Development and psychometric testing of a knowledge tool for incontinence-associated dermatitis for clinicians: The Know-IAD

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Abstract

Purpose: The purpose of this study is to describe the development and evaluation of the psychometric properties of a tool used to assess clinician knowledge of incontinence-associated dermatitis.

Design: The instrument was developed in three phases: Phase 1 involved item development; Phase 2 evaluated content validity of the instrument by surveying clinicians and lay stakeholders within a single state of Australia and, Phase 3 used a pilot multisite cross-sectional survey design to determine composite reliability and evaluate scores of the knowledge tool.

Subjects and Setting: In Phase 1, the instrument was developed by five persons with clinical and research subject expertise. In Phase 2, content validity was evaluated by a group of 13 clinicians (nurses, physicians, occupational therapists, dietitians, and physiotherapists) working in acute care across one Australian state, New South Wales, and two consumer representatives. In Phase 3, clinicians, working across five health districts in New South Wales and in hospitals and on wards with patients who were diagnosed with incontinence-associated dermatitis, participated in pilot- testing the instrument.

Methods: During Phase 1, a group of local and international experts developed a preliminary tool based on an international consensus document, our prior research evaluating incontinence-associated dermatitis knowledge, and consensus among expert panel of clinicians and researchers. Phase 2 used a survey design to determine content validity of the knowledge tool. Specifically, we calculated item- and scale-level content validity ratios and content validity indices for all questions within the draft instrument. Phase 3 comprised pilot-testing of the knowledge tool using a cross-sectional survey. Analysis involved confirmatory

factor analysis to confirm the hypothesized model structure of the knowledge tool, as measured by model goodness-of-fit. Composite reliability testing was undertaken to determine the extent of internal consistency between constituent items of each construct.

Results: Phase 1 developed the Barakat-Johnson Incontinence-Associated Dermatitis Knowledge tool (Know-IAD), comprising 19 items and divided into three domains of IAD-related knowledge: 1) Etiology and Risk, 2) Classification and Diagnosis, and 3) Prevention and Management. In Phase 2, 18 of the 19 items demonstrated high scale content validity ratios scores on relevance (0.75) and clarity (0.82); and high scale-content validity indices scores on relevance (0.87) and clarity (0.91). In Phase 3, 204 respondents completed the survey and the Know-IAD tool. The final 18-item Know-IAD tool demonstrated construct validity by model goodness-of-fit, as measured by the root mean square error of approximation (RMSEA), which was excellent for the Etiology and Risk domain (RMSEA=0.02) and Prevention and Management domains (RMSEA=0.02); and good in the Classification and Diagnosis domain (RMSEA=0.04). Composite reliability (CR) was good in the Etiology and Risk domain (CR=0.76) and Prevention and Management domains (CR=0.75) and adequate in the Classification and Diagnosis domain (CR=0.64). Respondents had good understanding of etiology and risk (72.6% correct responses); fairly good understanding of prevention and management of IAD (64.0% correct responses) and moderate understanding of classification and diagnosis (40.2% correct responses).

CONCLUSION: The Know-IAD demonstrated good psychometric properties and provides preliminary evidence that it can be applied to evaluate clinician knowledge of incontinence-associated dermatitis.

KEY WORDS: Incontinence-associated dermatitis, Knowledge, Psychometric testing, Reliability, Tool, Validity, Incontinence, Dermatitis

Introduction

To date, there are no validated instruments to assess healthcare professionals' knowledge of incontinence-associated dermatitis (IAD), a common skin condition caused by fecal and urinary incontinence.[1,2] IAD can reduce health-related quality of life, disrupt sleep and lead to depression.[3,4] The reported prevalence of IAD in acute care hospitals ranges from 5% to 50%, depending on the care setting and length of hospital stay.[5-8] Gray and colleagues recently conducted a large cross-sectional prevalence study of hospitalized patients across the United States which revealed an IAD prevalence of 21.3%.[8] This figure is supported by Kayser and colleagues who reported a 19% (9,699/51,045) prevalence rate of IAD among incontinent patients in acute care settings across the United States and Canada.[9] Other studies show incidence rates of IAD vary between 7.6% in 171 patients over a twelve-week period to 41% in 98 patients over a 52-day period.[5,10,11] However, it is possible that incidence and prevalence rates could be higher, given that IAD is an under-recognized clinical condition and prevalence audits are conducted irregularly, if at all.[12] Based on existing data and wide variations in percentages reported, IAD is an important neglected clinical problem.[6,12,13]

The best available evidence on IAD was recently outlined in a practice principles guideline[14] outlined the best available evidence on IAD and yielded recommendations for the identification, prevention and management of IAD and resulted in the development of the Ghent Global IAD categorization tool (GLOBIAD).[15] Despite this, there are currently deviations from evidence-based practice concerning IAD.[13] Reasons for deviation are multifactorial and include lack of clinician knowledge and awareness of IAD,[5,13,16] misdiagnosis of IAD,[2,3,17,18] lack or misuse of incontinence products,[5,6] inappropriate treatment of incontinence,[5] lack of resources,[5,16] and lack of familiarity with the recently published international best practice principles.[14] These practice gaps have led to

misdiagnosis of IAD often as a pressure injury (PI),[7,17,18] inappropriate management of IAD, and increased organization costs due to increased length of hospital stay.[19]

Despite the publication of international best practice principles and an increasing clinical practice focus on IAD, knowledge of this condition among healthcare professionals is limited.[17,20] Limited evidence suggests that clinicians may not have adequate knowledge to identify patients at risk of developing IAD, provide adequate skin care for patients who suffer incontinence, and prevent or manage the occurrence of IAD. Clinicians require complex knowledge and skills regarding assessment and management of incontinence and IAD in order to avoid poor outcomes, such as the development of a PI.[8] The aim of this study was to develop an instrument to assess clinicians' knowledge on IAD and evaluate its psychometric properties, including content validity, construct validity, and composite reliability.

Methods

We used a three-phase approach to develop the Barakat-Johnson Incontinence-Associated Dermatitis Knowledge tool (Know-IAD) instrument.

