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Changes in the Knowledge, Practice, and Confidence Levels of Nurses Following a Wound Care Training Program at Three Hospitals in Vietnam

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Abstract:

Introduction: Wound care is a specialized field of nursing that requires specific technical skills and clinical competencies. Inadequate training may lead to suboptimal wound management and compromised patient outcomes. This study aimed to evaluate changes in nurses' knowledge, practice, and confidence following a wound care training program across three hospitals in Northern Vietnam.

Methods: A quasi-experimental one-group pretest–posttest study was conducted from June 1, 2022, to December 31, 2023, at Ha Dong General Hospital, Hanoi Obstetrics and Gynecology Hospital, and Bac Ninh Obstetrics and Pediatrics Hospital. A total of 159 nurses participated. All participants completed pre-training assessments of wound care knowledge, practice, and confidence, attended a continuous wound care training program, and subsequently completed post-training assessments of the same three domains at 12 months after program completion. Data were analyzed using Microsoft Excel 2010 and SPSS version 27.0, with statistical significance set at $p < 0.05$.

Results: The mean post-training knowledge score (108.54 ± 13.18) was significantly higher than the pre-training score (88.10 ± 14.94; $p < 0.001$; Cohen's d = 1.45). Practice scores improved significantly in key domains, including patient assessment, wound assessment, care planning, and documentation ($p < 0.001$). Statistically significant changes were observed in the use of advanced wound dressings, particularly Lipido-Colloid with silver, Polyacrylate, Lipido-Colloid, and alginates (McNemar's test, $p < 0.001$). Nurses' confidence levels showed statistically significant post-training changes in seven of 13 domains, including communication skills, wound assessment, decision-making, clean wound care, pressure injury care, health education, and evaluation (Wilcoxon Signed-Rank test, $p < 0.05$); confidence increased in decision-making and pressure injury care but shifted from "very high" to "high" in the other five domains.

Discussion: The findings suggest that the structured wound care training program was associated with improvements in nurses' knowledge and clinical practice that persisted at 12 months after program completion, whereas self-reported confidence showed a redistribution rather than a uniform increase. The observed changes are consistent with the interpretation that targeted training may facilitate the adoption of advanced wound care practices and strengthen core nursing competencies in clinical settings.

Conclusion: The wound care training program was associated with significant improvements in nurses' knowledge and practice at 12 months post-training, while changes in self-reported confidence were mixed, with increases in some domains and fewer "very high" ratings in others. These results provide preliminary support for the integration of structured wound care training into continuing professional development programs for nurses to enhance the quality of wound management in clinical practice. Further controlled studies are needed to confirm these findings.

Keywords: Nursing education, Wound care, Clinical competence, Training program, Vietnam.

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1. INTRODUCTION

Wound care has remained a global challenge for health professionals, leading to substantial medical costs and resource utilization and potentially reducing patients' quality of life. In developing countries, the burden of wound care accounts for 2% to 4% of the total healthcare cost, with 1% to 1.5% of the population requiring wound care services [1].

In Vietnam, a developing country with more than 100 million people, the burden of health care across sectors is considerable, with wound care costs accounting for a significant share [2, 3]. According to the Vietnamese Ministry of Health's circular regarding regulations on nursing activities at hospitals, nurses play a crucial role in patient care [4]. Nevertheless, clinical practice reveals that gaps persist between theory and practice. Limitations in specialized training programs and the lack of continuous professional development opportunities adversely affect the competency of nursing staff at healthcare facilities [5, 6].

Nurses' wound care competency, including knowledge, practical skills, and self-confidence, is a key determinant of patient outcomes. Prior studies in Vietnam have shown that after competency-based training programs, the proportion of nurses with adequate practical skills increased significantly ($p < 0.001$); the efficacy indices for planning and intervention implementation ranged from 31.9% to 71.3% [7]. However, sustaining self-confidence and retaining related knowledge over time remain concerns; seniority (*i.e.*, years of work experience) and educational level are factors closely associated with nurses' practical competency ($p < 0.05$) [5, 8].

