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Knowledge, attitudes, and practices (KAP) of nurses towards wound cleansing: design and evaluation of measurement properties of a questionnaire

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ABSTRACT

Background: Wound cleansing is a fundamental component of chronic wound management; yet, high-quality evidence to guide practice is limited. Understanding nurses' knowledge, attitudes, and practices (KAP) is essential, but no instrument with published evidence of acceptable measurement properties exists.
Objective: To develop a KAP questionnaire on wound cleansing for community nurses and evaluate its measurement properties.
Methods: A multi-phase study was conducted, including literature/consensus item generation; a two-round international Delphi process; pilot cognitive interviews; and field testing in Canada. Knowledge was assessed for item and construct validity; attitude for internal consistency (Cronbach's α); and all KAP items for stability using test-retest reliability.
Results: 26 experts supported content relevance; feedback led to targeted revisions. Field testing involved 130 nurses (83.1 % homecare; >80 % with ≥5 years of wound care experience). Several knowledge items were too easy (≥.90); none negatively discriminated. Exploratory principal components analysis of attitudes yielded three components (63 % of variance); internal consistency ranged from $\alpha = 0.41$ to $\alpha = 0.76$. In the subsample ($n = 30$), knowledge κ values ranged from slight/fair to substantial; some items showed ceiling effects (uniform responses, κ undefined). Attitude and practice item-level intraclass correlation coefficients varied (.07–.95), with several ≥.75 and others <.60. Known-groups comparison supported higher knowledge among formally educated nurses.
Conclusion: Evidence supports content validity and a clarified attitudes structure; internal consistency and stability were acceptable for some elements but below the threshold for others. Future refinement and confirmatory testing are warranted.

1. Introduction

Chronic wounds are a significant health care challenge, contributing to prolonged healing times, increased risk of infection, increased nursing utilization, and substantial costs [1,2]. While most studies focus on direct costs, such as dressings (products), clinician time, and diagnostics, the broader economic burden includes costs associated with secondary infections, medications, reduced productivity, and increased strain on publicly funded programs. In Canada, wound care expenditures rose by an estimated 3 billion CAD between 2019 and 2022, with continued growth reaching over 12 billion CAD in 2023 [3], highlighting the urgent need for more efficient and evidence-based wound management strategies.

Wound cleansing is a fundamental component of chronic wound management, serving to remove bacteria and debris from the wound bed and supporting the body's innate healing mechanisms [4]. Inadequate cleansing fosters bacterial proliferation, increasing the risk of infection and potentially leading to life threatening conditions such as sepsis [2].

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Despite its importance, best practice recommendations are largely consensus-driven rather than evidence-based. Although calls for rigorous studies have persisted for decades, little empirical evidence exists on the effects of different cleansing techniques or outcomes of consensus-driven practice changes [2,4–7]. In the absence of high-level evidence, clinicians must rely on consensus-driven recommendations, training, and personal experience to make cleansing decisions. Understanding what clinicians currently know, believe, and do is essential to identifying gaps, guiding education, and informing future research. Knowledge, attitude, and practice surveys are well established in public health for these purposes [8].

The Knowledge-Attitude-Practice (KAP) framework, while not designed to test causality or predict behavioural change, is based on the assumption that knowledge and attitudes may influence practice. In the context of wound cleansing, multiple choice or true/false items can be used to assess knowledge (factual correctness), Likert scale items to gauge attitudes (beliefs and values), and frequency-based scales to assess practice (self-reported behaviours). This assessment serves several purposes: to establish a baseline understanding of current knowledge, attitudes, and practices; to identify gaps that are incorrect, incomplete, or outdated; to inform tailored educational interventions; and to ensure proposed changes are relevant and feasible for the clinicians' responsible for implementing them [8]. Importantly, such measurement is critical as foundational knowledge is not consistently established as a core competency in undergraduate curricula, such as nursing [9,10], and clinicians' preparation in wound care may vary considerably, ranging from post-graduate competency-based programs to informal, industry-sponsored sessions. These inconsistencies highlight the need for targeted, evidence-based approaches to education and practice that align with the best available scientific evidence.

KAP questionnaires are a widely used method for systematically capturing what clinicians know, believe, and do in practice; however, such instruments should demonstrate acceptable measurement properties (i.e., aspects of validity and reliability) before they are used to inform education or policy [11]. Currently, no instrument specifically designed to assess knowledge, attitudes, and practices related to chronic wound cleansing practices in community health care settings has published evidence of acceptable measurement properties. Developing a KAP survey and evaluating its measurement properties is therefore a necessary first step in assessing clinicians' understanding and application of evidence-based wound cleansing principles in this setting. Although high-level evidence remains limited, available scientific studies and consensus documents (where data are lacking) were used to guide construct development and establish benchmarks against which clinician knowledge can be assessed. These sources provide a defensible foundation for item generation and ensure the instrument reflects both the best available evidence and expert consensus in areas where research remains inconclusive. To address this gap, the present study employed the KAP framework as the conceptual model guiding survey development [12]. The KAP framework is particularly suited to areas where no predefined constructs exist, as it provides a structured approach to capturing essential domains of professional knowledge, attitudes, and practices [8,12]. Unlike behaviour-change theories, which aim to explain or modify behaviours, the KAP framework in this study was applied to develop the instrument and evaluate its measurement properties, enabling identification of knowledge gaps, misconceptions, and practice patterns among nurses to inform future education and evidence-based wound management.

1.1. Aim and objectives

The aim of this study was to develop a questionnaire assessing nurses' knowledge, attitudes, and practices regarding wound cleansing in the management of chronic wounds within community health care settings and evaluate its measurement properties.

2. Methods

2.1. Design

The questionnaire design was based on a comprehensive literature review and consultation with an expert panel and members of the target population (nurses caring for chronic wounds in community health care sectors). A study to evaluate the instrument's measurement properties was conducted, evaluating content validity, face validity, item quality (i.e., item difficulty, discriminating index, and distractor analysis), internal consistency, construct validity, and test-retest reliability.

