COMPETENCY STANDARDS FOR CRITICAL CARE NURSES: DO THEY MEASURE UP?

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Key words: competencies, competency standards, construct validity, critical care

ABSTRACT

Objective:

To determine the construct validity of the Australian College of Critical Care Nurses (ACCCN) competency standards as a tool for assessing the clinical practice of specialist level critical care nurses in Australia.

Design:

A comparative descriptive design was used to examine the relationship between the domains, competencies and elements of the ACCCN competency standards. Participants were sent a questionnaire and asked to describe on a 7-point Likert scale how closely each competency statement and related elements reflected their level of critical care nursing practice.

Subjects:

A systematic sampling method was used to randomly select 1000 critical care nurses from a prelisting of members of ACCCN. A total of 532 completed questionnaires were returned.

Main outcome measure:

The purpose of this study was to determine the construct validity of the ACCCN competency standards by examining two structural models. The first examined how well the descriptive elements fit with their respective competency standard. The second model examined how well the competency standards group together under specific domains.

Results:

Statistically there was no support for the current structure for the ACCCN competencies because the elements did not fit uniquely to a single competency, but were multidimensional and loaded across several competencies. Competency statements also loaded across several domains. Modification of the current model resulted in the identification of a four-factor competency model, which demonstrated reasonable model fit.

Conclusion:

Several issues are highlighted, resulting in concerns regarding the validity of the ACCCN Competency Elements and Standards as a tool with which to assess the practice of critical care nurses.

INTRODUCTION

In 1996 ACCCN developed competency standards for Australian specialist level critical care nurses (ACCCN competency standards 1996) from a multicentre observational study (Confederation of Australian Critical Care Nurses 1996). This development was in keeping with a move toward competency-based standards for industry and professions in addition to growing debate that beginning level competencies did not adequately capture more advanced nursing practice (McMillan et al 1997; Nursing Competencies Assessment Project 1990).

The structure of the ACCCN competency standards is three-tiered and includes elements, competencies and domains. ACCCN defines elements as related aspects of

performance that collectively provide evidence for a specific competency. All elements of a competency must be considered before inferences about the competency of an individual can be made. The competencies are attributes of a specialist nurse who functions at a high level of performance. Competency statements are grouped according to related facets of specialist practice known as domains. These domains include enabling, clinical problem solving, professional practice, reflective practice, teamwork and leadership (see figure 1) (ACCCN 2002).

The content validity of these standards has recently been examined (Greenwood et al 2001), however the construct validity has not been determined. Construct validity examines how well the conceptual theoretical definition, or in this case the structure of the competency standards, fits with the operational definition of measured variables. That is, do the elements and competency statements adequately measure the construct we call competence? While the ACCCN competency standards were not developed as a tool to measure clinical practice directly, many hospitals (Liverpool Health Service 2003), universities (University of Sydney 2001) and professional bodies (Underwood et al 1999) use them as a framework for the assessment of clinical performance (Fisher and Parolin 2000). To date, little research has been undertaken to examine the suitability of competency standards for use in the assessment of clinical practice (Williams et al 2001; Fisher and Parolin 2000) despite an articulated need for this to occur (Kendrick et al 2000). Without determining the construct validity the claim that the ACCCN competency standards can be used to measure clinical competence of specialist level critical care nurses must at best be viewed as problematic.

The purpose of this study was to determine the construct validity of the ACCCN competency standards as a tool for assessing the clinical practice of specialist level critical care nurses in Australia. It was hypothesised that a structural model using Confirmatory Factor Analysis should represent the theoretical construct of the ACCCN competency standards. This testing of the structural model of the ACCCN Competency Standards will in turn inform further development and refinement of tools for assessing the clinical competence of critical care nurses.