Phase 1

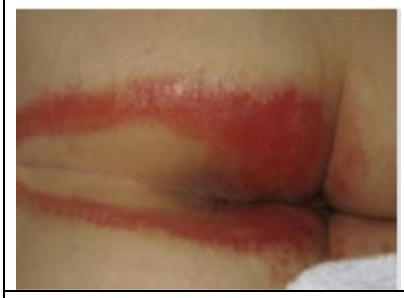
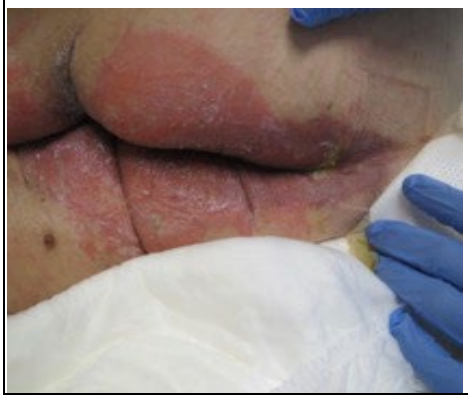
An expert panel, comprising of five persons with clinical skin integrity and research subject expertise from three Australian states and Belgium, was formed to develop the Know-IAD instrument. We used an iterative consensus process for group decision-making where information generated from iteration was disseminated to group members via email; this supported the group members' decision-making through structured video-conferencing discussion.[21]

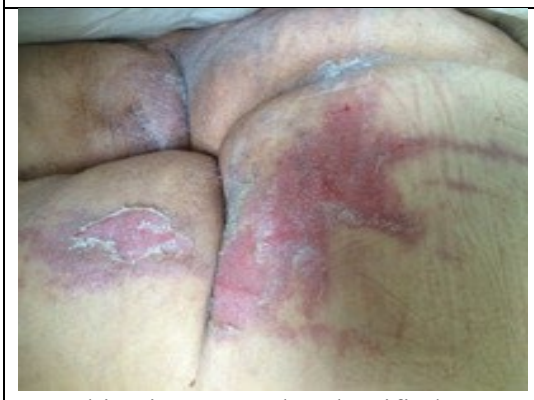
Development of the instrument was based on findings from our previous studies evaluating practice in IAD assessment, prevention, and management.[5,16] Prior to development of the instrument, we searched the literature but did not find instruments designed to evaluate clinicians' knowledge of IAD. We also identified key references to guide us during development of a validated instrument for testing clinician's knowledge of IAD.[22-26]

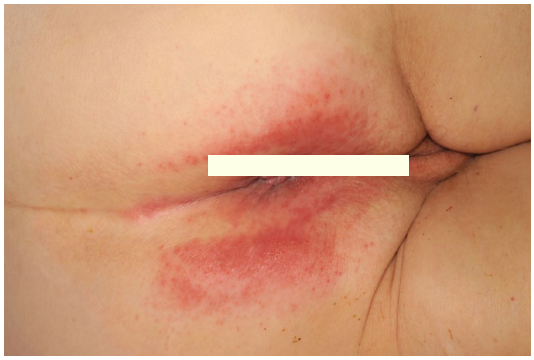
The initial version of the instrument comprised 19 items. The first draft was revised, with one item eliminated as it was determined to be overly rudimentary based on discussion among the expert panel (Supplemental Digital Content). The resulting 18 items were divided into three domains: the Etiology and Risk domain comprised 7 items, the Classification and Diagnosis domain comprised 5 items, and the third domain, Prevention and Management, comprised 6 items (Table 1).

Supplemental Digital Content – Initial 19 Item Knowledge tool before revision

Item	Correct response	Comment
1. Incontinence-Associated Dermatitis (IAD) is skin damage associated with urine or faeces affecting more than just the perineal area.	TRUE	
2. Risk factors for development of IAD are compromised mobility and antibiotic usage.	TRUE	Post content validity, statement revised to: *Risk factors for development of IAD are compromised mobility and inability to perform personal hygiene.*

3. IAD is a risk factor for the development of both superficial and deep pressure injuries.	TRUE	
4. Candidiasis (thrush) is one of the most common secondary infections associated with IAD.	FALSE	
5. Using water and soap to cleanse the skin after episodes of incontinence will reduce the skin pH and will lower the risk for IAD development.	FALSE	
6. IAD cannot be prevented if the patient suffers from sudden severe incontinence.	FALSE	
7. This picture can be classified as IAD category 1B - Persistent redness with clinical signs of infection. 	FALSE	
8. This picture depicts a pressure injury Category/Stage 2. 	FALSE	

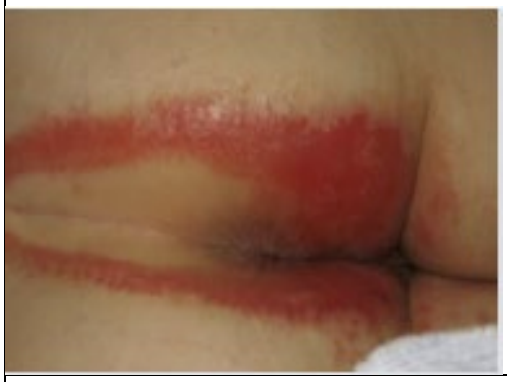
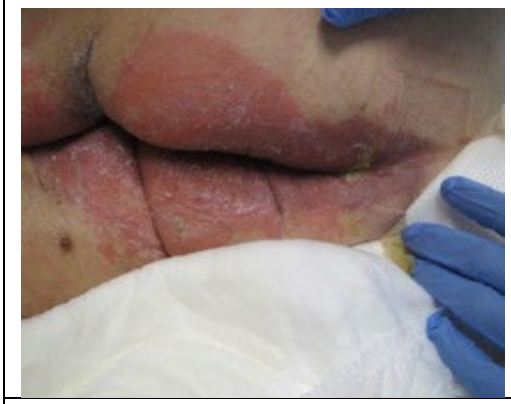
9. Incontinent patients vulnerable to skin injury from moisture are also likely to be vulnerable to skin damage resulting from pressure and shear.	TRUE	Statement eliminated prior to content validity
10. In over 60% of clinical observations, IAD is mistakenly diagnosed as a pressure injury or vice versa.	TRUE	
11. In some cases, IAD and pressure injury differentiation may not be possible until a management protocol has been in place for 3–5 days with response to treatment observed.	TRUE	
 12. This picture can be classified as IAD category 2A -Skin loss without clinical signs of infection.	TRUE	
13. Using soap and water is effective in preventing secondary skin infections such as thrush associated with IAD.	FALSE	Post content validity, statement revised to: '*Using soap and water with a washcloth is effective in preventing skin infections associated with IAD.'*