2.2. Questionnaire development

Questionnaire development and evaluation of measurement properties were guided by the COSMIN methodology for health measurement instruments [13] and conducted in two phases.

Consistent with COSMIN recommendations for content validity, phase one involved construct definition and item generation informed by scientific studies and consensus recommendations (where evidence was lacking), followed by a structured Delphi process with interprofessional expert reviewers. Face validity was subsequently assessed for clarity and comprehension via pilot testing with a small sample ($n = 5$) from the target population.

Phase two addressed additional measurement properties, including structural validity, internal consistency, and reliability. The questionnaire was developed in English, and therefore tested in Canada, where nurses in community health care settings were recruited using snowball sampling method and represent the intended target population.

2.2.1. Phase 1: construct definition and item generation

A literature review was conducted to identify existing sources on wound cleansing, providing the basis for construct definition and item generation to inform questionnaire development. Sources included consensus statements, best practice documents, organizational protocols, and research articles. Online databases (Cumulative Index to Nursing and Allied Health Literature [CINAHL] and PubMed) were searched for peer-reviewed literature, including empirical studies and reviews [5,6,14–18]. To ensure a thorough exploration of the field, a manual search of national and international wound care associations and societies was undertaken to locate consensus statements, best practice documents, and clinical protocols. [7,19-23]. No date restrictions were applied, enabling the inclusion of both historical and current guideline documents to capture changes in recommended practice over time.

The questionnaire consisted of three subscales, knowledge, attitudes, and practices. Using scientific literature, and expert opinion where evidence was lacking (i.e., consensus recommendations), the research team identified and conceptually defined constructs for the three subscales. Each subscale was organized into multiple constructs, with the knowledge subscale comprising 5 constructs (14 items), the attitude subscale comprising 10 constructs (14 items), and the practice subscale comprising 7 constructs (20 items). All items (statements, questions, response options, and distractors) were informed by the most current scientific evidence. In areas where evidence was lacking, consensus recommendations served as the basis for item development. The knowledge subscale included 12 true-or-false statements and two multiple-choice questions. A "do not know' option was included for each knowledge item to reduce guessing and enhance the accuracy of responses. Attitudes were assessed using a five-point Likert scale (strongly agree to strongly disagree), consistent with established survey design guidance where the purpose is to capture participants' perception concerning a single item and where neutrality is an acceptable position [24]. Nineteen practice items were measured using a four-point frequency scale (never, sometimes, most of the time, always), a format commonly applied in nursing and health research to capture the

frequency of self-reported behaviours in a straightforward and reliable way [25], while one item employed multiple-response format.

2.2.1.1. Content validity. All constructs and items were developed in English and underwent rigorous evaluation by an international panel of subject matter experts representing diverse geographical regions and disciplines, including nursing, dermatology, podiatry, infectious disease, internal medicine, endocrinology, and physiatry. The Delphi method, recognized for its structured approach to achieving expert consensus, was employed to guide the review process in a field where empirical data are limited [26]. A two-round Delphi process was conducted using an online platform to establish content validity.

For knowledge-related items, expert reviewers were asked to evaluate each item based on three criteria: relevance to the topic, clarity of wording, and the appropriateness of both the correct answer and alternative response options, where applicable. Relevance was assessed using a 5-point Likert scale (1 = strongly agree to 5 = strongly disagree). Categorical response options (agree/disagree) were used to assess the clarity of item wording, agreement with the designated correct answer, and the suitability of distractors in multiple-choice items. For attitude and practice-related items, relevance and clarity were assessed using the same response options. Comment boxes were provided for each item to allow experts to suggest rephrasing or other modifications. Based on expert feedback, items were revised accordingly in each round.

Content validity was quantified using the Content Validity Index (CVI) as described by Lynn [27]. The item-level CVI (I-CVI) was calculated by dividing the number of experts who rated an item as "agree" or "strongly agree" for relevance by the total number of experts. A minimum I-CVI of $\geq$.78 is considered acceptable for panels of 10 or fewer experts; for panels exceeding 10 experts, a modified threshold was applied. In this study, a level of agreement $\geq$.78 was used for each subscale. Items with an I-CVI between 70 % and 78 % were revised, while items with an I-CVI below 70 % were excluded from the final instrument.

2.2.1.2. Face validity. The questionnaire was subsequently pilot tested with five nurses from the target population to evaluate the readability and clarity of the items and to establish face validity [28]. A purposive sampling strategy was used to recruit nurses working in community settings in Canada who were responsible for cleansing chronic wounds. Participants were invited to complete the questionnaire during cognitive interviews to assess item clarity, interpretation, and overall comprehension. During the cognitive interviews, participants were asked to read each item aloud and explain its meaning in their own words to assess whether their interpretation aligned with the intended construct.

2.2.2. Phase 2: evaluation of measurement properties

Evaluation of measurement properties was completed for each subscale and included testing for item quality (item difficulty, discriminating index, and distractor analysis), construct validity, internal consistency, and test-retest reliability.

2.2.2.1. Sample. Participants were recruited through nonprobability snowball sampling, beginning with invitations distributed via professional associations and social networks. While a respondent-to-item ratio of 10:1 is considered ideal, a minimum ratio of 5:1 is generally accepted for psychometric evaluation [29]. As the largest subscale contained 20 items, a minimum sample size of 100 participants was targeted. Eligible participants who met the following criteria were able to complete the study: 1) working in any Canadian community health setting (e.g., homecare, long-term care, primary care); 2) were responsible for caring for patients with chronic wounds. Nurses working in the hospital or acute care sectors, those practising outside of Canada, and those who did not care for patients with chronic wounds were excluded from the study. Piping logic (a feature of the survey software that routes participants to specific questions based on previous responses) was used to eliminate any nurse not working in a community setting and those not involved in the day-to-day care of chronic wounds.