The role of training has been well established; however, few studies have evaluated the effectiveness of a standardized training program on a multicenter scale in Vietnam. Measuring concurrent changes across three domains, knowledge, practice, and confidence, is essential to refine specialized nursing training models. Therefore, this study was conducted to evaluate the changes in knowledge, practice, and confidence levels of nurses at three hospitals in Vietnam following participation in a wound care training program, thereby informing the design of future continuous training programs.

Specifically, this study addressed the following research questions: (1) Does participation in a structured wound care training program improve nurses' knowledge scores? (2) Does the training program lead to changes in wound care practice and the utilization of advanced wound dressings? (3) How do nurses' self-reported confidence levels in wound care competencies change following the training program?

2. METHODS

2.1. Study Design and Setting

The study employed a quasi-experimental one-group pretest–posttest design. It was conducted over a period of 18 months (from June 1, 2022, to December 31, 2023) at three hospitals: Ha Dong General Hospital (n = 76), Hanoi Obstetrics and Gynecology Hospital (n = 50), and Bac Ninh Obstetrics and Pediatrics Hospital (n = 33).

2.2. Participants

A total sampling method was used to recruit 159 nurses and midwives providing wound care at the three hospitals (hereafter collectively referred to as nurses). No a priori sample size or power calculation was performed because all eligible nurses at the participating hospitals were enrolled. All eligible nurses were informed about the study objectives, procedures, and their right to withdraw at any time without consequences. Written informed consent was obtained from each participant prior to data collection. Because the training program was integrated into the hospital's continuing professional development monitoring framework, all 159 enrolled participants completed both the baseline assessments and the 12-month post-training evaluation, resulting in a 100% follow-up rate.

2.3. Training Program

Before participating in a one-month continuous training program on wound care, participants completed baseline assessments of knowledge, practice, and confidence. The training program comprised 24 contact teaching hours, structured as follows: theoretical instruction (8 hours) covering wound physiology, assessment frameworks, infection control principles, and evidence-based dressing selection; and supervised clinical practice (16 hours) conducted at bedside under the guidance of wound care specialists.

The self-study component lasted 17 days (approximately 8 hours per day) and was organized as follows: participants received structured study guides and

training materials one week before the formal training; during the self-study period, they completed daily written assignments submitted *via* logbooks with instructor feedback within 24 hours (graded as Pass/Needs Improvement), engaged in clinical case-based learning and group discussions with presentations of learning outcomes, and maintained individual learning portfolios with self-assessment checklists. Monitoring mechanisms included: weekly supervisor review of learning diaries and written assignments to identify knowledge gaps early; formative assessments using competency evaluation forms at mid-course and end-of-module stages; and weekly group meetings for Q&A sessions and supplementary mentoring for participants who had not yet met competency benchmarks.

A post-training assessment covering all three domains (knowledge, practice, and confidence) was conducted 12 months after completion of the training program, using the same instruments as the pre-training assessment. Knowledge and confidence were assessed *via* self-administered questionnaires, whereas practice was evaluated through direct observation by trained research assistants.

2.4. Instruments

The instruments used in this study were adapted from those originally developed by Phan Thi Dung [9] and previously applied to evaluate a wound care training program at another Vietnamese hospital [10]. The adaptation process involved removing two domains from the original instrument that were not directly relevant to the clinical wound care focus of this study: (1) Knowledge of management and professional development, and (2) Knowledge of pressure injury care, as this content was incorporated into the confidence assessment and practical components instead. The remaining domains were retained without modification to preserve the established psychometric properties. Internal consistency of the adapted instrument was assessed using Cronbach's alpha ($\alpha = 0.791$), indicating acceptable reliability. Content Validity Index (CVI) and inter-rater reliability (ICC/kappa) were not formally assessed for the adapted version; these limitations are acknowledged in the Limitations section.

The battery comprised a self-administered Knowledge Questionnaire, a Direct Observation Checklist for Practice, and a Self-confidence Assessment Questionnaire.