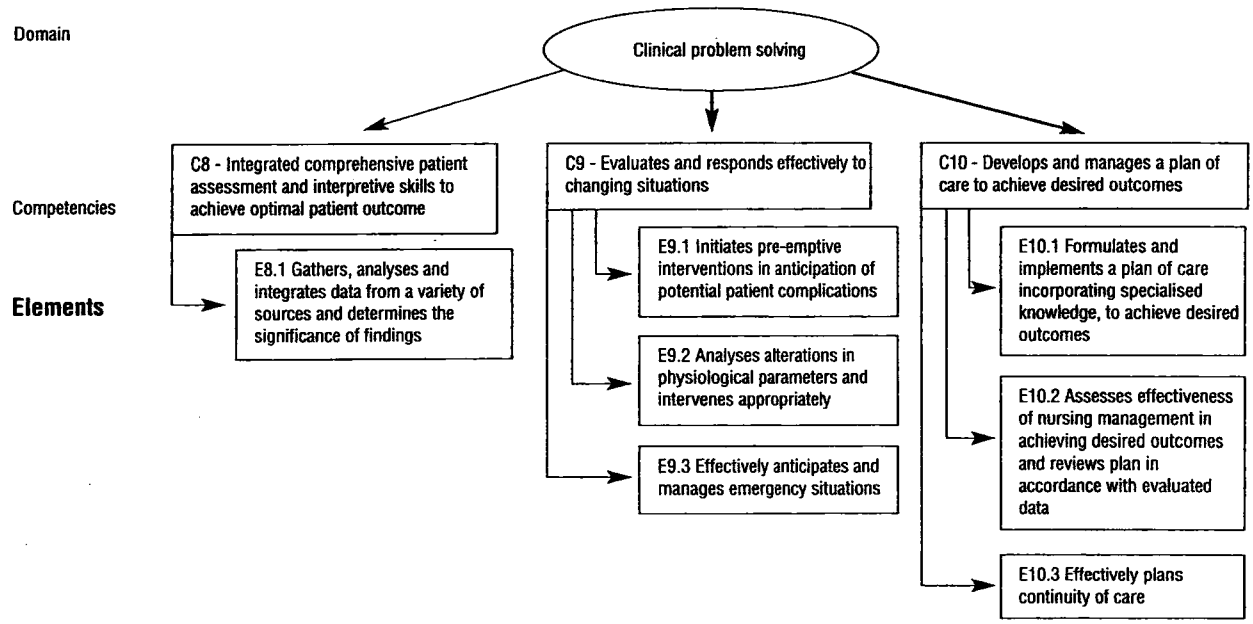
METHOD

A comparative descriptive design was used to examine relationships between the domains, competencies and elements of the ACCCN competency standards. This study examined two structural models. Model one examined the theoretical construct of the elements within the ACCCN competency standards by determining the degree of fit these elements have with their respective competency factor within the sample. Model two examined the degree of fit of the ACCCN competency standards with their respective domains. The Human Ethics Committee of the University of Sydney granted ethics approval.

Participants

The sampling procedure was designed to establish a representative sample of 1000 Australian critical care nurses. Thus a systematic sampling technique was used to

Figure 1: The relationship between elements, competencies and domains of the ACCCN competency standards



identify participants from the ACCCN membership database. Coded questionnaires were then mailed to the identified sample. A follow-up letter and replacement questionnaire was sent to non-respondents to maximise the response rate. This procedure achieved a response rate of 54% (n=540). Direct comparisons between the respondents and all Australian critical care nurses could not be established as no central repository of demographic data for Australian critical care nurses is held outside the ACCCN membership database. Consequently, the representativeness of the sample was unable to be determined, however the use of a random sampling technique coupled with a response rate of over 50% is considered sufficient to achieve adequate representation of the ACCCN membership.

Instrument

The initial section of the questionnaire asked subjects for demographic information. The second section listed 58 elements of ACCCN competencies and 20 competency statements. Participants were asked to describe on a 7-point Likert scale (where 1 = never or almost never true and 7 = always or almost always true) how closely each competency statement and the related elements reflected their view of their level of critical care nursing practice.

Data analysis

Both exploratory factor analyses (EFA) and confirmatory factor analyses (CFA) were performed to test the two independent 'a priori' models. These analyses were conducted firstly, to determine if the elements of each competency fit their proposed competency factor and secondly, the degree to which the competency statements load to particular domains and thus the construct of competence. Model fits were determined by utilising the Tucker Lewis Index (TLI), the Relative Non-Centrality Index (RNI) and the Root Mean Square Error of Approximation (RMSEA). An acceptable model fit utilising the TLI and RNI as fit indices is supported by results >0.90. The RMSEA is accepted as reasonable if <0.07 and good if <0.05 (Holmes-Smith 2002). By examining correlation coefficients and modification indices the researchers are able to make recommendations for model (competency) re-specifications.

Principal Component Analysis (PCA) with Varimax rotation procedure and Principal Axis Factoring (PAF) with an Oblimin rotation method were used to search for groups of items that have variance in common. To determine internal consistency, Cronbach's coefficient alphas were also calculated at the item and scale levels.

Exploratory factor analyses and reliability of the scales were examined using SPSS version 10 (SPSS Inc 2000). LISREL 8.0, (Jöreskog and Sörbom 1993) and AMOS version 4.0 (Arbuckle 1997) were used to conduct the confirmatory factor analyses.

RESULTS

Model 1: The Elements Model

Model one examined the theoretical construct of the 58 elements by determining the degree of fit these elements have with the 20 competency factors.

Descriptive statistics at item and factor level for the elements model

The results of a descriptive analysis at the element and competency level for the element's model revealed a narrow dispersion range suggesting non-normality in the data. Internal consistency (reliability) analyses demonstrated good scores (α0.6) for all factors that contained more than one item.