2.2.2.2. Procedure. The survey was tested for measurement properties in Canada between October 2024 and January 2025. Ethical approval for the study was obtained from the Swedish Ethical Review Authority (Dnr 2023-04397-01). National wound care associations, professional associations, and organizations employing nurses in community sectors across Canada (e.g., homecare agencies, long-term care facilities, family health teams) were contacted by email to request participation and to disseminate the survey to their members and staff. Each email included detailed information about the study and its objectives, a copy of the ethics approval, and all relevant materials for potential participants. This included a description of the study's purpose and procedures, informed consent information, assurances of anonymity and confidentiality, the right to withdraw at any time, and a link to the online survey. Participants were encouraged to share the survey with nursing colleagues and friends. The online survey remained open for a two-week period and included an optional field for participants to provide their email address for re-contact to participate in test-retest reliability assessment by completing the survey a second time two weeks later. No item-level feedback, training, or educational materials were provided between administrations.

2.3. Data analysis

Statistical analyses were performed using SPSS® 30.0 (IBM Corp., Armonk, NY, USA).

2.3.1. Item quality analysis

Statistical methods for assessing item quality followed the guidelines outlined by Haladyna & Rodriquez [30]. Responses in the knowledge subscale were recoded into a dichotomous variable, with "don't know" responses categorized as incorrect. Total knowledge scores were calculated by summing the number of correct responses.

Item difficulty was determined by the percentage of respondents who selected the correct answer for an item. Items with a correct response rate of 90 % or higher were classified as too easy, while those with a correct response rate of 10 % or lower were considered too difficult.

To compute the *discrimination index* for knowledge items, respondents were divided into two groups based on their overall scores: high scoring and low scoring, with 27 % of participants in each group. For each item, the proportion of correct responses in the low scoring group was subtracted from the proportion of correct responses in the high scoring group. A maximum value of 1.0 occurs when all respondents in the high scoring group answer correctly, while all respondents in the low scoring group answer incorrectly. The discrimination index ranges from −1.0 to 1.0, where 1.0 indicates a strong positive correlation between correct responses and high overall performance, whereas −1.0 suggests that respondents who answered incorrectly tended to score higher overall [31]. Recommended values for the discrimination index typically range from .20 to .40 and up [32].

Distractor analysis, which evaluates the effectiveness of incorrect answer options, was conducted by examining the proportion of respondents selecting each alternative response (range: .0–1.0). Alternative responses with a selection proportion of .0 were classified as unattractive, whereas those with a proportion of 1 were considered highly attractive.

2.3.2. Construct validity

Known groups validity was assessed by comparing total knowledge scores between nurses with formal (Group A) and informal (Group B) wound care education and training. Formal education and training included established, competency-based programs with theoretical and

practical components; informal education and training included offerings from specialty associations, conferences, webinars, and industry-led sessions. We tested the a priori hypothesis that Group A would score higher using an independent-samples *t*-test (two-tailed). Homogeneity of variances was assessed with Levene's test; when this assumption held, the equal-variances result was reported. The mean difference with 95 % confidence intervals (CI) and Cohen's d with 95 % CIs as the effect size were reported. Statistical significance was set at $p = < .05$. Significant difference supports construct validity [33].

For the attitude subscale, sampling adequacy was assessed with the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of the sphericity; analyses proceeded when KMO >.5 and Bartlett's test was significant ($P < 0.001$). Exploratory *principal components analysis* with varimax rotation was then conducted to summarize the underlying structure of the subscale and enhance interpretability by maximizing each item's loadings on one component while minimizing cross loadings. Varimax was selected a priori as constructs were presumed to be relatively independent. Components with Eigenvalues >1.0 were retained (with scree inspection), and items were assigned to components based on their loadings.

2.3.3. Internal consistency

Internal consistency was assessed only for attitude components judged unidimensional based on exploratory principal components analysis. For those components, Cronbach's alpha (α) was calculated; values ≥ .70 were considered acceptable and ≥.90 excellent [33].