The Knowledge Questionnaire covered eight domains: (1) Communication skills (17 points); (2) General wound knowledge (44 points); (3) Aseptic technique/infection control (10 points); (4) Clean wound care (2 points); (5) Infected wound care (20 points); (6) Wound care with drainage (8 points); (7) Suture removal (14 points); and (8) Health education and counseling (10 points). Each correct response was assigned 1 point and each incorrect response 0 points, yielding a maximum knowledge score of 125 points.

The Direct Observation Checklist for Practice comprised 16 items, each rated on a scale of 1 to 10 points (maximum practice score: 160). Practice was assessed by trained research assistants who conducted direct observations using the standardized checklist.

Nurses' confidence in wound care was evaluated using a 5-point Likert scale Self-confidence Assessment Questionnaire comprising 13 domains: communication skills, patient assessment, wound assessment, identifying wound care problems, planning wound care, making wound care decisions, performing clean wound care, performing infected wound care, performing exuding wound care, performing pressure injury care, changing dressings per procedure, health instructions and patient education, and evaluation.

2.5. Statistical Analysis

Data entry and analysis were performed using Microsoft Excel 2010 and SPSS version 27.0, respectively. Descriptive statistics were used to summarize variables: mean and standard deviation (SD) for continuous variables (*e.g.*, age, knowledge, and practice scores), and frequencies with percentages for categorical variables (*e.g.*, confidence level). The paired-sample t-test was used to compare pre- and post-training continuous scores. The Wilcoxon Signed-Rank test was used to compare pre- and post-training confidence levels, as these data are ordinal in nature. McNemar's exact test was used to compare pre- and post-training use of each wound dressing type, dichotomized as ever used (occasionally or frequently) *versus* never used or unfamiliar; Cohen's g, calculated as $|c/(b + c) - 0.5|$ where b and c are the discordant pairs, was reported as the effect size. Cohen's d was calculated as the mean pre–post difference divided by the pooled standard deviation of the two time points ($\sqrt{[(SD_pre^2 + SD_post^2)/2]}$) for all paired continuous comparisons and interpreted as small (0.2), medium (0.5), or large (0.8). For the Wilcoxon signed-rank test, the effect size was calculated as $r = |Z|/\sqrt{N}$ ($N = 159$ pairs) and interpreted as small (≈ 0.1), medium (≈ 0.3), or large (≈ 0.5). Analyses were conducted at the individual nurse level, as the training content and assessment tools were standardized across participating hospitals. A p-value of < 0.05 was considered statistically significant.

2.6. Ethical Considerations

The study received approval from the management boards of the three hospitals and the Ethics Committee of the Hanoi University of Public Health (Decision No. 248/2020/YTCC-HD3, dated June 19, 2020). Although ethical approval was granted in June 2020, the start of the study was postponed until June 2022 because of the COVID-19 pandemic. Written informed consent was obtained from all participants prior to enrollment. All participant information was coded, anonymized, and kept strictly confidential.

3. RESULTS

3.1. General Characteristics of the Participants

Participants were recruited from three hospital sites: Ha Dong General Hospital (n = 76, 47.8%), Hanoi Obstetrics and Gynecology Hospital (n = 50, 31.4%), and

Bac Ninh Obstetrics and Pediatrics Hospital (n = 33, 20.8%).

As presented in Table 1, female participants constituted 95%, and married participants accounted for 91.2%. The mean age of all participants was 36.93 ± 6.88 years, with the 31–40 age group comprising 57.2%. Regarding educational level, most nurses held a college degree (64.8%), compared to 23.3%, 10.7%, and 1.3% with university, intermediate, and postgraduate qualifications, respectively. More than half (57.2%) of participants had permanent employment, and bedside nurses accounted for 97.5%. The mean years of experience was 7.54 years, with 45.3% having worked for fewer than five years.

3.2. Knowledge Scores

As shown in Table 2, mean scores across all eight knowledge domains increased significantly after training, with the total mean score improving from 88.10 ± 14.94 to 108.54 ± 13.18 ($p < 0.001$; Cohen's d = 1.45, indicating a large effect size).

Table 1. General characteristics of the participants (n = 159).