Correlation analysis at the element item and factor level

A Pearson's correlation coefficient generated for each item and proposed factor revealed that a number of elements correlated more with other competencies than their own. Due to the propensity of elements to correlate more with non-theoretically determined factors, it was impossible to determine any factor structure from the results of the correlation matrix. Therefore, both exploratory and confirmatory factor analyses were undertaken.

Exploratory factor analysis of the elements model

An exploratory factor analysis using PCA with a Varimax rotation, revealed 10 factors with eigenvalues over one. The 10-factor model accounted for 64% of the variance. The exploratory factor analysis did not support the 20 theoretically proposed competency factors for the elements model. All element items loaded onto the first factor (>0.3) and were split across the other nine factors in a random pattern. No factor structure was discernable.

Confirmatory Factor Analysis (CFA) of the elements model

A CFA of the elements was conducted by allowing each element to load only onto the hypothesised latent factor (competency) (table 1). Results based on the CFA demonstrate that the factor loadings were generally greater than 0.6. Six elements demonstrated target loadings less than 0.6, indicating that a significant portion of the variance of these elements is not accounted for by their respective competency factor.

The confirmatory factor analysis revealed high correlations between competency factors (Table 2). A third of competency factors were correlated greater than 0.70 with other competency factors, suggesting there is little difference between the competency factors. For example, C1 was highly correlated with C2 (>0.90) suggesting that there is no statistical difference between C1 and C2. Confirmatory factor analysis testing of the ACCCN element model in this sample showed

unacceptable fit (χ^2=4436.02, df=1405; TLI=0.81; RNI=0.84; RMSEA=0.06).

Model 2: The competency model

Model two (figure 2) examined the degree of fit of the twenty ACCCN competency standards with the six domains: enabling, clinical problem solving, professional practice, reflective practice, teamwork and leadership (Australian College of Critical Care Nurses 2002).

Descriptive statistics at item and factor level for the competency model

In a similar manner to the Elements Model, the item (competency) means fell within a narrow range (6.12 to 6.77). Standard deviations were at a low and narrow range for both competencies (0.49 to 1.0) and domains (0.49 to 0.67). Cronbach's alpha was examined at competency item and domain levels. Only those domains with three or more competencies produced item estimations. The results at competency level reveal consistent results within the proposed domain. Those domains with only two competency items demonstrated the lowest alpha scores. The domain 'Reflective Practice' (C15 and C16) revealed a low alpha score (α=0.34) demonstrating unacceptable internal consistency for this factor.

Results of a correlation analysis at competency item and factor level

Pearson's coefficients generally demonstrated acceptable correlation for each competency and domain: Enabling - 0.31 to 0.56; Clinical Problem Solving - 0.52 to 0.61; Professional Practice - 0.38 to 0.49; Teamwork -

Table 1: Results of the Confirmatory Factor Analysis for the ACCCN competency element subscales (n=532)

	ACCCN Competency element subscale factor loadings																			
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20
E1.1	0.58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E1.2	0.69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E1.3	0.74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E1.4	0.65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E2.1	0	0.63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E2.2	0	0.69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E2.3	0	0.73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E2.4	0	0.77	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E3.1	0	0	0.91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E4.1	0	0	0	0.91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E5.1	0	0	0	0	0.59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E5.2	0	0	0	0	0.81	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E5.3	0	0	0	0	0.83	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E5.4	0	0	0	0	0.80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E6.1	0	0	0	0	0	0.68	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E6.2	0	0	0	0	0	0.76	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E7.1	0	0	0	0	0	0	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0
E7.2	0	0	0	0	0	0	0.81	0	0	0	0	0	0	0	0	0	0	0	0	0
E8.1	0	0	0	0	0	0	0	0.90	0	0	0	0	0	0	0	0	0	0	0	0
E9.1	0	0	0	0	0	0	0	0	0.79	0	0	0	0	0	0	0	0	0	0	0
E9.2	0	0	0	0	0	0	0	0	0.80	0	0	0	0	0	0	0	0	0	0	0
E9.3	0	0	0	0	0	0	0	0	0.77	0	0	0	0	0	0	0	0	0	0	0
E10.1	0	0	0	0	0	0	0	0	0	0.79	0	0	0	0	0	0	0	0	0	0
E10.2	0	0	0	0	0	0	0	0	0	0.77	0	0	0	0	0	0	0	0	0	0
E10.3	0	0	0	0	0	0	0	0	0	0.73	0	0	0	0	0	0	0	0	0	0
E11.1	0	0	0	0	0	0	0	0	0	0	0.72	0	0	0	0	0	0	0	0	0
E11.2	0	0	0	0	0	0	0	0	0	0	0.76	0	0	0	0	0	0	0	0	0
E11.3	0	0	0	0	0	0	0	0	0	0	0.69	0	0	0	0	0	0	0	0	0
E11.4	0	0	0	0	0	0	0	0	0	0	0.69	0	0	0	0	0	0	0	0	0
E11.5	0	0	0	0	0	0	0	0	0	0	0.66	0	0	0	0	0	0	0	0	0
E12.1	0	0	0	0	0	0	0	0	0	0	0	0.76	0	0	0	0	0	0	0	0
E12.2	0	0	0	0	0	0	0	0	0	0	0	0.79	0	0	0	0	0	0	0	0
E13.1	0	0	0	0	0	0	0	0	0	0	0	0	0.64	0	0	0	0	0	0	0
E13.2	0	0	0	0	0	0	0	0	0	0	0	0	0.64	0	0	0	0	0	0	0
E13.3	0	0	0	0	0	0	0	0	0	0	0	0	0.69	0	0	0	0	0	0	0
E14.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0.69	0	0	0	0	0	0
E14.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0	0	0	0
E14.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0.66	0	0	0	0	0	0
E14.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0.59	0	0	0	0	0	0
E15.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.68	0	0	0	0	0
E15.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.72	0	0	0	0	0
E16.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.78	0	0	0	0
E16.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.87	0	0	0	0
E16.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.78	0	0	0	0
E16.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.78	0	0	0	0
E17.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.78	0	0	0
E17.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0	0
E17.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.59	0	0	0
E17.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.78	0	0	0
E18.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.91	0	0
E19.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.77	0
E19.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	0
E19.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.68	0
E19.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.77	0
E19.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.36	0
E19.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.63	0
E20.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.78
E20.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.54