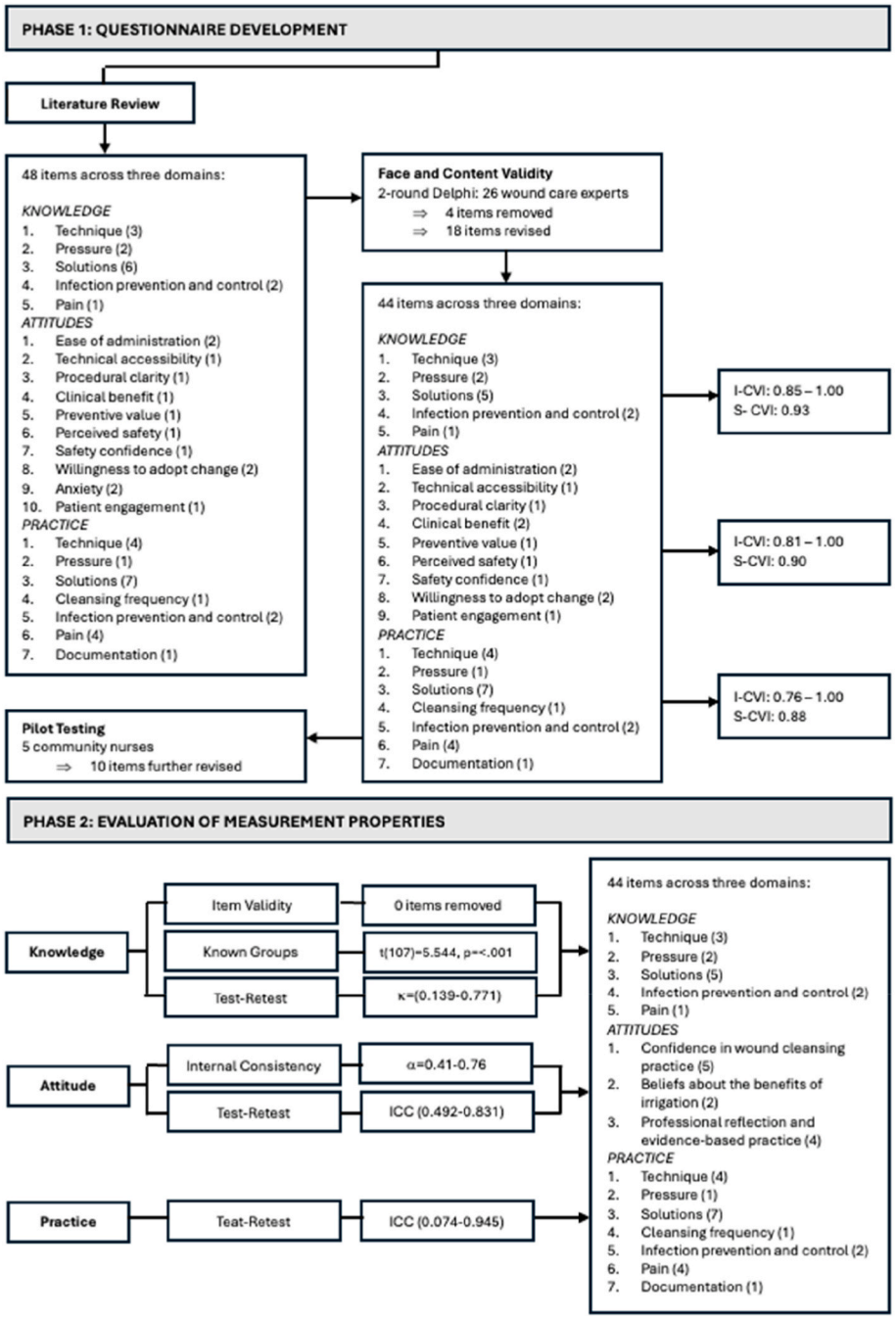

Fig. 1. Questionnaire development.

2.3.4. Test-retest reliability

Participants who consented to re-contact were invited to complete the questionnaire a second time two weeks later; no feedback or training was provided between administrations. Item-level stability was assessed as follows: for knowledge items (dichotomous), Cohen's kappa (95 % CI) was computed, with percentage of observed agreement reported when kappa (κ) could not be estimated due to uniform responses. For attitudes and practice items, test-retest reliability was estimated using a two-way mixed-effects, absolute-agreement intraclass correlation coefficient, average-measure (ICC[3,2]) with 95 % CIs [34]. Interpretation thresholds were κ = .21–.40 fair, .41–.60 moderate, .61–.80 substantial, and ≥.81 almost perfect [35]; ICC ≥.70 was considered satisfactory and ≥.80 considered exceptional [36]. Total subscale scores were not computed or reported as item sets were not yet established as unidimensional scales. In keeping with COSMIN guidance [37], only item-level stability (Choen's κ/ICC) was assessed, as wound cleansing subscales reflect conceptually distinct constructs (e.g., solutions, techniques) and were not treated as unidimensional in this study.

3. Results

3.1. Content validity

A total of 31 experts from 12 countries were invited via email to participate in the Delphi process. The response rate for Round 1 was 83 % (n = 26). Four items with I-CVI scores between 70 and 78 % were substantially revised, 18 items were reworded for improved clarity, and four items were removed. Expert feedback was incorporated into all necessary revisions. The invitation for Round 2 was sent to the 26 experts who completed Round 1. This included the original and revised statements, along with supporting references for items where feedback had indicated the need for additional supporting evidence. The response rate for Round 2 was 81 % (n = 21). All items achieved a level of agreement exceeding 80 %, except for one item that reached 76 %. Given the panel size of more than 10 experts, this item was retained, as it met the adjusted threshold for acceptance. See Fig. 1 for an overview of the questionnaire development process.

3.2. Face validity

Cognitive interviews indicated that participants interpreted items as intended, with minor wording revisions made to ten items to improve clarity. After pilot cognitive interviews, the practice scale was revised from a four-point forced-choice to a five-point frequency format and category labels were refined with brief definitions to reduce forced-choice bias, improve discrimination and clarity, and strengthen response-process validity [33,38].

3.3. Demographic characteristics

A total of 188 nurses participated in the online questionnaire. Twenty nurses were removed because they did not work in a community setting, and an additional 6 were removed because they did not work with chronic wounds. Of the remaining 162 participants, 19 dropped out prior to answering demographic questions, 5 dropped out after completing the knowledge items, and another 8 dropped out after completing the attitude items making the total completion rate 70 % (n = 130). The average time to complete the questionnaire was approximately 9 min and 30 s. Most participants worked in the homecare setting (83.1 %) and over 80 % had 5 or more years of experience managing chronic wounds. Over half of respondents indicated receiving further training in wound management either via a formal post-graduate education program or via informal methods (e.g., attending conference, seminars, and workshops). An overview of demographic characteristics is provided in Table 1.

Table 1
Demographic characteristics of respondents.

	Nurses (n = 130) n (%)
Practice setting	
Nursing home/LTC	22 (16.9)
Primary care/FHT	0 (.0)
Homecare/community clinic	108 (83.1)
Number of patients cared for weekly	
<10	45 (34.6)
10–15	36 (27.7)
16–20	15 (11.5)
>20	34 (26.2)
Years of experience in managing chronic wounds	
<5	23 (17.7)
5–10	44 (33.8)
10–15	20 (15.4)
>15	43 (33.1)
Level of education	
College diploma or certificate in nursing	54 (41.5)
Bachelor's degree in nursing	60 (46.2)
Master's degree in nursing	15 (11.5)
Doctoral degree in nursing, or equivalent	1 (.8)
Wound education and training	
Nursing program	4 (3.1)
Post-grad education program	65 (50.0)
Employer	15 (11.5)
Conferences/webinars/industry led workshops	44 (33.8)
No education and training	2 (1.5)

Note. LTC = long-term care; FHT = family health team.

3.4. Psychometric testing of the questionnaire

3.4.1. Item quality analysis

Item difficulty index ranged from .48 to .98. Three items were shown to be too easy (correct response rate was >.90). No items had a difficulty index of less than .10. Correct response rate is provided in Table 2.

Overall results for *discriminating index* ranged from .06 to .60. None of the items resulted in a negative discriminating index; however, two items had a discriminating index of <.20. Results are outlined in Table 2.

