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EFFECT OF EDUCATIONAL INTERVENTIONS ON KNOWLEDGE AND PRACTICE OF NURSES ABOUT VACUUM ASSISTED WOUND CLOSURE THERAPY AT TERTIARY SECTOR HOSPITAL

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Abstract

Background

Vacuum-Assisted Wound Closure (VAC) therapy is a widely used advanced wound management technique that promotes healing through controlled negative pressure. Nurses play a critical role in its application and monitoring; however, gaps in knowledge and practice can limit its effectiveness. Educational interventions can significantly enhance clinical competency and patient care outcomes.

Aim

To evaluate the effectiveness of an educational intervention on nurses' knowledge and practice regarding VAC therapy in surgical and intensive care settings.

Methods

A quasi-experimental pre-test/post-test design was conducted among 84 staff nurses from surgical wards, plastic surgery, and surgical ICU of Sheikh Zayed Hospital, Lahore, Pakistan. A convenience sampling method was applied. Data were collected using a structured knowledge questionnaire and an observational practice checklist before and after a structured educational intervention. Statistical analysis was performed using SPSS version 23.0, and a paired sample t-test determined the significance level at $p \leq 0.05$.

Results

The mean knowledge score improved from 12.55 ± 2.51 in the pre-test to 21.48 ± 1.53 in the post-test (mean difference = 8.93, 95% CI [8.05, 9.81], $p < 0.001$). Good knowledge levels increased from 7.2% to 86.9% post-intervention, while satisfactory practice scores improved from 5.9% to 97.6%. All improvements were statistically significant, indicating a strong impact of the intervention.

Conclusion

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The educational program was highly effective in enhancing nurses' knowledge and practice regarding VAC therapy. Regular training, simulation-based workshops, and standardized protocols are recommended to sustain competency levels.

INTRODUCTION

The Negative Pressure Wound Therapy (NPWT) or Vacuum-Assisted Wound Closure (VAC) therapy is a new wound healing intervention implemented by pressing the wound bed with gentle negative pressure related to a dressing mounted to a vacuum pump (Normandin, 2021; Tian, 2024). It works enhancing the tissue granulation by mechanical micro-deformation at cellular level; removing exudate; and, minimizing edema (Yamashiro, 2023; Fotea, 2023). The important terminology involved in this study is a medical treatment, described as Negative Pressure Wound Therapy, which involves applying negative pressure to a wound to aid in wound healing; Clinical Competence, which can be defined as a combination of knowledge, skills, and judgment in clinical practice; and Educational Intervention, a teaching process focused on helping a professional learn (Astasio-Picado, 2022; McMahon, 2024). These propositions are instrumental in conceptualizing the evaluation of the effects of training programs on the NPWT-related performance of the nurses.

NPWT use in Pakistan is growing consistently with greater adoption in tertiary care hospitals but there is a dearth of national data (Alvina et al., 2023). Based on hospital-level data, NPWT is involved in 18 to 25 percent of the cases of surgery and wound treatment, with diabetic foot ulcers accounting for 40 percent of cases, followed by post-operative infections (30 percent), traumatic woundings (20 percent) and pressure ulcers (10 percent) (Janssen, 2021; Almeida, 2021). In five years, the utilization of NPWT increased by 35-40% in large cities owing to the better supply of devices and better awareness in the clinical community (Tayyib, 2021; Hassan Ibrahim, 2023). This positive trend represents demonstrated efficacy of the therapy in complex wound and also indicates the necessity of trained nursing staff who are able to provide safe and effective NPWT.

The main mechanism that facilitates wound healing due to NPWT is high blood perfusion, bacteria load reduction, and the appearance of granulation tissue (Borzykh, 2022; Moog, 2021). It shortens the interval of healing and virtually eliminates the chances of having issues with an infected wound (Berry, 2021; Tseng, 2022). These effects are provided by the therapy that utilizes mechanical forces leading to cell proliferation and angiogenesis, the latter is essential to regenerate tissue (Chien, 2023; Dornseifer, 2024). Nursing competence plays a pivoting role in determining the outcomes of the patients as the success of NPWT relies on the correct application methods.

Those frontline individuals who administer NPWT and hence give surrogacy to woundhouse will be nurses, who may identify wounds, apply the dressing, make pressure changes, and monitor complications (Bishop, 2021; Tenorio-Pacheco, 2024). They not only perform technical duties but also educate patients, help them manage their emotions and interact with them to induce compliance which has a direct impact on the success of therapy (Hassan Ibrahim, 2023; Astasio-Picado, 2022). Poorly applied or poorly sealed or improper settings of pressure may slow down the process of healing and result in unnecessary complications, which means that specialized NPWT training will be necessary (Borzykh, 2022; McMahon, 2024).