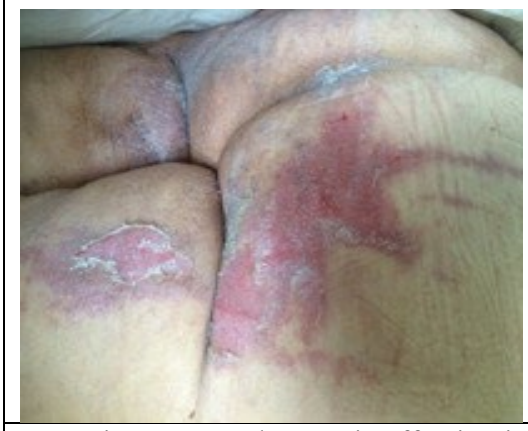
14. Prevention of IAD should only be aimed at patients with frequent liquid stool.	FALSE	
15. Hospitalised patients suffering from incontinence should have a systematic skin inspection performed every 48 hours.	FALSE	Statement retained based on local and international experts
16. The correct incontinence pad size should be part of the overall management of IAD.	FALSE	Post content validity, statement revised to: '*All-in-one large pads (nappy style) should be worn by all incontinent patients as part of IAD prevention even if the incontinence is infrequent.'*
17. Management of IAD in this picture should comprise of: A skin cleanser, protectant and in cases such as candida infection (thrush), a microbiology sample to decide on other appropriate therapy. 	TRUE	Post content validity, statement revised to: 'Management of IAD in this picture should comprise of: *A skin cleanser, moisturiser, protectant/barrier and, in cases such as candida infection (thrush), a microbiology sample to*

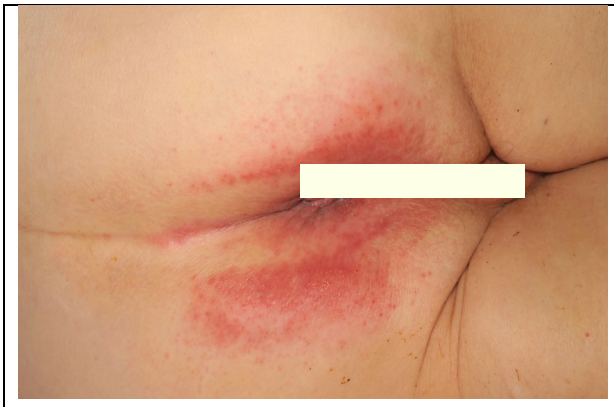
		decide on other appropriate therapy.'
18. A thick application of zinc ointment applied with an absorbent incontinence pad will reduce the risk of IAD for incontinent patients.	FALSE	
19. The incidence of IAD is generally less than 5% in patients in elderly care units.	FALSE	Statement moved to the risk category

Table 1. Phase One of the Barakat-Johnson Incontinence-Associated Dermatitis Knowledge tool (Know-IAD)

Item	Correct response	Scale
1. Incontinence-Associated Dermatitis (IAD) is skin damage associated with urine or faeces affecting more than just the perineal area.	TRUE	ER
2. Risk factors for development of IAD are compromised mobility and antibiotic usage.	TRUE	ER
3. IAD is a risk factor for the development of both superficial and deep pressure injuries.	TRUE	ER
4. Candidiasis (thrush) is one of the most common secondary infections associated with IAD.	FALSE	ER

5. Using water and soap to cleanse the skin after episodes of incontinence will reduce the skin pH and will lower the risk for IAD development.	FALSE	ER
6. The incidence of IAD is generally less than 5% in patients in elderly care units.	FALSE	ER
7. IAD cannot be prevented if the patient suffers from sudden severe incontinence.	FALSE	ER
8. This picture can be classified as IAD category 1B - Persistent redness with clinical signs of infection. 	FALSE	CD
9. This picture depicts a pressure injury Category/Stage 2. 	FALSE	CD
10. In over 60% of clinical observations, IAD is mistakenly diagnosed as a pressure injury or vice versa.	TRUE	CD

11. In some cases, IAD and pressure injury differentiation may not be possible until a management protocol has been in place for 3–5 days with response to treatment observed.	TRUE	CD
12. This picture can be classified as IAD category 2A -Skin loss without clinical signs of infection. 	TRUE	CD
13. Using soap and water is effective in preventing secondary skin infections such as thrush associated with IAD.	FALSE	PM
14. Prevention of IAD should only be aimed at patients with frequent liquid stool.	FALSE	PM
15. Hospitalised patients suffering from incontinence should have a systematic skin inspection performed every 48 hours.	FALSE	PM
16. The correct incontinence pad size should be part of the overall management of IAD.	FALSE	PM
17. Management of IAD in the picture should comprise of: A skin cleanser, protectant and in cases such as candida infection (thrush), a microbiology sample to decide on other appropriate therapy.	TRUE	PM

		
18. A thick application of zinc ointment applied with an absorbent incontinence pad will reduce the risk of IAD for incontinent patients.	FALSE	PM

ER = Etiology and Risk, CD = Classification and Diagnosis, PM = Prevention and Management

Phase 2

The purpose of this phase was to evaluate the content validity of the Know-IAD tool. Content validity is the extent to which a measure represents all facets of a given domain.[27] Based on techniques recommended by Zamanzadeh and collegues.[26] Specifically, we invite a panel of 15 individuals from one state in Australia to rank items for relevancy to IAD knowledge. The panel comprised 13 clinicians from the fields of nursing, medicine, and dietetics, along with 2 consumer representatives. Panelists were recruited using a purposive sampling technique. The criterion used to select clinician panelists was at least 10 years of experience managing patients with skin integrity, tissue viability, and continence, nutrition, or mobility management needs. The expert clinician panel selected was purposely multi-disciplinary, consisting of nurses, physicians, occupational therapists, dieticians, and physiotherapists. The criterion for lay members were a history of personal or caregiver experience related to IAD.

An email was sent to participants inviting them to complete the knowledge tool online through the REDCap system (an electronic system for building and managing online surveys and data) hosted by the Sydney Local Health District, New South Wales, Australia.[28] Panelists were asked to rank Know-IAD items using a 4-point ordinal scale based on relevance where a response of 1 indicated highly relevant, 2 indicated quite relevant, 3 indicated somewhat relevant and 4 indicated not relevant. Panelists also ranked items based on clarity where a response of 1 indicated very clear, 2 indicated clear but needs some minor revision, 3 indicated item needs some revision, and 4 indicated not clear.