Distractor analysis was conducted for the two items with multiple-choice answer options. Responses marked as "don't know" were excluded from the analysis, and the results were adjusted based on the total number of respondents who engaged with the available answer options. The proportion of respondents selecting alternative responses ranged from .04 to .42. Individual response distributions are presented in Table 2.

3.4.2. Construct validity

Levene's test indicated homogeneity of variances, F (1,107) = 1.10, p = 0.298. An independent samples *t*-test (equal variances assumed) showed that nurses with formal wound care education and training (n = 65, M = 10.32, SD = 1.59) scored higher on the knowledge subscale than nurses with informal education and training (n = 44, M = 8.48, SD = 1.86), t (107) = 5.54, p = < .001. The mean difference was 1.85 (95 % CI [1.19, 2.51]). The effect size was large, Cohen's d = 1.08 (95 % CI [.67, 1.48).

For the attitudes subscale, the Kaiser-Meyer-Olkin (KMO) value was .788, and Bartlett's test of sphericity was significant (<.001). Principal components analysis (varimax rotation) yielded a three-component solution retained on interpretability and Eigenvalues >1.0, explaining 63 % of the total variance. Internal consistency was highest for Component 1 ('confidence in wound cleansing practice'; Cronbach's α = 0.76) and lowest for Component 3 ('professional reflection and evidence-based practice'; Cronbach's α = 0.41). Results are shown in Table 3.

3.4.3. Test-retest reliability

Thirty nurses completed both administrations within 14–28 days.

Table 2
Item quality analysis results (proportions).

Item	Technique			Pressure		Solutions					IPAC		Pain
	1	2	3	1	2	1	2	3	4	5	1	2	1
Option a	.68[a]	.22	.85[a]	.03	.28	.53[a]	.91[a]	.79[a]	.39	.12	.86[a]	.94[a]	.97[a]
Option b	.30	.76[a]	.11	.21	.31[a]	.21	.06	.16	.56[a]	.83[a]	.12	.05	.02
Option c				.45[a]	.06[a]								
Option d				.08									
Don't know[b]	.02	.02	.04	.23	.35	.26	.03	.05	.05	.05	.02	.01	.01
D-value[c]	.54	.49	.40	.57	.40	.40	.26	.31	.49	.29	.31	.11	.06

[a] correct answer.
[b] proportion of respondents who chose "don't know".
[c] discrimination index.

Table 3
Principal components analysis (varimax rotation) results.

Items		Components		
		1	2	3
Component 1: Confidence in Wound Cleansing Practice (Cronbach's α = 0.76)				
1.	I am confident with my technique when cleansing a chronic wound using irrigation.	**.780**	.418	.102
4.	I understand the steps required to perform irrigation correctly.	**.765**	.338	.221
2.	I am confident with my technique when cleansing a chronic wound by swabbing with gauze.	**.754**	−.208	−.040
5.	I am confident with my ability to select the necessary supplies and equipment to achieve optimal irrigation pressure of 12–15 psi when cleansing a chronic wound.	**.745**	.094	.152
9.	I am confident I am using all necessary safety precautions when performing wound irrigation.	**.700**	.160	.245
Component 2: Beliefs About the Benefits of Irrigation (Cronbach's α = 0.51)				
3.	I believe wound irrigation is an important step in promoting the healing of chronic wounds.	.051	**.860**	.184
7.	I believe irrigation reduces the risk of infection in chronic wounds.	.226	**.796**	.218
Component 3: Professional Reflection and Evidence-Based Practice (Cronbach's α = 0.41)				
8.	I believe cleansing chronic wounds using irrigation increases the risk of wound-related complications.	−.071	−.555	**.360**
11.	I believe patients should be involved in the decision about which method of cleansing is to be used.	.008	−.100	**.834**
6.	I improve my knowledge of wound cleansing practice by looking for evidence-based ways to cleanse chronic wounds.	.390	.177	**.662**
10.	I am willing to change my practice as new evidence emerges.	.214	.252	**.515**

For knowledge items (dichotomous), Cohen's κ (95 % CI) and observed agreement are reported in Table 4; where κ could not be computed because of uniform responses (e.g., zero variance), percentage agreement is shown. For attitudes and practice items, ICC (two-way mixed-effects, absolute agreement, average-measure) with 95 % CIs are presented in Table 5. Within the knowledge item set, 4 items demonstrated slight/fair agreement (κ = .139–.365), 3 moderate agreements (κ = .443–.570), and 2 demonstrated substantial agreement (.625–.771). Four items demonstrated high observed agreement (93 %–97 %); however, Cohen's κ could not be calculated due to response uniformity.

The final survey is available in Appendix A.

Table 4
Intra-rater reliability analysis for the knowledge subscale.

Item	Significance		
	κ[a] (95 % CI)	*P*[b]	*(%)*[c]
Knowledge			
1. Chronic wounds should be cleansed starting with the area that is least contaminated moving to the area that is most contaminated.	.139 (.000–.478)	.400	60
2. Chronic wounds with tunnels where the base cannot be felt (unable to meet resistance with a probe) should be cleansed using irrigation.	.570 (.233–.907)	<.001	87
3. Only wounds where the solution can be retrieved or recovered should be irrigated.	.625 (.323–.927)	<.001	90
4. Research suggests the following pressure range is needed to dislodge bacteria in chronic wounds.	.771 (.567–.975)	<.001	87
5. What combination of syringe volume and needle diameter is recommended to generate irrigation pressure for dislodging bacteria.	.443 (.214–.672)	<.001	60
6. Evidence suggests using at least 50 ml of solution per square centimeter of wound surface.	.281 (.018–.544)	.028	60
7. Preservative free solutions must be disposed of within 24 h of opening the bottle.	.000[d]	–	93
8. For chronic wounds showing signs of infection, and where povidone iodine 10 % solution is indicated and clinically appropriate, it must be applied at least daily in the homecare setting.	.365 (.000–.775)	.023	87
9. When using antiseptic solutions, the wound and periwound must first be cleansed with normal saline or water.	.353 (.049–.657)	.030	67
10. After the wound is cleansed with antiseptic solutions, the wound and periwound must be cleansed with normal saline or water.	.508 (.181–.835)	<.001	83
11. A water-resistant gown and mask with eye protection should be worn when irrigating wounds.	.000[d]	–	97
12. When cleansing wounds using swabbing technique, a new piece of gauze should be used for each swab.	.000[d]	–	100
13. A pain assessment should be performed before, during, and after wound cleansing.	.000[d]	–	97