Characteristics	Category	n	%
Hospital site	Ha Dong General Hospital	76	47.8
Hospital site	Hanoi Obstetrics and Gynecology Hospital	50	31.4
Hospital site	Bac Ninh Obstetrics and Pediatrics Hospital	33	20.8
Gender	Male	8	5.0
Gender	Female	151	95.0
Marital status	Single	11	6.9
Marital status	Married	145	91.2
Marital status	Widowed	2	1.3
Marital status	Divorced/Separated	1	0.6
Education level	Intermediate	17	10.7
Education level	College	103	64.8
Education level	University	37	23.3
Education level	Postgraduate	2	1.3
Employment type	Permanent nurses	91	57.2
Employment type	Contract nurses	68	42.8
Position	Head nurse	0	0
Position	Team leader	4	2.5
Position	Bedside nurse	155	97.5
Age group (years)	22–30	26	16.4
Age group (years)	31–40	91	57.2
Age group (years)	41–50	34	21.4
Age group (years)	≥51	8	5.0
Mean age: 36.93 ± 6.88 years			
Years of experience	<5	72	45.3
Years of experience	5 to <10	36	22.6
Years of experience	10 to <15	22	13.8
Years of experience	15 to <20	20	12.6
Years of experience	20 to <30	4	2.5
Years of experience	≥30	5	3.1
Mean working experience: 7.54 ± 6.8 years			

Table 2. Mean knowledge scores before and after wound care training (n = 159).

Domain	Before Training Mean ± SD	After Training (12 months) Mean ± SD	Difference	95% CI	*p*-value	Cohen's d
Communication skills (17 pts)	12.37 ± 3.56	14.65 ± 3.84	2.27	1.43–3.12	**<0.001**	0.61
General wound knowledge (44 pts)	32.76 ± 5.99	37.44 ± 3.96	4.67	3.42–5.91	**<0.001**	0.92
Aseptic technique (10 pts)	6.93 ± 1.88	8.69 ± 1.46	1.76	1.32–2.19	**<0.001**	1.05
Clean wound care (2 pts)	1.59 ± 0.55	1.98 ± 0.13	0.38	0.29–0.47	**<0.001**	0.95
Infected wound care (20 pts)	14.34 ± 2.94	17.39 ± 3.31	3.05	2.32–3.77	**<0.001**	0.97
Drainage wound care (8 pts)	6.00 ± 1.40	6.98 ± 1.15	0.97	0.71–1.23	**<0.001**	0.76
Suture removal (14 pts)	8.89 ± 3.73	12.30 ± 1.85	3.41	2.95–3.86	**<0.001**	1.16
Health education and counseling (10 pts)	8.06 ± 1.97	9.08 ± 1.44	1.01	0.61–1.42	**<0.001**	0.59
Total (125 pts)	88.10 ± 14.94	108.54 ± 13.18	20.44	16.97–23.90	**<0.001**	1.45

Note: Paired-sample t-test was used.

3.3. Wound Dressing Use

Use was defined as having used the dressing occasionally or frequently. *McNemar's exact test for paired binary comparisons; g = Cohen's g. Post-training data for conventional gauze were available for 158 nurses. Bold *p*-values indicate statistical significance ($p < 0.05$).

As shown in Table 3, the use of Lipido-Colloid with silver, Polyacrylate, Lipido-Colloid, and alginates increased significantly after training (McNemar's test, $p < 0.001$), with effect sizes ranging from g = 0.22 (Polyacrylate) to g = 0.50 (Lipido-Colloid with silver). The use of conventional gauze remained high (99.4% before and 96.2% after training; $p = 0.125$), and changes in the use of foams and hydrogels were not statistically significant.

3.4. Practice Scores

Several domains showed significant post-training improvements, including patient assessment (d = 0.88), wound assessment (d = 0.68), care planning (d = 1.03), patient preparation (d = 0.73), ensuring a safe and private environment (d = 0.49), communication with patients (d = 0.27), procedure timing (d = 0.58), documentation (d = 0.35), and post-care observation (d = 1.13) (Table 4). Effect sizes ranged from −0.09 to 1.13. The largest improvements were observed in post-care observation (d = 1.13, large effect) and care planning (d = 1.03, large effect). Seven domains (items 3, 6, 7, 8, 9, 13, and 14) did not show statistically significant changes (items 3 and 13 were borderline, $p = 0.050$), with three domains showing minimal score decreases (items 6, 7, and 14).