The evidence-based approach to augmenting the NPWT expertise of nurses can be a form of education interventions (Callender, 2021; Lindahl, 2021). Formatted courses that include lectures, model-based practice, and practical exercises were proven to increase the level of knowledge, technical abilities, and confidence in handling of wounds (Jeffries, 2024; Przybek-Mita, 2023). Critical thinking and adherence to clinical protocols should also be encouraged by these interventions as it is also vital in the practice of NPWT safely. Educational interventions are indirectly associated with morbidity and costs of patients due to their ability to increase the skill level of nurses.

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According to the evidence reported in several studies, trained nurses provide better outcomes of NPWT resulting in quicker wound closure, a decrease in infection levels, and shorter hospital stays (MacLean, 2024; ALKHAZALI, 2024). It is especially significant in the tertiary care environment where expert care is needed in treating complex wounds (Kumaar, 2022; Vains, 2022). As there is much at clinical stake, the lack of NPWT instruction in the majority of nursing education is a gap in professional preparation. This gap can be overcome by specific training, which will raise the standards of wound care both on an institutional and national level.

The high burden of chronic and infected wounds in the Pakistani healthcare setting is predetermined by late presentation of wounds, poor initial management, and inappropriate guidelines of wound treatment (Burhan, 2022; Awar, 2023). On the other hand, more intentional treatments requiring advanced care facilities like Sheikh Zayed Hospital and Mayo Hospital usually handle the complex cases that express the use of NPWT but can often mean inconsistent quality of care depending on training of nurses (Morton, 2023; Capitulo, 2022). This scenario dictates the urgency of including the systematic NPWT training into the nursing practice to provide patients with the most appropriate recovery and promote rational use of hospital resources.

Methodology

This paper used the quasi-experimental design that embraced the pre-test, post-test method to assess the impact of an education program on the knowledge and clinical competence of nurses in relation to Vacuum-Assisted Closure (VAC) therapy. The research time was carried on a period of nine months in surgical wards of Sheikh Zayed Hospital, Lahore, Pakistan including the departments of plastic surgery and surgical ICU. The sample of study was registered staff nurses employees in these departments. A sample of 84 nurses was selected with the use of a convenience sampling method based on a calculated sample size using OpenEpi Info software with a 95% level of confidence and a 80 percent power and an extra 10 percent to cater to the non response. Eligibility criteria were male and female nurses aged between 23 years and 45 years and had at least one year of working in the surgical setting and direct patient responsibility of patients undergoing VAC therapy. Admin-related positions, contract or board-Designated jobs, student nurses, and rotation staff as well as other employees who received training in VAC therapy within the past six months, were excluded.

Data Collection Procedure

Three instruments were used to gather data namely, a demographic questionnaire, a knowledge questionnaire based on a prior research, and an observational performance checklist of a VAC therapy. The knowledge tool included 25 items evaluating the knowledge of the VAC therapy principles with poor, average, and good being the scores categories. The checklist included 30 items that assessed VAC application, removal, troubleshooting, education on patients, and documentation steps with the performance being graded as satisfactory or unsatisfactory. The collection of pre-intervention data was based on the administration of knowledge questionnaire and direct observation of the practice of VAC therapy during the various shifts to reduce the problem of observation bias.

Interventional Protocols

The intervention in education was created with the help of needs assessment and literature. Topics included definition, indications, contraindications, VAC system components, dressing change, patient consent, discharge planning, how to apply, etc. The program was implemented in small groups (12 nurses per group) on a weekly basis over the course of three sessions of length between 30 and 45 minutes. Some of these teaching strategies were interactive lectures, group discussions, power points, posters, videos as well as use of hands in the demonstration followed by re-demonstration. Participants received printed booklets and video materials for reference. Practical sessions incorporated real-case scenarios to reinforce skills. The post assessment was done through the same instruments to ascertain improvement in knowledge and practice.

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Data Analysis Procedure

Data were analysed using SPSS version 23.0. The presentation of the qualitative variables was in the form of frequencies and percentages whereas quantitative data were expressed in the form of the means and standard deviations of variables. A paired sample t-test was used to determine the difference between the pre- and post-intervention knowledge and practice scores with a p-value of 0.05 or less being significantly different. Confirmation of reliability was seen in Cronbach alpha coefficients of 0.79 in the knowledge and 0.88 in the practice, which were enough to ascertain the internal consistency of the tools.

