VAC therapy. The estimated cost per low-cost VAC dressing was approximately ₱50, compared with ₱2,000-₱5,000 for a commercial VAC dressing. Based on three to four dressing changes per patient, the estimated total dressing-material cost was ₱150-₱200 for low-cost VAC and ₱6,000-₱20,000 for commercial VAC therapy. The estimated reduction in dressing-material cost ranged from 97.5% to 99.0%. These findings represent a direct comparison of estimated dressing-material costs rather than a formal cost-effectiveness analysis (Table 6).

Cost Variable	Low-Cost VAC	Commercial VAC
Cost per dressing	₹50	₹2,000–₹5,000
Number of VAC dressing changes per patient	3–4	3–4
Estimated total cost per patient	₹150–₹200	₹6,000–₹20,000
Approximate cost reduction	97.5%–99%	—

TABLE 6: Cost comparison between low-cost and commercial vacuum-assisted closure (VAC) therapies

Reference: [9]

Discussion

In the present study, the mean age of participants was 40.60 ± 10.87 years, indicating that non-healing wounds affected mainly young and middle-aged adults. This differs from the broader studies described by Sen [2] and Sharma et al. [4], where chronic wounds were commonly associated with ageing populations and the presence of comorbidities. The lower mean age in our study may be because these age groups are commonly exposed to trauma, occupational injury, and surgical wound complications. Also, male predominance was observed in the present study. A similar pattern was reported in a Chinese study by Zhou et al. [10], which found that 60.8% were male. This provides strong epidemiological support for greater exposure to trauma, outdoor work, and surgical wound complications among males.

Post-operative wounds were the most common wound type in seven patients (46.7%), followed by post-traumatic and post-debridement wounds, indicating that low-cost VAC was mainly used for complex surgical and trauma-related wounds. This pattern is supported by Zaver et al. [5], who described NPWT as useful in acute and chronic wounds, including open surgical wounds, infected wounds, ulcers, traumatic wounds and wounds requiring bed preparation before grafting. Similarly, Rehman et al. [11] reported the use of VAC therapy for complex wounds, highlighting its broader role in difficult wound management. In contrast, Ramula and Arivzhagan [12] reported that VAC was useful in the management of chronic non-healing wounds, supporting its role in wound bed preparation and healing. The predominance of post-operative wounds in this study may be due to the surgical inpatient setting, where wound dehiscence, infected surgical wounds, and post-debridement defects are more frequently selected for VAC therapy.

The mean wound duration was 6.40 ± 2.24 weeks, indicating that most wounds had persisted beyond the expected period of normal healing before VAC application. This is consistent with the clinical use of NPWT in delayed or complicated wounds, as Yang et al. [13] applied VAC therapy for complicated post-reconstructive wounds after wound infection, salivary leakage, fistula formation, or partial flap loss, with VAC usually initiated after stabilisation of the reconstructed wound. However, the duration appears longer in our study because our cases included chronic post-operative, post-traumatic, and post-debridement wounds presenting to a general surgical setting, whereas Yang et al. [13] studied a specific head and neck reconstruction population where VAC was used earlier after flap surgery.

Comorbidities were present in 10 patients (66.7%) in the present study, with type 2 diabetes mellitus being the most common comorbidity. This is comparable to Rehman et al. [11], who reported diabetes in 25.0% and obesity in 26.7% of patients with complex wounds, and Zhou et al. [10], who identified diabetes as an important factor associated with delayed healing in hard-to-heal wounds. The predominance of diabetes in our study is clinically relevant, as Gurung et al. [14] described that chronic hyperglycemia impairs angiogenesis, increases oxidative stress, prolongs inflammation, and increases susceptibility to infection, all of which can delay wound closure and increase the need for advanced wound care such as VAC therapy.

Baseline wound culture showed bacterial growth in 10 patients (66.7%), with *Klebsiella pneumoniae* being the most common organism isolated in four patients (26.7%). This finding is supported by Ding et al. [15], who described Gram-negative organisms, including *Pseudomonas aeruginosa*, *Acinetobacter baumannii,* and *Klebsiella pneumoniae*, as important pathogens in acute and chronic wound infections. Similarly, Shariati et al. [16] highlighted the clinical relevance of *Acinetobacter baumannii* and *Klebsiella pneumoniae* in wound infections. The predominance of Gram-negative organisms in our study may be related to the chronicity of wounds, prior surgical intervention, wound contamination, and hospital-based wound care exposure.