Phase 3

This phase used a pilot multisite cross-sectional survey design to determine content and construct validity and composite reliability and evaluate scores of the knowledge tool (Figure 1) and was conducted between September and November 2019. The setting was six hospitals (four tertiary hospitals, one regional and one rural) in five health districts across New South Wales, Australia. Participants were registered nurses, physicians, occupational therapists, dietitians and physiotherapists working on wards with patients diagnosed with urinary or fecal incontinence and at risk for development of IAD.

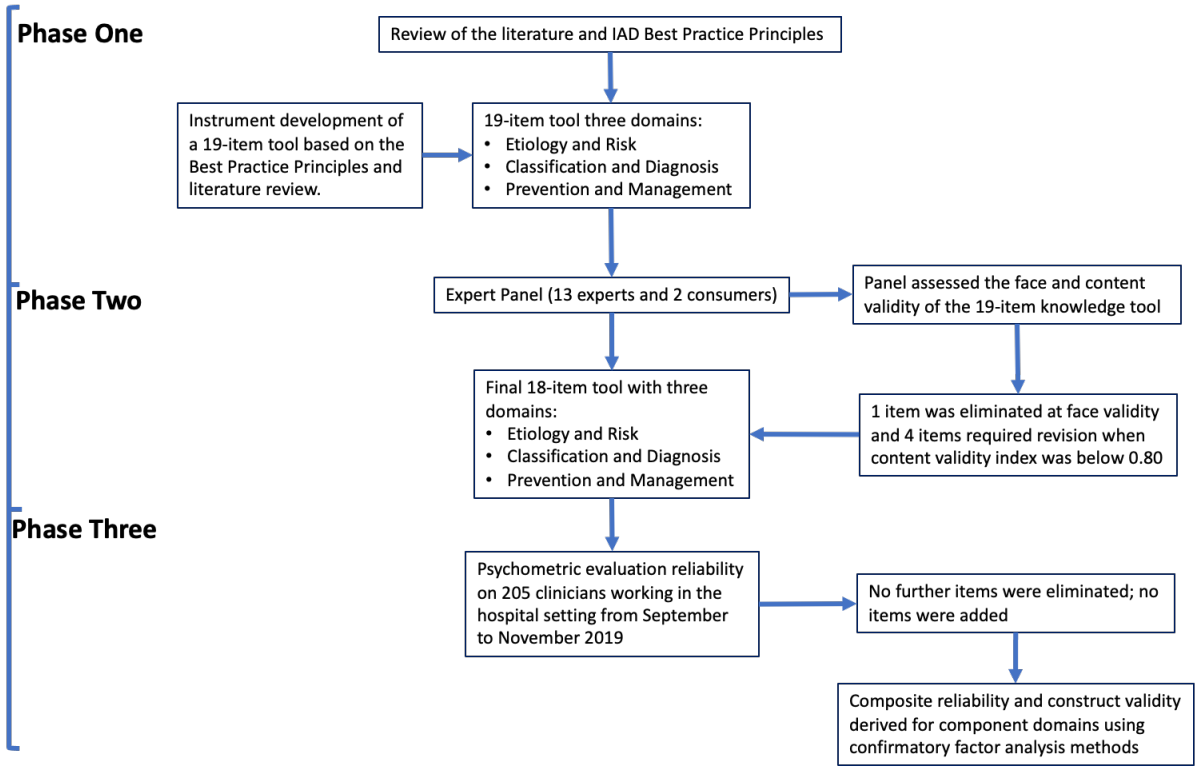


Figure 1. Flow chart of the process to develop the [redacted] Incontinence-Associated Dermatitis Knowledge tool (Know-IAD)

A draft version of the Know-IAD instrument was made available by the Skin Integrity Champions in each facility who informed ward nursing unit managers of the study. The nursing unit manager then approached clinicians to participate. The purpose of the study was explained by the clinical nurse consultant or champion to clinicians who were interested in participating. Completion and return of the knowledge tool implied consent. The tool was administered at the end of team meetings, at clinical handover, or at a time suitable for staff. Completion of the hardcopy tool took 5 to 10 minutes via paper and pen. Participants completed the tool independently and were not permitted to use a smartphone to search for the answers. Once finished, the participant placed the tool in a supplied envelope. A research assistant collated and entered the data from the paper tool into the REDCap software.

Items in the knowledge tool were not organized into the 3 domains identified earlier

to minimize the probability of responses being affected by perceptions of item domains. Participants selected from three forced choice responses: “True”, “False” or “Don’t Know”. A correct response to each item was awarded one point. An incorrect response, selection of “Don’t Know”, or a blank or otherwise invalid response to an item was scored 0 points. All items were weighted equally. Domain scores were constructed as a simple total of scores of individual items within that domain. Two demographic questions relating to role and years of clinical experience were included in the pilot test.

Ethical considerations

Study procedures for phases 2 and 3 were reviewed and approved by the local health district hospital research ethics committee (ref: HERCC/EXCOR\19-05; X19-0121 & 2019/ETH08742). As phase 2 and 3 utilized a survey design, the ethics committee determined that completion and return of the knowledge tool implied consent and no individual consent was required.

Data Analysis

Phase 2

Data were analyzed using IBM SPSS Statistics version 24 (IBM Corp, Armonk, NY) and Stata Version I/C 14 (Stata Corp).[29,30]

Content validity ratios were calculated from the number of panelists who consider that an item is essential to the scale as a transformed proportion of the total number of panelists, using the following formula:

$$CVR = \frac{N_e - N/2}{N/2}$$

where N_e is the number of panelists who ranked an "essential" to the scale; and N is the total number of panelists.

Item- and domain-level content validity ratios values range from -1 to +1; with larger values indicating higher content validity.[25,26] Critical values of content validity ratios have been calculated by Ayre and Scally[31] which give the lowest level of content validity ratio such that the level of agreement exceeds that of chance for a given item, for a given Type I error probability, 0.05 using a one-tailed test. For a panel size of 15, a minimum content validity ratio of 0.50 was required, corresponding to 12 or more raters considering that an item was essential to the scale.