Table 3. Proportion of nurses who had used each wound dressing type before and after training (n = 159).

Dressing Type	Pre-training (%)	Post-training (12 months) (%)	*p*-value*	g
Conventional gauze	99.4	96.2	0.125	0.36
Lipido-Colloid with silver	47.8	99.4	**<0.001**	0.50
Polyacrylate	47.8	75.5	**<0.001**	0.22
Lipido-Colloid	6.3	27.0	**<0.001**	0.34
Alginates	0.6	10.7	**<0.001**	0.44
Foams	4.4	8.8	0.189	0.17
Hydrogels	1.3	2.5	0.688	0.17

Table 4. Mean practice scores for all 16 observational domains before and after wound care training (n = 159).

Domain	Pre-training	Post-training (12 months)	*p*-value	Cohen's d
	Mean ± SD	Mean ± SD		
Assessment				
1. Patient assessment	7.60 ± 1.47	8.72 ± 1.03	**<0.001**	0.88
2. Wound assessment	8.25 ± 0.77	8.84 ± 0.96	**<0.001**	0.68
3. Wound care devices: adequate, ready, and relevant	8.40 ± 1.00	8.62 ± 1.18	0.050	0.20
Wound care planning				
4. Making a relevant wound care plan	7.47 ± 1.32	8.72 ± 1.09	**<0.001**	1.03
5. Making sure patients are ready for wound care	8.09 ± 1.11	8.83 ± 0.91	**<0.001**	0.73
Wound care workflows				
6. Introducing the patient and informing about wound care	8.85 ± 0.54	8.77 ± 1.13	0.451	−0.09
7. Changing the bandage safely	8.53 ± 0.86	8.48 ± 1.22	0.742	−0.05
8. Strictly following disinfection principles	8.65 ± 0.78	8.82 ± 0.93	0.062	0.20
9. Dealing with the right patient and right devices	8.43 ± 0.95	8.55 ± 0.99	0.290	0.12
10. Ensuring a safe and private environment	8.32 ± 0.84	8.79 ± 1.06	**<0.001**	0.49
11. Communicating with the patient during wound care	8.35 ± 0.89	8.65 ± 1.26	**0.008**	0.27
12. Performing wound care within acceptable time	8.24 ± 0.85	8.80 ± 1.08	**<0.001**	0.58
13. Completing procedure and ensuring patient comfort	8.45 ± 0.70	8.70 ± 1.04	0.050	0.28
14. Cleaning medical equipment after wound care	8.43 ± 0.83	8.39 ± 1.05	0.702	−0.04
Documentation and follow-up				
15. Clearly and adequately documenting the medical record	8.33 ± 0.94	8.69 ± 1.09	**<0.001**	0.35
16. Observing the patient after wound care	7.35 ± 1.44	8.79 ± 1.08	**<0.001**	1.13

Note: Paired-sample t-test was used. Bold *p*-values indicate statistical significance ($p < 0.05$).

Table 5. Self-reported confidence levels in wound care domains before and after training (n = 159).