Healthy granulation tissue formation was achieved within three to four days, suggesting rapid wound bed improvement following low-cost VAC therapy. This finding is supported by Bhat et al. [17], who used low-cost custom-made VAC in open lower limb fractures and considered adequate granulation tissue with no

drainage as the endpoint before definitive closure. Similarly, De Caridi et al. [18] reported that VAC therapy was continued until sufficient granulation tissue formation and disappearance of local infection in foot wounds. The faster granulation observed in our study may be due to early debridement, controlled negative pressure, regular dressing changes, and the relatively smaller study population. Also, the mean wound size reduction increased from 35.33 ± 6.67% on Day 7 to 72.67 ± 12.08% on Day 14, showing progressive wound contraction within two weeks. Similar findings were reported by Suhagpure et al. [19], where VAC dressing showed significantly better granulation tissue formation compared with conventional dressings. Wu et al. [20] also described that NPWT promotes wound healing by removing exudate, controlling infection and inflammation, improving perfusion, and promoting granulation tissue formation.

Following low-cost VAC therapy, seven patients (46.7%) became suitable for definitive wound closure, including skin grafting in 26.7% and secondary suturing in 20.0%. This is comparable to Chaudhary et al. [21], who reported wound closure using split-thickness skin grafting in 67.8% and secondary suturing in 32.2% of infected orthopaedic wounds treated with low-cost modified NPWT. In the present study, low-cost VAC was well tolerated, with no complications in 13 patients (86.7%).

In the present study, cost reduction was one of the most important findings, as low-cost VAC required approximately ₱50 per dressing and ₱150-200 per patient for three to four VAC dressing changes, compared with ₱2,000-5,000 per dressing and ₱6,000-20,000 per patient for commercial VAC therapy. This finding is supported by Jain et al. [9], who reported that indigenous VAC systems reduced the daily cost of therapy to ₱300-₱500, compared with commercial VAC costs exceeding ₱8,500 per day. Similarly, Madrigal et al. [22] concluded that non-commercial NPWT alternatives were less costly and non-inferior to commercial VAC for outcomes such as granulation tissue formation, wound size reduction, and graft take. These findings support the usefulness of low-cost VAC as an affordable and effective wound care option in public-sector and resource-limited settings.

This study has certain limitations. It was conducted as a small, single-arm prospective interventional case series involving only 15 patients from a single public-sector tertiary care hospital. There was no control group receiving conventional dressing or commercial VAC therapy; therefore, direct comparative effectiveness could not be assessed. Although clinically relevant baseline variables such as age, diabetes mellitus, systemic hypertension with coronary artery disease, obesity, hypothyroidism, anemia, wound duration, baseline wound size, wound site, wound etiology, and baseline bacterial culture status were recorded, adjusted analysis was not performed because of the small sample size and non-comparative study design. The follow-up duration was short, and long-term outcomes such as complete wound healing time, recurrence, graft uptake, functional recovery, patient satisfaction, and delayed complications could not be evaluated. In addition, the cost analysis was limited mainly to dressing material cost and did not include indirect costs such as hospital stay, staff time, antibiotics, investigations, or additional procedures. The estimated low-cost VAC dressing expenditure reflects the government hospital setting, where suction tubing and adhesive drapes were provided without direct charge. Consequently, the reported ₱50 per-dressing expenditure does not represent the full economic cost of all materials and may not be generalisable to institutions where these supplies must be purchased separately.

Conclusions

The present study suggests that low-cost VAC therapy using locally available sterile materials is a feasible, safe, and economical option for supporting wound healing in a public-sector tertiary care setting. This approach may be especially useful in resource-limited hospitals where commercial NPWT systems are not routinely accessible. However, larger controlled studies with longer follow-up are required to confirm its effectiveness, safety, cost-benefit, and long-term wound healing outcomes.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Indhu Mohanarangan, Sabari Girieasen M

Acquisition, analysis, or interpretation of data: Indhu Mohanarangan

Drafting of the manuscript: Indhu Mohanarangan

Critical review of the manuscript for important intellectual content: Sabari Girieasen M

Supervision: Sabari Girieasen M

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Institutional Human Ethics Committee, Madras Medical College issued approval (IRC - MMC/Approval/56072026). **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