Item-level content validity indices were determined by calculating the number of expert responses of 'essential' or 'very essential' received, as a proportion of the number of experts ranking the item with item-level content validity indices accepted indices of > 0.79 indicating the item was relevant; between 0.70 and 0.79, the item needed revision and below 0.70 the item should be eliminated.[26]

Average-agreement scale content validity index was evaluated as the sum of item-level content validity indices scores as a proportion of the total number of items. Domains with average-agreement scale content validity index values reaching 0.90 or above are considered to have excellent content validity.[25]

Phase 3

Data collected were crosschecked for accuracy and incomplete data were coded as missing. Summary statistics were calculated for demographic variables and knowledge item responses in each scale. Items with a correct response were assigned a score of 1; incorrect, *Don't know*, or missing answers were assigned a score of 0.

Confirmatory factor analysis (CFA) was used to analyze findings. CFA is a technique used to test a hypothesis that a given construct can be measured by several measured variables; and is commonly used in the piloting process, such as in this case where domains such as Etiology and Risk, Classification and Diagnosis, and Prevention and Management are postulated to be modelled by individual item scores.

The CFA approach was used to determine construct validity of the Know-IAD. Construct validity is the degree to which a test measures what it claims to be measuring. We measured the construct validity of the 3 domains of the Know-IAD (Etiology and Risk, Classification and Diagnosis, Prevention and Management) using goodness-of-fit statistics; assessed using the root mean squared error of approximation. A well-fitting model is indicated by low root mean squared error of approximation; a value of 0.01 demonstrates excellent fit, 0.05 indicates good fit, 0.08 indicates moderate fit.[32] We used the cut point of 0.10 as a threshold for adequacy of fit based on recommendations from Maccallum and collegues.[32]

CFA was also used to evaluate the adequacy of sample size (in terms of the numbers of survey respondents used to validate the hypotheses) based on the number of parameters in the model; with three parameters per variable (path coefficient, variance, and disturbance term. The sample size of the current study should be adequate to ensure accuracy of estimates and model fit statistics according to established rules reported by multiple statisticians and researchers.[34,33]

CFA also provided a measure of composite reliability (a measure of internal reliability), defined as the total amount of true score variance relative to the total scale score variance. [22-25,32-34] We chose this method over standard methods, such as evaluation of

Cronbach's alpha or its specific case of the Kuder-Richardson coefficient, because they are sub-optimal methods to assess internal consistency of measures of knowledge.[24,35]

Netemeyer and colleageus[24] suggest that it is "reasonable" for a narrowly defined domain with 5-8 items to meet a minimum threshold of 0.80. However, in other contexts, a threshold as low as 0.60 may be acceptable: an appropriate threshold depends on the number of items in the scale (smaller numbers of items tend to result in lower reliability levels, while larger numbers of scale items tend to have higher levels).

Descriptive analysis was conducted on the hypothesized constructs to evaluate the mean scores in each domain, including measures of dispersion. Correlation coefficients between scores obtained on each domain were also calculated to assess the extent of the relationship between the scales, to assess the extent to which specific domains could be considered to represent distinct aspects of clinician knowledge.

Results

Phase 2

All 15 panelists completed assessments of item relevance and 12 completed the assessments of item clarity. Item-and scale-level content validity ratio and content validity index scores are summarized in Table 2. Good content validity was demonstrated with index values in excess of the threshold of 0.70 for item elimination.[26] Scale content validity ratio (S-CVR) values were good with respect to both relevance (S-CVR=0.75) and clarity (S-CVR=0.82). Items 2, 13 and 16 (based on assessment for relevance) and items 2 and 15 (based on assessment for clarity) fell in a range indicating need for revision. Each of these items was revised, except for item 15. Suggestions from two expert panel members were to give the correct answer for item 15 which would be an obvious true/current answer. Following discussion with the expert panel, and senior clinicians, we elected to retain the

item as originally written. Item 2 was revised to have similar risk causes of IAD "compromised mobility and inability to perform personal hygiene." Item 13 was amended by removing the word 'thrush' and 'secondary' and making it broader to the known fallacy that soap and water remove skin infections. Item 16, "*The correct incontinence pad size should be part of the overall management of IAD"* was amended to *"All-in-one large pads (nappy style) should be worn by all incontinent patients as part of IAD prevention even if the incontinence is infrequent.*" Additional minor changes were made for clarity and the revised instrument was distributed for reliability analysis. Table 3 presents items from the revised instrument.

Table 2. Content Validity Ratios and Content Validity Indices scores

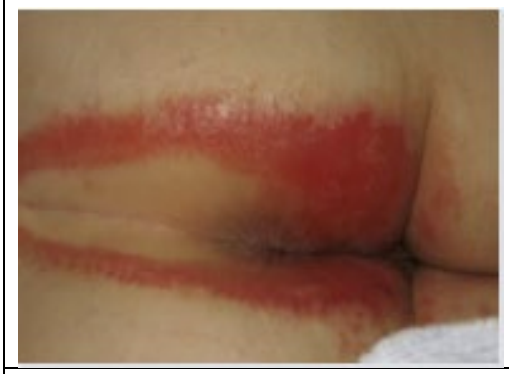
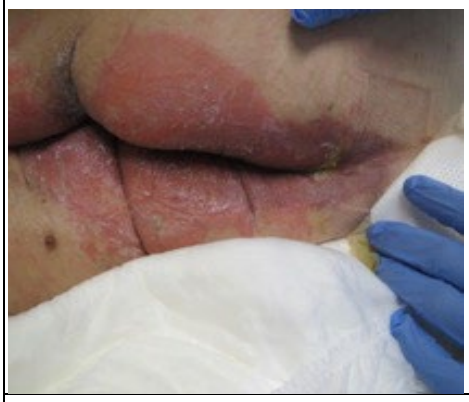
Item number	Scale	CVR		CVI	
		Relevance	Clarity	Relevance	Clarity
1	ER	1.000	0.833	1.000	0.917
2	ER	0.467	0.333	0.733	0.667
3	ER	0.867	1.000	0.933	1.000
4	ER	0.600	0.667	0.800	0.833
5	ER	1.000	1.000	1.000	1.000
6	ER	0.867	1.000	0.933	1.000
7	ER	0.733	0.667	0.867	0.833
8	CD	0.733	0.833	0.867	0.917
9	CD	0.867	1.000	0.933	1.000
10	CD	0.867	1.000	0.933	1.000
11	CD	0.733	0.833	0.867	0.917
12	CD	0.733	1.000	0.867	1.000