Domain	Before Training, n (%)					After Training (12 months), n (%)					*p*-value*	r
	VL	L	M	H	VH	VL	L	M	H	VH		
1. Communication skills	0	0	6 (3.8)	113 (71.1)	40 (25.2)	0	0	11 (6.9)	131 (82.4)	17 (10.7)	**<0.001**	0.32
2. Assessing patients	0	0	14 (8.8)	133 (83.6)	12 (7.5)	0	0	19 (11.9)	131 (82.4)	9 (5.7)	0.283	0.09
3. Assessing wounds	0	0	25 (15.7)	101 (63.5)	33 (20.8)	0	0	23 (14.5)	129 (81.1)	7 (4.4)	**0.010**	0.20
4. Identifying wound care problems	0	0	50 (31.4)	79 (49.7)	30 (18.9)	0	0	33 (20.8)	121 (76.1)	5 (3.1)	0.419	0.06
5. Planning wound care	0	0	55 (34.6)	80 (50.3)	24 (15.1)	0	0	25 (15.7)	122 (76.7)	12 (7.5)	0.103	0.13
6. Making wound care decisions	0	0	52 (32.7)	100 (62.9)	7 (4.4)	0	0	13 (8.2)	125 (78.6)	21 (13.2)	**<0.001**	0.38
7. Performing clean wound care	0	0	10 (6.3)	119 (74.8)	30 (18.9)	0	0	22 (13.8)	123 (77.4)	14 (8.8)	**0.002**	0.25
8. Performing infected wound care	0	0	29 (18.2)	119 (74.8)	11 (6.9)	0	0	16 (10.1)	132 (83.0)	11 (6.9)	0.112	0.13
9. Performing exudating wound care	0	0	23 (14.5)	114 (71.7)	22 (13.8)	0	0	26 (16.4)	122 (76.7)	11 (6.9)	0.642	0.04
10. Performing pressure injury care	0	0	49 (30.8)	94 (59.1)	16 (10.1)	0	0	12 (7.5)	134 (84.3)	13 (8.2)	**0.002**	0.25
11. Changing dressings per procedure	0	0	23 (14.5)	110 (69.2)	26 (16.4)	0	0	5 (3.1)	145 (91.2)	9 (5.7)	0.850	0.02
12. Health instructions and patient education	0	0	12 (7.5)	122 (76.7)	25 (15.7)	0	0	12 (7.5)	139 (87.4)	8 (5.0)	**0.031**	0.17
13. Evaluation	0	0	10 (6.3)	121 (76.1)	28 (17.6)	0	0	12 (7.5)	139 (87.4)	8 (5.0)	**0.004**	0.23

Note: VL = Very low; L = Low; M = Medium; H = High; VH = Very high. *Wilcoxon Signed-Rank test. Bold *p*-values indicate statistical significance ($p < 0.05$). r = effect size for the Wilcoxon signed-rank test ($|Z|/\sqrt{N}$, N = 159 pairs; 0.1 = small, 0.3 = medium, 0.5 = large).
No participants selected 'Very low' or 'Low' categories across any domain at baseline or follow-up.

3.5. Levels of Confidence in Wound Care

Confidence was measured at both pre- and post-training time points. At 12 months post-training, statistically significant changes were observed in seven of 13 domains (Table **5**): communication skills ($p < 0.001$, r = 0.32), wound assessment ($p = 0.010$, r = 0.20), decision-making ($p < 0.001$, r = 0.38), clean wound care ($p = 0.002$, r = 0.25), pressure injury care ($p = 0.002$, r = 0.25), health education ($p = 0.031$, r = 0.17), and evaluation ($p = 0.004$, r = 0.23). Notably, these changes did not uniformly indicate increased confidence. In several domains, the proportion of nurses selecting “High” confidence increased while the proportion selecting “Very high” confidence decreased. For example, in communication skills, “High” confidence rose from 71.1% to 82.4%, whereas “Very high” decreased from 25.2% to 10.7%. Similar redistribution patterns were observed in wound assessment, clean wound care, health education, and evaluation, whereas in decision-making and pressure injury care the proportion of nurses reporting medium confidence decreased. Thus, of the seven significant changes, two reflected higher confidence (decision-making and pressure injury care), whereas five reflected lower confidence, mainly through fewer “Very high” ratings (communication skills, wound assessment, clean wound care, health education, and evaluation). Possible explanations for this pattern are discussed in Section 4.4.

4. DISCUSSION

Nursing competency in wound care is widely recognized as a core component of nursing education, training, and practice, with a direct impact on the quality of patient care. The annual wound management cost for the United Kingdom National Health Service was £8.3 billion, representing a nearly 50% increase from previous periods, driven by intensive use of human and material resources [1].