References

1. Sharma A, Shankar R, Yadav AK, Pratap A, Ansari MA, Srivastava V: Burden of chronic nonhealing wounds: an overview of the worldwide humanistic and economic burden to the healthcare system. Int J Low Extrem Wounds. 2026, 25:371-8. 10.1177/15347346241246339
2. Sen CK: Human wound and its burden: updated 2020 compendium of estimates . Adv Wound Care (New Rochelle). 2021, 10:281-92. 10.1089/wound.2021.0026
3. Sen CK: Human wound and its burden: updated 2025 compendium of estimates . Adv Wound Care (New Rochelle). 2025, 14:429-38. 10.1177/21621918251359554
4. Sharma A, Srivastava V, Shankar R, Yadav AK, Ansari MA, Gupta SK: Epidemiological profile of chronic wounds in an Indian population: a community-based cross-sectional observational study. Cureus. 2024, 16:e68684. 10.7759/cureus.68684
5. Zaver V, Marietta M, Kankanalu P: Negative Pressure Wound Therapy. StatPearls [Internet], StatPearls Publishing, Treasure Island, FL; 2026.
6. Cozza V, Pepe G, Cintoni M, et al.: Vacuum-assisted closure (VAC®) systems and microbiological isolation of infected wounds. World J Emerg Surg. 2018, 13:53. 10.1186/s13017-018-0216-z
7. Novak A, Khan WS, Palmer J: The evidence-based principles of negative pressure wound therapy in trauma & orthopedics. Open Orthop J. 2014, 8:168-77. 10.2174/1874325001408010168
8. Mattox EA: Reducing risks associated with negative-pressure wound therapy: strategies for clinical practice . Crit Care Nurse. 2017, 37:67-77. 10.4037/ccn2017308
9. Gupta S, Sagar S, Maheshwari G, Kisaka T, Tripathi S: Chronic wounds: magnitude, socioeconomic burden and consequences. Wounds Asia. 2021, 4:8-13.
10. Zhou JQ, Huang LF, Lu YC, et al.: Prevalence and prognosis of hard-to-heal wounds with comorbidities in China. J Wound Care. 2022, 31:S7-S15. 10.12968/jowc.2022.31.Sup10.S7
11. Rehman A, Kausar A, Saleem S, et al.: Outcomes of reconstructive surgery using vacuum-assisted closure in patients with complex wounds. Cureus. 2024, 16:e76300. 10.7759/cureus.76300
12. Ramula M, Arivzhagan N: VAC (vacuum assisted closure) in the management of chronic non-healing wounds: Institutional study. Int J Surg Sci. 2020, 4:82-6. 10.33545/surgery.2020.v4.i4b.543
13. Yang YH, Jeng SF, Hsieh CH, Feng GM, Chen CC: Vacuum-assisted closure for complicated wounds in head and neck region after reconstruction. J Plast Reconstr Aesthet Surg. 2013, 66:e209-16. 10.1016/j.bjps.2013.03.006
14. Gurung A, Gurung S, Adhikari A, Sapkota A, Saikia J: Wound healing mechanism in diabetes. Int J Pharma Sci. 2026, 4:2343-56. 10.5281/zenodo.19142546
15. Ding X, Tang Q, Xu Z, et al.: Challenges and innovations in treating chronic and acute wound infections: from basic science to clinical practice. Burns Trauma. 2022, 10:tkac014. 10.1093/burnst/tkac014
16. Shariati A, Moradabadi A, Ghaznavi-Rad E, Dadmanesh M, Komijani M, Nojoomi F: Investigation into antibacterial and wound healing properties of platelets lysate against Acinetobacter baumannii and Klebsiella pneumoniae burn wound infections. Ann Clin Microbiol Antimicrob. 2021, 20:40. 10.1186/s12941-021-00442-x
17. Bhat TA, Ibrahim R, Bhat TA, Bhat AA: In-hospital low-cost custom made VAC: effective method for reducing infection in late presenting open lower limb fractures in overburdened Indian hospitals. J Clin Orthop Trauma. 2019, 10:195-200. 10.1016/j.jcot.2017.11.010
18. De Caridi G, Massara M, Greco M, et al.: VAC therapy to promote wound healing after surgical revascularisation for critical lower limb ischaemia. Int Wound J. 2016, 13:336-42. 10.1111/iwj.12301
19. Suhagpure A, Rathod Y, Baitule R, Pundkar G, Jaiswal S, Rathod A: Clinical significance of vacuum assisted closure in management of infected wound: an observational, comparative study. J Orthop Case Rep. 2025, 15:264-8. 10.13107/jocr.2025.v15.i06.5732
20. Wu L, Wen B, Xu Z, Lin K: Research progress on negative pressure wound therapy with instillation in the treatment of orthopaedic wounds. Int Wound J. 2022, 19:1449-55. 10.1111/iwj.13741
21. Chaudhary S, Kumar V, Gandhi P, Koichade M, Mandal S: Low cost, modified negative pressure wound therapy in infected orthopaedic wounds: can it be as effective as its costly counterparts?. J Clin Orthop Trauma. 2020, 11:S876-82. 10.1016/j.jcot.2020.07.005
22. Madrigal P, Moshal T, Bernabe R, Yenikomshian H, Gillenwater J: A comparison of negative pressure wound therapy modalities, VAC versus non-commercial NPWT alternatives: a systematic review of RCTs/CCTs. J Tissue Viability. 2022, 31:630-6. 10.1016/j.jtv.2022.10.002