[a] Cohen's κ (*Negative lower confidence limits, which are not meaningful in rater agreement studies, were truncated to 0.000)*.
[b] p value.
[c] percentage of observed agreement.
[d] Cohen's κ could not be interpreted for items with no variability in ratings, as observed agreement is indistinguishable from chance agreement under these conditions. In such cases, κ is undefined despite perfect agreement being present.

4. Discussion

This study reports on the development and evaluation of measurement properties of a questionnaire designed to assess nurses'

Table 5
Intra-rater reliability analysis for Attitudes and Practice Subscales.

Item	Significance	
	ICC (95 % CI)	P^b
Attitudes		
1. I am confident with my technique when cleansing a chronic wound using irrigation.	.827 (.634–.918)	<.001
2. I am confident with my technique when cleansing a chronic wound by swabbing with gauze.	.635 (.253–.824)	.002
3. I believe wound irrigation is an important step in promoting the healing of chronic wounds.	.584 (.112–.804)	.012
4. I understand the steps required to perform irrigation correctly.	.810 (.598–.910)	<.001
5. I am confident with my ability to select the necessary supplies and equipment to achieve optimal irrigation pressure of 12–15 psi when cleansing a chronic wound.	.797 (.578–.903)	<.001
6. I improve my knowledge of wound cleansing practice by looking for evidence-based ways to cleanse chronic wounds.	.743 (.459–.878)	<.001
7. I believe irrigation reduces the risk of infection in chronic wounds.	.492 (.000–.758)	.037
8. I believe cleansing chronic wounds using irrigation increases the risk of wound-related complications.	.831 (.645–.920)	<.001
9. I am confident I am using all necessary safety precautions when performing wound irrigation.	.586 (.140–.802)	.010
10. I am willing to change my practice as new evidence emerges.	.683 (.328–.850)	.002
11. I believe patients should be involved in the decision about which method of cleansing is to be used.	.645 (.267–.830)	.003
Practice		
1. If the supplies required for the most clinically appropriate cleansing method are not available, I request the necessary items.	.843 (.673–.925)	<.001
2. When cleansing chronic wounds via irrigation, I usually use the following supplies.		
3. When cleansing chronic wounds, I include the periwound skin.	.088 (.000–560)	.400
4. When cleansing chronic wounds, I begin at the edges of the wound (periwound) and work my way to the centre.	.773 (.529–.891)	<.001
5. For wounds that do not show signs of infection, I use normal saline or water as the solution for wound cleansing.	.738 (.447–.876)	<.001
6. For wounds that do not show signs of infection, I use low-toxicity solution other than normal saline or water for wound cleansing.	.425 (.000–.725)	.070
7. For wounds that show signs of infection, I use an antiseptic solution for wound cleansing.	.708 (.397–.860)	<.001
8. When irrigating chronic wounds with normal saline or water, I continue using the solution until the runoff from the wound is clear.	.835 (.652–.922)	<.001
9. When irrigating noninfected wounds, I use at least 50 ml of normal saline or water per square centimeter of wound.	.074 (.000–.545)	.413
10. When cleansing wounds with preservative free solution, I dispose of the solution within 24 h.	.929 (.852–.966)	<.001
11. When there is normal saline left-over in the single-use sterile irrigation bottle, I save it for use at the next dressing change.	.945 (.885–.974)	<.001
12. When irrigating wounds, I use the appropriate equipment to deliver a pressure of 12–15 psi in a steady continuous stream of solution.	.708 (.372–.863)	<.001
13. I cleanse chronic wounds at each dressing change.	.768 (.518–.889)	<.001
14. When performing wound irrigation, I wear a fluid resistant gown and mask with eye protection.	.811 (.583–.912)	<.001
15. When cleansing wounds and periwound skin using swabbing technique, I use a new piece of gauze for each swab/wipe.	.395 (.000–.705)	.079
16. When cleansing wounds, I perform a pain assessment on my patients before wound cleansing.	.763 (.499–.888)	<.001
17. When cleansing wounds, I perform a pain assessment on my patients during wound cleansing.	.552 (.101–.782)	.011
18. When cleansing wounds, I perform a pain assessment on my patients after wound cleansing.	.688 (.355–.850)	.001
19. When patients report pain during wound cleansing, I use less force to deliver the solution to the wound bed.	.530 (.014–.776)	.024
20. I always document how the wound was cleansed.	.668 (.313–.841)	.002

Note: Negative lower confidence limits, which are not meaningful in rater agreement studies, were truncated to .000.

knowledge, attitudes, and practices concerning the cleansing of chronic wounds in community health settings. Using literature/consensus-informed construct definition and item generation, an international two-round Delphi, pilot cognitive interviews, and field testing, evidence of content relevance, structural clarity for attitudes, and item-level stability was obtained.

4.1. Content validity (Delphi)

The expert panel supported content relevance and comprehensibility, leading to targeted revisions. Debate centred on optimal irrigation pressure, reflecting persistent guideline variability and the paucity of high-quality evidence in chronic wounds. Current practice has largely shifted toward irrigation using a pressure range from 4 to 15 psi on the basis of expert consensus [7,19,20,22,23], while existing experimental work (mostly acutely wounded animal models) suggests pressure >10 psi may be needed to dislodge bacteria [6,39,40]. This divergence highlights genuine clinical uncertainty, underscores the need for empirical studies in chronic wound populations, and justifies including items benchmarked to available empirical evidence.