4.1. Participant Characteristics and Vietnamese Context

The mean age of the 159 participating nurses was 36.93 ± 6.88 years, and female participants accounted for the majority (95%); both figures are higher than those reported by Phan Thi Dung (31.24 ± 6.65 years; 74.5% female) [7]. Among all participants, 64.8% held a college degree, and 54.7% had at least five years of nursing experience, which was lower than the 68% of participants with >5 years of experience reported by Niyongabo *et al*. [11]. Participants were distributed across three hospital sites with varying profiles: Ha Dong General Hospital contributed the largest proportion (47.8%), followed by Hanoi Obstetrics and Gynecology Hospital (31.4%) and Bac Ninh Obstetrics and Pediatrics Hospital (20.8%).

4.2. Knowledge Gains and Changes in Dressing Use

The overall mean knowledge score increased significantly from 88.10 ± 14.94 to 108.54 ± 13.18 ($p < 0.001$; Cohen’s d = 1.45), suggesting a substantial positive change associated with the training program that was sustained at 12 months post-training. This finding is consistent with results from a systematic review by Kim *et al*., studies by Tegegne *et al*. and Francis and Sharma, all of which reported a positive association between wound care training or educational intervention and nurses' wound care knowledge ($p < 0.05$) [8, 12, 13]. Ibrahim and Khdhir similarly demonstrated significant improvement in wound care knowledge following educational intervention (mean score: 10.84 ± 2.13 to 13.61 ± 2.53; $p < 0.001$) [14]. In addition, a previous study at another Vietnamese hospital reported significant improvements in knowledge and practice 12 months after a wound care training program [10].

After training, nurses more frequently used advanced dressings, including Lipido-Colloid with silver (47.8% to 99.4%), Polyacrylate (47.8% to 75.5%), Lipido-Colloid

(6.3% to 27.0%), and alginates (0.6% to 10.7%). However, overall uptake of alginates (10.7%), foams (8.8%), and hydrogels (2.5%) remained limited, suggesting that factors beyond knowledge, such as cost, clinical indications, and hospital procurement constraints, may restrict uniform adoption of advanced wound care materials [15, 16].

4.3. Practice Performance Before and After Training

Practice scores improved significantly in nine of the 16 observational domains following the program. Pre-training, three domains had mean scores below 8; after training, all domains achieved mean practice scores above 8, with notable gains in patient assessment (d = 0.88), wound assessment (d = 0.68), care planning (d = 1.03), and post-care observation (d = 1.13). These findings suggest that the program may have contributed to strengthening nurses' capacity for evidence-based practice, with the largest effect sizes observed in domains requiring systematic clinical reasoning (care planning, patient assessment) and comprehensive post-procedural follow-up. Consistent with these results, Ibrahim and Khdhir reported a significant improvement in wound care skills (mean score: 42.93 ± 5.26 to 56.95 ± 5.91; $p < 0.001$) [14]. That certain domains (*e.g.*, bandage changing, disinfection, equipment cleaning) showed no significant change may reflect ceiling effects, as pre-training scores in these areas were already above 8.4.

4.4. Confidence in Wound Care Skills

After training, nurses showed statistically significant changes in confidence levels in seven of 13 domains. Importantly, these changes were not uniformly in the direction of higher confidence. In several domains, the proportion of nurses selecting "Very high" confidence decreased while "High" confidence increased, so that the net shift was downward in five domains and upward only in decision-making and pressure injury care. This pattern may reflect more realistic self-appraisal following deeper engagement with wound care complexities, consistent with evidence that individuals with limited competence tend to overestimate their abilities, whereas improved competence enables more accurate self-assessment [17]. However, as the study lacked a control group, it is not possible to attribute these changes solely to the training program; maturation, clinical experience, or other concurrent factors may also have contributed. Osman *et al*. concluded that improved self-efficacy promoted more frequent use of advanced wound care dressings [16]. Gillespie *et al*. showed that with enhanced knowledge and skills gained through training, nurses felt more confident in using advanced wound care methods [18].