Results and Analysis

Demographics Characteristics of Participants:

The study comprised 84 nurses from a tertiary care hospital, with a mean age of 29.8 ± 4.7 years. Most participants were female (78.6%), while 21.4% were male. A majority (58.3%) were married, whereas 41.7% were single. Regarding professional experience, most nurses (61.9%) had 2–5 years of service, whereas 38.1% had more than 5 years of experience. In terms of educational qualifications, 40.5% held a nursing diploma, 33.3% had a Bachelor of Science in Nursing (BSN), 17.9% were Post RN graduates, and 8.3% possessed a Master of Science in Nursing (MSN) degree. [Table 1].

Table 1: Demographic characteristics of participants (n=84)

Variables		Frequency	%Age	Mean±SD
Age		-	-	29.8±4.7
Gender	Male	18	21.4%	-
	Female	66	78.6%	-
Marital Status	Single	35	41.7%	
	Married	49	58.3%	
Working Experience	2-5 years	52	61.9%	-
	>5 years	32	38.1%	-
Education	Diploma	34	40.5%	-
	BSN	28	33.3%	-
	Post RN	19	22.6%	-
	MSN	3	3.6%	-

Comparison of Pre-test and Post-test Knowledge Scores

The comparison shows a marked improvement in nurses' knowledge of VAC therapy after the educational intervention. Correct response rates increased substantially across all 25 items, with pre-test scores ranging from 35.7% to 61.9% and post-test scores ranging from 77.4% to 97.6%. The highest improvement was observed in understanding the role of foam dressing in wound healing, while even the lowest post-test score demonstrated notable gains. These results confirm the intervention's strong

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effectiveness in enhancing theoretical knowledge. [Table 2].

Table 2: Comparison of Pre-test and Post-test Knowledge Scores on Vacuum-Assisted Wound Closure (VAC) Therapy among Study Participants (n = 84)

Sr. No.	Knowledge Item	Pre-Test Incorrect n (%)	Pre-Test Correct n (%)	Post-Test Incorrect n (%)	Post-Test Correct n (%)
1	Primary purpose of VAC therapy	36 (42.9)	48 (57.1)	8 (9.5)	76 (90.5)
2	Primary indication for VAC therapy	40 (47.6)	44 (52.4)	14 (16.7)	70 (83.3)
3	Condition contraindicated for VAC therapy	46 (54.8)	38 (45.2)	12 (14.3)	72 (85.7)
4	Contraindication for using VAC therapy	40 (47.6)	44 (52.4)	16 (19.0)	68 (81.0)
5	Non-component of VAC machine	36 (42.9)	48 (57.1)	17 (20.2)	67 (79.8)
6	Foam for wounds with large exudate	36 (42.9)	48 (57.1)	16 (19.0)	68 (81.0)
7	Frequency of VAC dressing change	40 (47.6)	44 (52.4)	8 (9.5)	76 (90.5)
8	Recommended negative pressure setting	40 (47.6)	44 (52.4)	16 (19.0)	68 (81.0)
9	Key consideration in patient consent	48 (57.1)	36 (42.9)	19 (22.6)	65 (77.4)
10	Foam for fragile wound bed	44 (52.4)	40 (47.6)	14 (16.7)	70 (83.3)
11	Potential complication of VAC therapy	50 (59.5)	34 (40.5)	3 (3.5)	81 (96.5)
12	Part collecting wound exudate	40 (47.6)	44 (52.4)	16 (19.0)	68 (81.0)
13	Condition requiring protocol modification	46 (54.8)	38 (45.2)	10 (11.9)	74 (88.1)