4.2. Measurement properties

Item quality analyses indicated an acceptable performance overall. A few knowledge items were very easy or weakly discriminating; however, these items were kept as they assess important aspects of the construct that cannot be fully captured by other items, and therefore, removing them may weaken the instrument's ability to comprehensively measure the topic. Future refinement of these items may be considered to enhance spread and sensitivity.

Construct validity was supported by significantly higher knowledge scores among nurses with formal wound care education compared to those with informal training. This finding suggests that structured, competency-based education, incorporating both theoretical content and preceptorship components, may lead to improved knowledge. It also underscores the importance of reinforcing the translation of evidence-based wound cleansing principles into both training programs and everyday clinical practice.

Exploratory principal components analysis (varimax) of the attitude items yielded three interpretable components (63 % variance explained). Internal consistency ranged from low ($\alpha = 0.41$; 'professional reflection/evidence-based practice') to acceptable ($\alpha = 0.76$; 'confidence in wound cleansing practice'). A low alpha could indicate that respondents interpreted the items differently, possibly due to ambiguity in item wording or varied understanding of the construct itself. In such cases, low internal consistency can reflect either conceptual fragmentation within the item set or inconsistencies in how participants relate to or understand the topic, both of which can compromise the reliability of the scale.

The test-retest analysis of knowledge items showed mixed stability. Several items (2, 3, 4, 10) exhibited high observed agreement (≥83 %) with κ in the substantial-almost perfect range (.508–.771), indicating they reliably capture knowledge over time and are suitable for repeated use. In contrast, items 5 and 6 showed only fair/moderate κ despite moderate observed agreement, suggesting either ambiguity in wording

or variability in how knowledge is retained or recalled across administrations. Notably, item 5 (supplies needed to achieve target irrigation pressure) drew shifts from the keyed correct answer to response options commonly promoted in consensus-based best practice documents (e.g., 35 ml syringe with 19-gauge needle), highlighting the tension between consensus recommendations and the evidence base and implying a need to sharpen the distractors and cite the evidentiary benchmark more explicitly. Four items (7, 11, 12, 13) showed very high observed agreement (93–100 %) but undefined κ due to uniform responses, consistent with ceiling effects for core content; these items may be retained for essential knowledge but contribute little to discrimination. Item 1 (κ = .14; 60 % agreement) demonstrated low stability and likely requires revision for clarity and alignment with the intended construct. Overall, refinements should target ambiguous wording, overly easy items, and any residual misalignment between expert-driven guidance and the empirical reference standard.

Attitude item-level ICCs ranged from .49 to .83, indicating moderate to excellent stability overall. Several items exceeded .75 (items 1, 4, 5, and 8), suggesting strongly held beliefs that were consistently endorsed across administrations. Mid-range items (.63–.74; items 2, 6, 10, and 11) showed good stability, plausibly reflecting variability in reflection, recent learning, or local practice norms. Lower ICCs (.49–.59) likely stem from residual ambiguity, differing interpretations, or social-desirability effects. These items are candidates for tightening stems/anchors and clarifying the intended construct.

Practice item-level ICCs spanned .07 to .95, reflecting greater heterogeneity in self-reported behaviours. Items above .80 (items 1, 8, 10, 11, 14) likely capture embedded, policy-driven routines; moderate values for items on technique, pain assessment, and documentation suggest behaviours that are generally consistent but sensitive to workload, case-mix, or recall. Poor ICCs indicate context dependence (e.g., supply availability), low base rates, or lingering ambiguity in frequency anchors, and warrant review for clarity, applicability to scope of practice, and potentially the addition of a 'not applicable' option or tighter time frame.

Overall, acceptable measurement properties included content validity; known-groups difference for knowledge; internal consistency for one attitude component (α = 0.76); and multiple attitude/practice items with ICC ≥.75. Properties requiring refinement included two attitude components (α = 0.41 and .51); attitude/practice items with ICC <.60; knowledge items showing ceiling effects or only fair κ; and items with very high ease or weak discrimination.

4.3. Limitations

Several limitations should be considered when interpreting the findings of this study. Construct validity was supported through known-groups comparison on knowledge, but other aspects (e.g., convergent or discriminant validity and responsiveness), were not assessed and warrant future study. Within attitudes, one component, ('Professional Reflection and Evidence-Based Practice') exhibited low internal consistency (α = 0.41), which may reflect ambiguity in item wording or multifaceted construct. Targeted item revision may be needed to improve the reliability of this subscale.

Test-retest findings were mixed. Item-level ICCs for attitude and practice varied from poor to excellent, and κ for knowledge ranged from fair to substantial. Variability may reflect the 14-28-day interval (allowing real changes), learning effects (including increased knowledge-seeking behaviour) after the first administration, and ceiling effects (uniform responses yielded undefined κ).

Generalizability is limited by a Canadian, primarily homecare sample, modest retest subsample (n = 30), and voluntary participation, which may introduce self-selection of more motivated or knowledgeable nurses. Self-reported practice is also vulnerable to recall and social desirability bias. Finally, some items, especially those linked to irrigation pressure, are anchored in consensus-based guidance due to limited chronic wounds evidence, so items should be updated as stronger data emerge.

Next steps include clarifying low consistency items, revising easy/low discrimination knowledge items, considering a 'not applicable' option and tighter time frames for practice, adding SEM/SDC and (where relevant) equivalence testing, and conducting CFA in larger, diverse samples across community settings and roles (e.g., physicians, allied health). Ongoing alignment with evolving guidance, particularly around cleansing techniques and pressure parameters, will help maintain the instrument's relevance and measurement fidelity.

5. Conclusion

This study aimed to develop and evaluate a questionnaire to assess nurses' knowledge, attitudes, and practices related to the cleansing of chronic wounds in community settings. Using a COSMIN-aligned approach, literature/consensus-informed item generation, an international two-round Delphi, and pilot cognitive interviews, evidence supported content validity, and the attitude structure was further clarified through PCA. Internal consistency was acceptable for some attitude components and low for others, indicating where conceptual and wording refinements are needed. Item-level test-retest analyses (κ for knowledge; ICC for attitudes and practice) showed variable stability, with several items performing well and others limited by ceiling effects or ambiguity.