5. LIMITATIONS

This study has several limitations. First, the one-group pretest–posttest design, which lacks a concurrent control group, limits the ability to attribute observed changes solely to the training intervention. Improvements may have been influenced by testing effects (familiarity with the instruments), the Hawthorne effect (awareness of being observed), maturation, or other concurrent clinical experiences during the 12-month follow-up period. Second, although the 12-month follow-up interval demonstrates sustained retention, it also introduces the possibility that factors other than the training program, such as accumulated clinical experience, peer learning, or institutional policy changes, contributed to the observed improvements. Third, the variable uptake of advanced dressings across types suggests that institutional factors, including cost and procurement constraints, limit the generalizability of practice change findings. Fourth, although the training program and assessment tools were standardized across sites, the three hospitals may differ in staff mix, wound care resources, baseline practice patterns, and patient populations; between-site comparisons were not performed, and hospital-level heterogeneity should be considered when interpreting the results. Fifth, Content Validity Index (CVI) and inter-rater reliability (ICC/kappa) were not formally assessed for the adapted instruments, which limits the ability to fully evaluate the psychometric properties of the modified assessment tools. Sixth, specific details on the number of practice observers and duration of their standardized training were not systematically documented, which should be addressed in future studies. Seventh, no a priori sample size or power calculation was performed; the sample was determined by total sampling of all eligible nurses, and the study may therefore have been underpowered for some secondary comparisons. Eighth, multiple statistical comparisons were performed across knowledge, practice, and confidence domains without adjustment for multiplicity, which increases the risk of type I error; domain-level findings with *p*-values close to 0.05 should be interpreted with caution.

CONCLUSION

The knowledge and practice of nurses at the three participating hospitals in Vietnam showed significant improvements at 12 months following the wound care training program, whereas self-reported confidence showed a redistribution, increasing in some domains and decreasing in others. These findings provide preliminary evidence that a well-designed curriculum tailored to the specific needs of clinical nurses can help bridge the gap between knowledge and practice in wound care, with effects sustained beyond the immediate training period.

RECOMMENDATIONS

Based on the study results, it is recommended that: (i) the wound care training program could be considered for integration into Continuing Professional Development (CPD) curricula, pending further evaluation in larger, controlled studies across diverse clinical settings; (ii) advanced dressing materials, especially those with limited uptake, should be made consistently available; (iii) clinical mentorship models and periodic refresher courses may be valuable for maintaining long-term self-efficacy and practice standards; and (iv) future longitudinal and controlled studies should be conducted to assess the impact of improved nursing practices on patient healing rates and healthcare costs.

AUTHORS' CONTRIBUTIONS

The authors confirm their contribution to the paper as follows: P.T.D.: Designed the study and completed the paper; D.K.H., N.T.P., D.T.T., T.N.L.: Data collection; V.M.L., P.P.K.: Analysis and interpretation of results. All authors reviewed the results and approved the final version of the manuscript.

LIST OF ABBREVIATIONS

CI	=	confidence interval
CPD	=	continuing professional development
CVI	=	content validity index
ICC	=	intraclass correlation coefficient
IRB	=	Institutional Review Board
SD	=	standard deviation
SPSS	=	Statistical Package for the Social Sciences
TREND	=	Transparent Reporting of Evaluations with Nonrandomized Designs

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Institutional Review Board (IRB)/Ethics Committee of the Hanoi University of Public Health under Decision No. 248/2020/YTCC-HD3, dated June 19, 2020. Although ethical approval was granted in June 2020, the start of the study was postponed until June 2022 because of the COVID-19 pandemic.

HUMAN AND ANIMAL RIGHTS

All procedures involving human participants were conducted in accordance with the ethical standards of the institutional research committee and the 1964 Declaration of Helsinki and its later amendments (revised in 2013).

CONSENT FOR PUBLICATION

Written informed consent was obtained from all participants prior to enrollment.

STANDARDS OF REPORTING

The TREND (Transparent Reporting of Evaluations with Nonrandomized Designs) guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

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None.

CONFLICT OF INTEREST

The author(s) declare no conflict of interest, financial or otherwise.

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