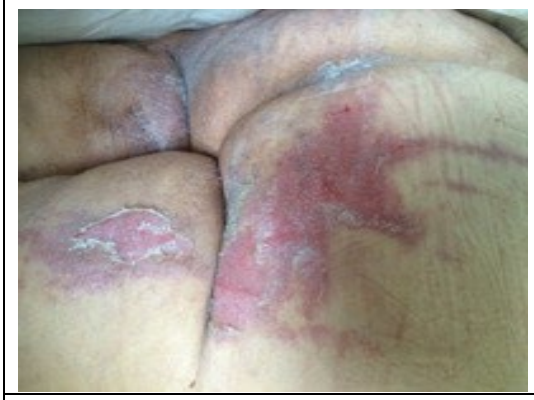
13	PM	0.467	0.667	0.733	0.833
14	PM	0.867	0.833	0.933	0.917
15	PM	0.600	0.500	0.800	0.750
16	PM	0.467	0.667	0.733	0.833
17	PM	1.000	1.000	1.000	1.000
18	PM	0.600	0.833	0.800	0.917
All items (Scale-level measures)	**-**	**0.748**	**0.815**	**0.874**	**0.907**

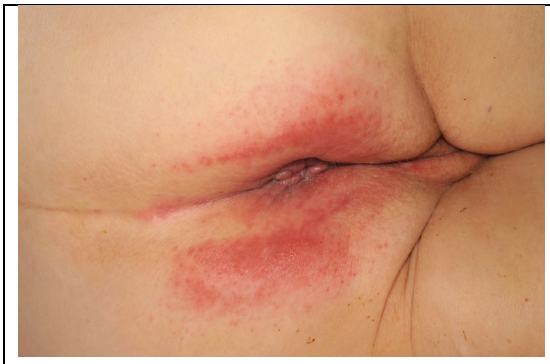
ER = Etiology and Risk, CD = Classification and Diagnosis, PM = Prevention and Management

Table 3. Barakat-Johnson Incontinence-Associated Dermatitis Knowledge tool (Know-IAD)

1. Incontinence-Associated Dermatitis (IAD) is skin damage associated with urine or faeces affecting more than just the perineal area.	TRUE	ER
2. Risk factors for development of IAD are compromised mobility and inability to perform personal hygiene.	TRUE	ER
3. IAD is a risk factor for the development of both superficial and deep pressure injuries.	TRUE	ER
4. Candidiasis (thrush) is one of the most common secondary infections associated with IAD.	FALSE	ER
5. Using water and soap to cleanse the skin after episodes of incontinence will reduce the skin pH and will lower the risk for IAD development.	FALSE	ER
6. The incidence of IAD is generally less than 5% in patients in elderly care units.	FALSE	ER

7. IAD cannot be prevented if the patient suffers from sudden severe incontinence.	FALSE	ER
8. This picture can be classified as IAD category 1B - Persistent redness with clinical signs of infection. 	FALSE	CD
9. This picture depicts a pressure injury Category/Stage 2. 	FALSE	CD
10. In over 60% of clinical observations, IAD is mistakenly diagnosed as a pressure injury or vice versa.	TRUE	CD
11. In some cases, IAD and pressure injury differentiation may not be possible until a management protocol has been in place for 3–5 days with response to treatment observed.	TRUE	CD

12. This picture can be classified as IAD category 2A -Skin loss without clinical signs of infection. 	TRUE	CD
13. Using soap and water with a washcloth is effective in preventing skin infections associated with IAD.	FALSE	PM
14. Prevention of IAD should only be aimed at patients with frequent liquid stool.	FALSE	PM
15. Hospitalised patients suffering from incontinence should have a systematic skin inspection performed every 48 hours.	FALSE	PM
16. All-in-one large pads (nappy style) should be worn by all incontinent patients as part of IAD prevention even if the incontinence is infrequent.	FALSE	PM
17. Management of IAD in this picture should comprise of: A skin cleanser, moisturiser, protectant/barrier and, in cases such as candida infection (thrush), a microbiology sample to decide on other appropriate therapy.	FALSE	PM

		
18. A thick application of zinc ointment applied with an absorbent incontinence pad will reduce the risk of IAD for incontinent patients.	FALSE	PM

ER = Etiology and Risk, CD = Classification and Diagnosis, PM = Prevention and Management

Phase 3

Responses were received from 204 respondents. Years of experience was recorded by 189 respondents and ranged from 0 to 39 years, with a mean of 7.4 years (SD 8.1 years). Role was recorded by 204 respondents, with just over half of respondents registered nurses within the clinician cohort (Table 4).

Table 4: Summary of respondent roles (N=204)

Role	Frequency (valid %)
Registered Nurse	119 (58.3%)
Enrolled Nurse	27 (13.2%)
Clinical Nurse Consultant	9 (4.4%)
Clinical Nurse Specialist	8 (3.9%)

Junior Medical Officer	8 (3.9%)
Nursing Unit Manager	6 (2.9%)
Resident Medical Officer	5 (2.5%)
Senior Medical Officer	2 (1.0%)
Other*	20 (9.8%)

*Occupational Therapist; Dietitian; Physiotherapist.

Clinical Nurse Specialist: A senior nurse specialist with a high level of skill in a specialist area

Junior Medical officer: A doctor in their first post graduate year of training

Resident Medical officer: A doctor in their second or subsequent years of post-graduate training

Model convergence in the confirmatory factor analysis process was achieved for the Etiology and Risk, and Prevention and Management domains. The root mean squared error of approximation (RMSEA) values for the Etiology and Risk, and Prevention and Management domains was 0.02. The RMSEA value for the Classification and Diagnosis domain was 0.04. These findings indicate that items within the Etiology and Risk and Prevention and Management domains achieved excellent construct validity; and that items within the Classification and Diagnosis domain achieved good construct validity.[32] The hypotheses tested in the CFA procedure are thus validated in all domains.

Composite reliability values were calculated to be 0.76 for the Etiology and Risk scale, 0.64 for the Classification and Diagnosis Scale and 0.75 for the Prevention and Management scale using the method reported by Netemeyer and colleagues.[24] Hence

according to the criteria of Netemeyer,[24] the instrument has achieved good composite reliability on all of the hypothesized domains.