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14	Crucial aspect in discharge plan	44 (52.4)	40 (47.6)	16 (19.0)	68 (81.0)
15	Early VAC dressing change criteria	54 (64.3)	30 (35.7)	12 (14.3)	72 (85.7)
16	Foam dressing role in wound healing	42 (50.0)	42 (50.0)	2 (2.4)	82 (97.6)
17	First step in VAC dressing application	50 (59.5)	34 (40.5)	10 (11.9)	74 (88.1)
18	Material of adhesive drape	34 (40.5)	50 (59.5)	16 (19.0)	68 (81.0)
19	Patient education at discharge	42 (50.0)	42 (50.0)	13 (15.5)	71 (84.5)
20	Importance of airtight dressing	48 (57.1)	36 (42.9)	11 (13.1)	73 (86.9)
21	Proper foam cutting method	44 (52.4)	40 (47.6)	6 (7.1)	78 (92.9)
22	When to discontinue VAC therapy	44 (52.4)	40 (47.6)	5 (5.9)	79 (94.1)
23	Immediate healthcare provider notification	32 (38.1)	52 (61.9)	15 (17.9)	69 (82.1)
24	VAC therapy in diabetic foot ulcers	37 (44.0)	47 (55.9)	11 (13.1)	73 (86.9)
25	Component responsible for negative pressure	38 (45.2)	46 (54.8)	13 (15.5)	71 (84.5)

Knowledge and practice score

The findings indicate a substantial improvement in both knowledge and practice scores regarding VAC therapy following the educational intervention. In the pre-test, most participants demonstrated average knowledge (80.9%) and unsatisfactory practice (94.1%). Post-test results showed a sharp shift, with 86.9% achieving good knowledge and 97.6% demonstrating satisfactory practice. These results highlight the intervention's strong impact on enhancing both theoretical understanding and practical competency. [Table 3].

Table 3: Knowledge and practice score about Vacuum Assisted Wound Closure Therapy among study participants (n=84 each group).

Score		Pre-test	Post-test
Knowledge Score	Poor	10 (11.9%)	0 (0%)

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	(0-8)		
	Average **(9-16)**	68 (80.9%)	11 (13.1%)
	Good **(17-25)**	6 (7.2%)	73 (86.9%)
Practice Score	Satisfactory **(19-30)**	5 (5.9%)	82 (97.6%)
	Un-satisfactory **(<19)**	79 (94.1%)	2 (2.3%)

Paired sample t-test

The paired sample t-test results demonstrate a statistically significant improvement in knowledge scores after the intervention. The mean pre-test knowledge score was 12.55 ± 2.51, which increased to 21.48 ± 1.53 post-intervention. The mean difference of 8.93 (95% CI: 8.05–9.81) with a p-value of <0.001 indicates a highly significant effect of the educational program in enhancing participants' knowledge regarding VAC therapy. [Table 4].

Table 4: Paired sample t-test for knowledge score before and after the intervention (n=84 each group).

Measure	M (SD)	Mean Difference	95% CI for Mean Difference	*p-value*
Pre-Test Knowledge Score	12.55 (2.51)	8.93	[8.05, 9.81]	<0.001
Post-Test Knowledge Score	21.48 (1.53)			

Discussion

The analysis of the study findings demonstrated a marked improvement in the knowledge and practice of nurses regarding Vacuum-Assisted Wound Closure (VAC) therapy following the educational intervention. Statistical evaluation showed that, before the intervention, only 7.2% of nurses possessed good knowledge, while 5.9% demonstrated satisfactory practice. These results indicated a moderate baseline understanding and limited clinical application of VAC therapy among participants. However, post-intervention analysis revealed a significant shift, with 86.9% achieving good knowledge and all participants (100%) reaching satisfactory practice levels. The observed differences were statistically significant, confirming that the educational intervention had a profound and measurable impact on enhancing both theoretical understanding and practical skills of nurses about VAC therapy.

These findings are well supported by several studies carried out in both domestic and foreign environments. A study by Angga Davida et al. (2023) identified that workshop on education about VAC therapy greatly improved nurses' knowledge about negative pressure wound therapy (NPWT) systems and their confidence in clinical practice (Angga Davida, 2023). The increase in post-intervention

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scores witnessed by our study is in line with theirs, indicating that effective, hands-on methods of teaching can directly equate to clinical proficiency.

In a similar vein, a study conducted by Alvina et al. (2023) in Lahore found similar knowledge gaps among nurses' baseline knowledge of VAC therapy, with post-training findings indicating significant improvement (Alvina, 2023). Their results highlighted the necessity for regular, organized continuing nursing education (CNE) programs in Pakistan, particularly regarding advanced wound care modalities. This comes very much in line with our findings and highlights the necessity for institutionalizing professional development modules in tertiary hospitals across the country.

Additional support comes from Ma et al. (2024), who established that simulation-based training and interactive education resulted in notable improvements in nursing practices for the care of complex wounds (Ma, 2024). Their research indicated not only increased practice checklist scores but also improved patient outcomes because of improved wound care. These findings also support the high post-test practice scores obtained in our participants, particularly in activities like setting vacuum pressure, conducting system checks, and assessing pain pre-therapy, all of which were above 95% post-intervention.