The instrument addresses a critical gap in standardized assessment of wound cleansing KAP, particularly in domains where practice has been driven by expert opinion despite sparse chronic wound evidence. Findings highlight specific targets for improvement (e.g., overly easy or weak discriminating knowledge items, low consistency attitude component, lower stability practice items) and support continued revision of stems, anchors, and applicability to scope of practice before finalizing subscale scoring.

Next steps include iterative item refinement, confirmatory evaluation of dimensionality (e.g., CFA) to enable defensible subscale score, incorporation of additional validity evidence (e.g., convergent, discriminant, responsiveness), and testing in larger, more diverse settings and roles. As empirical evidence and guidance on chronic wound cleansing evolve, periodic updating of items will help ensure the tool remains relevant for education, quality improvement, and research.

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Conflict of interest statement

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The authors declare there are no conflicts of interest regarding the development or publication of this paper.

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APPENDIX A

Final version of the survey after validation.

Knowledge Items	
1.	Chronic wounds should be cleansed starting with the area that is least contaminated moving to the area that is most contaminated.
2.	Chronic wounds with tunnels, where the base cannot be felt (unable to meet resistance with a probe), should be cleansed using irrigation.
3.	Only wounds where the cleansing solution can be retrieved or recovered should be irrigated.
4.	Research suggests the following pressure range is needed to dislodge bacteria in chronic wounds.
5.	What combination of syringe volume and needle diameter is recommended to generate sufficient irrigation pressure for dislodging bacteria.
6.	Evidence suggests using at least 50 ml of cleansing solution per square centimeter of wound surface.
7.	Preservative free solutions must be disposed of within 24 h of opening the bottle.
8.	For chronic wounds showing signs of infection, and where povidone iodine 10 % solution is indicated and clinically appropriate, it must be applied at least daily in the homecare setting.
9.	When using antiseptic solutions, the wound and periwound must first be cleansed with normal saline or water.
10.	After the wound is cleansed with antiseptic solution, the wound and periwound must be cleansed with normal saline or water.
11.	A water-resistant gown and mask with eye protection should be worn when irrigating wounds.
12.	When cleansing wounds using swabbing technique, a new piece of gauze should be used for each swab.
13.	A pain assessment should be performed before, during, and after wound cleansing.

Answer options: true, false, don't know (1–3, 6–13); 4–7 psi, 8–11 psi, 12–15 psi, 16–20 psi, don't know (4); 35 ml syringe + 19 g needle, 20 ml syringe + 18 g needle, 12 ml syringe + 22 g needle, 6 ml syringe + 19 g needle, don't know (5).

Attitude Items	
1.	I am confident with my technique when cleansing chronic wounds using irrigation.
2.	I understand the steps required to perform irrigation correctly.
3.	I am confident with my technique when cleansing chronic wounds by swabbing with gauze.
4.	I am confident with my ability to select the necessary supplies and equipment to achieve optimal irrigation pressure of 12–15 psi when cleansing a chronic wound.
5.	I am confident I am using all necessary safety precautions when performing wound irrigation.
6.	I believe wound irrigation is an important step in promoting the healing of chronic wounds.
7.	I believe irrigation reduces the risk of infection in chronic wounds.
8.	I believe cleansing chronic wounds using irrigation increases the risk of wound-related complications.
9.	I believe patients should be a collaborative partner when deciding which method of cleansing is to be used.
10.	I improve my knowledge of wound cleansing practice by looking for evidence-based ways to cleanse chronic wounds.
11.	I am willing to change my practice as new evidence emerges.

Answer options: strongly agree, agree, neither agree nor disagree, disagree, strongly disagree (1–11).

Practice Items	
1.	If the supplies required for the most clinically appropriate cleansing method are not available, I request the necessary supplies.
2.	When cleansing chronic wounds via irrigation, I usually use the following supplies. (Select all that apply).
3.	When cleansing chronic wounds, I begin at the edges of the wound (periwound) and work my way to the centre.
4.	When cleansing chronic wounds, I include the periwound skin.
5.	For wounds that do not show signs of infection, I use normal saline or water as the solution for wound cleansing.
6.	For wounds that do not show signs of infection, I use low-toxicity solution other than normal saline or water for wound cleansing.
7.	For wounds that show signs of infection, I use an antiseptic solution for wound cleansing.
8.	When irrigating wounds with normal saline or water, I continue using the solution until the runoff from the wound is clear.
9.	When irrigating noninfected wounds, I use at least 50 ml of normal saline or water per square centimeter of wound.
10.	When cleansing wounds with preservative-free solution, I dispose of the solution within 24 h.
11.	When there is normal saline left-over in the single-use sterile irrigation bottle, I save it for use at the next dressing change.
12.	When irrigating wounds, I use the appropriate equipment to deliver a pressure of 12–15 psi in a steady continuous stream of solution.
13.	I cleanse chronic wounds at each dressing change.
14.	When performing wound irrigation, I wear a fluid resistant gown and mask with eye protection.
15.	When cleansing wounds and periwound skin using swabbing technique, I use a new piece of gauze for each swab/wipe.
16.	When cleansing wounds, I perform a pain assessment on my patients before wound cleansing.
17.	When cleansing wounds, I perform a pain assessment on my patients during wound cleansing.
18.	When cleansing wounds, I perform a pain assessment on my patients after wound cleansing.
19.	When patients experience pain during wound cleansing, I use less force to deliver to solution to the wound bed.
20.	I document how the wound was cleansed.

Answer options: always (consistently without exception), usually (there may be occasional exceptions), sometimes (on occasion, but not consistently; somewhat sporadic), rarely (infrequently, not common), never (absent in all instances) (1, 3–20); squeeze bottle with pressurized tip, syringe and needle/IV catheter combination, administration set with needle/IV catheter, I use none of these methods, I use all these methods where clinically indicated (2).

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