The Know-IAD tool scoring ranges, based on the 3 domains of the instrument, were 0-7 for the Etiology and Risk domain, 0-5 in for the Classification and Diagnosis domain and 0-6 in for the Prevention and Management domain. Domain scores are generated as the sum total of individual item scores within each domain, with higher scores indicate greater knowledge in each of these domains. Results indicated highest knowledge (expressed as a proportion of the maximum possible score) in the Etiology and Risk domain (mean 5.08; SD 1.23), followed by the Prevention and Management domain (mean 3.84; SD 1.29) and the Classification and Diagnosis domain (mean 2.01; SD 1.10). Scores on different domains were not strongly correlated with each other (r=0.22 for Etiology and Risk & Classification and Diagnosis; r=0.31 for Etiology and Risk & Prevention and Management; r=0.19 for Classification and Diagnosis & Prevention and Management). The low intra-domain correlations suggest that the individual domains are capturing distinct aspects of clinical knowledge as intended.

DISCUSSION

We developed and psychometrically evaluated a knowledge tool to assess clinicians' understanding of IAD (Know-IAD). To our knowledge, this is the first study to describe the development of a validated tool to assess clinician knowledge of IAD with satisfactory content validity and reliability. The high levels of composite reliability achieved on the Etiology and Risk, and Prevention and Management domains in particular implies that constituent items of these domains are unlikely to have been misplaced elsewhere, and items which correctly belong in the Classification and Diagnosis domain have not been erroneously

assigned to other domains, with beneficial implications for the reliability of the Classification and Diagnosis domain.

The analyses indicate that the tool can be used to determine clinician knowledge of IAD. Items within the Know-IAD was informed by issues identified as important by international and local experts and informed by out prior research in this area.[5,16] Content validity for most items was robust. While a small number of individual items had only moderate content validity ratio and content validity index scores, the instrument achieved robust scale measures and these items were ultimately retained in the revised instrument. This decision was supported by confirmatory factor analysis findings, where all domains demonstrated good construct validity and composite reliability. Moreover, we assert that the robust construct validity and composite reliability of the Etiology and Risk and Prevention and Management domains suggest no cross-contamination of items between domains. Our analysis also found low correlation among domain scores and some divergence between scores on the Classification and Diagnosis domain versus the other two domains. These findings suggest these domains may be treated as independent entities, though further analysis is needed to definitively characterize relationships between the three domains.

Findings from our study support the Barakat-Johnson Incontinence-Associated Dermatitis Knowledge tool (Know-IAD) may be used in the clinical or research setting to measure clinicians' knowledge of IAD. For example, the Know-IAD may be used to identify gaps in clinician knowledge of the various domains of IAD, or measure IAD knowledge before implementation of a protocol or guideline for IAD. In addition, the Know-IAD may be used to test the effectiveness of educational programs, protocol or guidelines for PI prevention including IAD prevention and management.

A literature review of publications on knowledge instruments revealed that, at the time of the conduct of the study, there were no validated instruments to assess healthcare professionals' knowledge of IAD. One instrument, recently published by Sahin and colleagues[20] was designed to determine nurses' knowledge of IAD in an intensive care setting. Nevertheless, this instrument was not evaluated for validity and reliability.

Strengths and Limitations

To our knowledge, this is the first study to describe the development of a IAD knowledge tool guided by literature review, international guidelines, input from an expert panel of clinicians and researchers, and psychometric evaluation. The research team employed a rigorous methodology for development of the Know-IAD, including evaluation of the instrument for content and construct validity and composite reliability. Panelists employed to evaluate content validity were a multi-disciplinary and included nurses, physicians, occupational therapists, dieticians, and physiotherapists. Occupational therapists, dieticians and physiotherapists were included because they play a key role in managing assisting patients compromised personal hygiene, mobility and dexterity, toileting techniques and nutrition; all of which are linked to IAD risk and best practices for its prevention and management.[14,36] Another strength was the excellent response rate we achieved from clinicians during Phase 3 where construct validity and composite reliability was tested. Generally high values of composite reliability and excellent levels of content validity and construct validity yielded from the CFA process add foundation to the tool, with high levels of confidence that the tool is measuring the intended concepts, is fully representative of what it aims to measure, and constituent items demonstrate good internal consistency.

We obtained 204 completed tools (over the target sample size of 180) with a diversity of respondent backgrounds. Obtaining a large and representative sample such as this

strengthens the generalizability of the findings, potentially increasing the stability of the findings observed. The large number of respondents participating in the pilot also improves precision of findings.

This study was conducted only among hospital clinicians, thus limiting generalizability of findings in other healthcare settings. Additional validation is needed in clinicians in multiple healthcare setting, along with translation and validation into other languages. Model convergence and acceptable model fit was achieved in the three measures. We assert that it is unlikely that items included in any particular domain have been erroneously assigned to these domains.

Draft items for the instrument were revised based on feedback during content validation. However, the revised items were not reviewed again by the expert panel. Instead, they were reviewed by five of the authors acting on behalf of the larger panel used to establish content validity.

CONCLUSIONS

The Know-IAD instrument we developed demonstrated robust psychometric properties and can be applied to evaluate clinician knowledge on IAD on etiology and risk, classification and diagnosis, and prevention and management of IAD. This instrument can be used to inform interventions or educational programs to improve clinical practice or evaluate the efficacy of educational interventions or programs in addressing knowledge gaps.

REFERENCES

1. Black JM, Gray M, Bliss DZ, et al. MASD part 2: incontinence-associated dermatitis and intertriginous dermatitis: a consensus. *J Wound Ostomy Continence Nurs.* 2011;38(4):359-372.
2. Gray M, Black JM, Baharestani MM, et al. Moisture-associated skin damage: overview and pathophysiology. *J Wound Ostomy Continence Nurs.* 2011;38(3):233-241.
3. Doughty D, Junkin J, Kurz P, et al. Incontinence-associated dermatitis: consensus statements, evidence-based guidelines for prevention and treatment, and current challenges. *J Wound Ostomy Continence Nurs.* 2012;39(3):303-317.
4. Minassian VA, Devore E, Hagan K, Grodstein F. Severity of urinary incontinence and effect on quality of life in women by incontinence type. *Obstet Gynecol.* 2013;121(5):1083-1090.
5. Barakat-Johnson M, Barnett C, Lai M, Wand T, White K. Incontinence, Incontinence-Associated Dermatitis, and Pressure Injuries in a Health District in Australia: A Mixed-Methods Study. *J Wound Ostomy Continence Nurs.* 2018;45(4):349-355.
6. Campbell JL, Coyer FM, Osborne SR. Incontinence-associated dermatitis: a cross-sectional prevalence study in the Australian acute care hospital setting. *International Wound Journal.* 2016;13(3):403-411.
7. Demarre L, Verhaeghe S, Van Hecke A, Clays E, Grypdonck M, Beeckman D. Factors predicting the development of pressure ulcers in an at-risk population who receive standardized preventive care: secondary analyses of a multicentre randomised controlled trial. *J Adv Nurs.* 2015;71(2):391-403.