On the other hand, there are some studies with opposite findings. Abu Setta et al. (2025) carried out a study in an Egyptian hospital and reported that although theoretical knowledge among the nurses increased after education, practical implementation had very little effect (Abu Setta, 2025). According to the authors, this discrepancy resulted from a lack of resources, poor administrative support, and low availability of VAC devices. This contrasts with our study, where improvements in practice were as significant as those in knowledge, likely due to the availability of proper equipment and administrative encouragement during the educational program.

Additionally, Bankanie et al. (2021) found that while baseline VAC knowledge was already high due to standardized nursing education, significant improvements in practical execution only occurred after the implementation of hands-on simulation workshops (Bankanie, 2021). Our research's integration of real-time demonstrations and supervised practice sessions could account for comparably high post-intervention practice scores. This supports the need to integrate didactic and clinical elements in any effective educational strategy.

Results also proved that some of the specific areas, e.g., assessing pain in the patient, checks of the system, and preservation of airtight seals, evidenced the most satisfactory performance scores upon training and that nurses not only were grasping theoretical content but also interpreting it well within clinical practice. In addition, the average knowledge score increased from 12.55 (SD = 2.51) to 21.48 (SD = 1.53) and practice score from 12.19 (SD = 2.04) to 27.50 (SD = 1.57), both with $p < 0.001$, clearly showing that the educational intervention was statistically significant.

One of the main advantages of this study is the strict evaluation process, encompassing both knowledge-based questionnaires and direct observation of clinical practice through structured checklists. The double assessment provided a truer picture of the nurses' skills and enabled a complete assessment of the effectiveness of the intervention. Additionally, the application of pre-test and post-test design facilitated an unambiguous cause-and-effect relationship between the intervention and evidenced improvements.

Although with very encouraging results, the study has some limitations. It was carried out at a single tertiary care center with a comparatively small sample size of 84 subjects and might therefore restrict generalizability of the results. Further, the study evaluated only immediate outcomes following the intervention without long-term follow-up to ascertain retention of knowledge and persistent practice. Future studies ought to be multi-center and have larger and more diverse samples, and longitudinal designs to measure retention of knowledge and practical sustainability in the long term.

The research proved that properly designed educational interventions are able to notably improve nurses' knowledge and clinical skills in VAC therapy management. The changes in both areas justify the integration of ongoing competency-based training programs into hospital policy, especially for specialized wound care procedures. With the growing sophistication of patient care and the mounting use of VAC therapy for both acute and chronic wound

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treatment, investment in continuing education and clinical training is critical to guarantee patient safety and best outcomes.

Conclusion

The outcomes emphasized that the educational intervention resulted in a major improvement in the knowledge as well as the actual application of VAC Therapy in the participants. The statistically significant results confirmed the efficacy of specialized training in upholding evidence-based wound care strategies.

Future research should consider conducting multi-center studies with larger and more diverse samples to enhance external validity. Incorporating long-term follow-up assessments would help evaluate the retention of knowledge and skills over time. Comparative studies of different training approaches, such as simulation-based education or e-learning modules, could identify the most effective teaching strategies for VAC therapy. Additionally, research should assess the direct impact of improved nursing competencies on patient wound healing outcomes and explore barriers and facilitators to the adoption of VAC therapy across various healthcare settings.

Recommendations

1. Regular in-service training programs should be implemented for nursing staff to maintain and further enhance knowledge and skills regarding Vacuum-Assisted Wound Closure (VAC) therapy.
2. Standardized clinical guidelines and protocols for VAC therapy should be developed and made accessible in all surgical and intensive care units to ensure uniformity of practice.
3. Simulation-based workshops and hands-on demonstrations should be integrated into routine clinical education to improve practical competency and confidence in VAC therapy application.
4. Continuous monitoring and periodic competency assessments should be conducted to identify skill gaps and address them through targeted refresher courses.
5. Nursing curricula in academic institutions should incorporate VAC therapy as a part of advanced wound management training to prepare graduates for modern clinical practices.
6. Hospital administration should ensure the provision of adequate resources, equipment, and maintenance support for VAC devices to facilitate effective therapy delivery.
7. A multidisciplinary approach involving surgeons, wound care specialists, and nurses should be encouraged for optimal patient outcomes in VAC therapy.

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