8. Gray M, Giuliano KK. Incontinence-Associated Dermatitis, Characteristics and Relationship to Pressure Injury: A Multisite Epidemiologic Analysis. *J Wound Ostomy Continence Nurs.* 2018;45(1):63-67.
9. Kayser SA, Phipps L, VanGilder CA, Lachenbruch C. Examining Prevalence and Risk Factors of Incontinence-Associated Dermatitis Using the International Pressure Ulcer Prevalence Survey. *J Wound Ostomy Continence Nurs.* 2019;46(4):285-290.
10. Bliss DZ, Funk T, Jacobson M, Savik K. Incidence and Characteristics of Incontinence-Associated Dermatitis in Community-Dwelling Persons With Fecal Incontinence. *J Wound Ostomy Continence Nurs.* 2015;42(5):525-530.
11. Long MA, Reed LA, Dunning K, Ying J. Incontinence-associated dermatitis in a long-term acute care facility. *J Wound Ostomy Continence Nurs.* 2012;39(3):318-327.
12. Beeckman D, Van Lancker A, Van Hecke A, Verhaeghe S. A systematic review and meta-analysis of incontinence-associated dermatitis, incontinence, and moisture as risk factors for pressure ulcer development. *Res Nurs Health.* 2014;37(3):204-218.
13. Beeckman D. A decade of research on Incontinence-Associated Dermatitis (IAD): Evidence, knowledge gaps and next steps. *J Tissue Viability.* 2017;26(1):47-56.
14. Beeckman D, Campbell J, Campbell K, et al. Incontinence-associated dermatitis: moving prevention forward. *Wounds International.* 2015.
15. Beeckman D, Van den Bussche K, Alves P, et al. *The Ghent Global IAD Categorisation Tool.* Skin Integrity Research Group, Ghent University 06/01 2017.
16. Barakat-Johnson M, Lai M, Wand T, Coyer F, White K. Cultivating Incontinence-associated Dermatitis Prevention Practices in an Australian Local Health District: A Quasi-experimental Study. *Ostomy Wound Manage.* 2018;64(12):16-28.

17. Barakat-Johnson M, Lai M, Barnett C, et al. Hospital-acquired pressure injuries: Are they accurately reported? A prospective descriptive study in a large tertiary hospital in Australia. *J Tissue Viability.* 2018;27(4):203-210.

18. Campbell J, Gosley S, Coleman K, Coyer F. Combining pressure injury and incontinence-associated dermatitis prevalence surveys: An effective protocol? *Wound Prac Res.* 2016;24(3):170-177.

19. Avşar P, Karadağ A. Efficacy and Cost-Effectiveness Analysis of Evidence-Based Nursing Interventions to Maintain Tissue Integrity to Prevent Pressure Ulcers and Incontinence-Associated Dermatitis. *Worldviews Evid Based Nurs.* 2018;15(1):54-61.

20. Şahin F, Karadağ A, Avşar P. A Survey of Turkish Nurses' Knowledge of Incontinence-Associated Dermatitis. *J Wound Ostomy Continence Nurs.* 2019;46(5):434-440.

21. Lee Y, Park YB. A Proposal of Iterative Consensus Process for Group Decision Making. Paper presented at: 2019 International Conference on Platform Technology and Service (PlatCon); 28-30 Jan. 2019, 2019.

22. Deng L, Chan W. Testing the Difference Between Reliability Coefficients Alpha and Omega. *Educ Psychol Meas.* 2016;77(2):185-203.

23. Glockner-Rist A, Hoijtink H. The Best of Both Worlds: Factor Analysis of Dichotomous Data Using Item Response Theory and Structural Equation Modeling. *Struct Equ Modeling.* 2003;10(4):544-565.

24. Netemeyer RG. *Scaling procedures issues and applications.* Thousand Oaks, California: SAGE; 2003.

25. Shi J, Mo X, Sun Z. Content validity index in scale development. *Zhong Nan Da Xue Xue Bao Yi Xue Ban.* 2012;37(2):152-155.

26. Zamanzadeh V, Ghahramanian A, Rassouli M, Abbaszadeh A, Alavi-Majd H, Nikanfar A-R. Design and Implementation Content Validity Study: Development of an instrument for measuring Patient-Centered Communication. *J Caring Sci.* 2015;4(2):165-178.

27. Sireci SG. The Construct of Content Validity. *Soc Indic Res.* 1998;45(1):83-117.

28. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)—A metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform.* 2009;42(2):377-381.

29. *IBM SPSS Statistics for Windows, Version 24.0* [computer program]. Armonk, NY2016.

30. *Stata Statistical Software: Release 14* [computer program]. College Station, TX2015.

31. Ayre CA, Scally AJ. Critical values for Lawshe's content validity ratio: revisiting the original methods of calculation. *Meas Eval Couns Dev.* 2014;47(1):79-86.

32. Maccallum R, Browne M, Sugawara H. Power analysis and determination of sample size for covariance structure modeling. *Psychol Methods.* 1996;1(2):130-149.

33. Boomsma A. Nonconvergence, improper solutions, and starting values in lisrel maximum likelihood estimation. *Psychometrika.* 1985;50(2):229-242.

34. Brunner M, Süβ H-M. Analyzing the Reliability of Multidimensional Measures: An Example from Intelligence Research. *Educ Psychol Meas.* 2005;65(2):227-240.

35. Peterson RA, Kim Y. On the relationship between coefficient alpha and composite reliability. *J Appl Psychol.* 2013;98(1):194-198.

36. Heywood N, Holloway S. Risk factors for incontinence-associated dermatitis: An evidence-based review. *Wounds UK.* 2014;10:22-33.