0.51 and Leadership - 0.48. However, the two competencies that theoretically constitute the Reflective Practice domain were only weakly correlated at 0.25. A number of competencies had higher correlations with domains other than their own, specifically those competencies in Reflective Practice, Teamwork and Leadership.

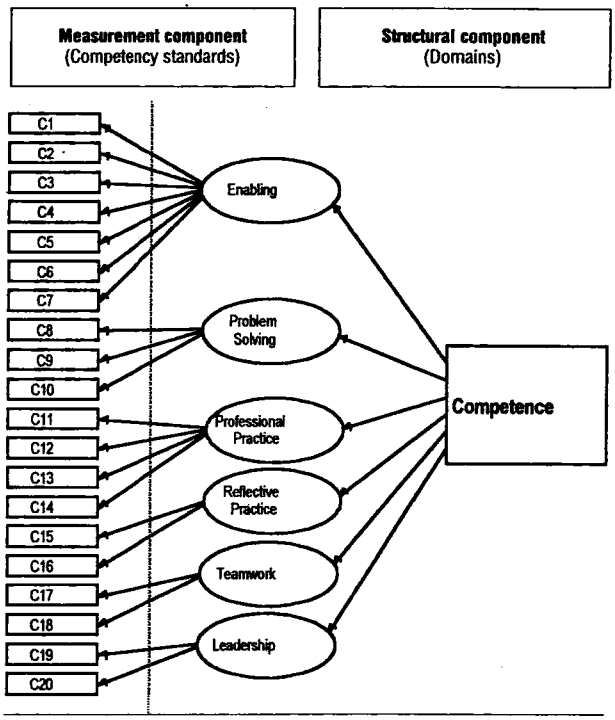
All domains demonstrated significant correlations (<0.001). Overall, all the competency standards correlated more with their current assigned domain than with any other domain. The Enabling and Clinical Problem Solving domains revealed the highest correlation value of 0.78 whilst other correlations ranged from 0.49 to 0.72. In a similar manner to the elements model, there is a propensity of competencies to correlate with non-theoretically determined factors, causing some difficulty in determining an overall item to factor structure for the competency model.

Results of an exploratory factor analysis of the competency model

The competency items were entered into a factor analysis (PCA with Varimax rotation) to assess any theoretically derived factor structure. The factor analysis revealed three factors with eigenvalues >1.0 accounting for 56% of the variance. The competency model, which is constructed from the elements model, theoretically consists of six factors (domains); however these are not supported in this analysis. Item factor loadings greater than 0.3 were distributed evenly throughout the three factors, however a number of item loadings (competencies 4, 8, 14, 15 and 17) were split across all three factors. No clear factor structure was discernable.

A further factor analysis was undertaken in an attempt to clarify the factor structure. By utilising Principal Axis Factoring (PAF) with an Oblimin rotation method and by fixing items to their theoretically designated factors, the results determined that the theoretical factors are not supported in this analysis. Target loadings were modest to substantial ranging from 0.32 to 0.93; however, the competency standards did not load into pre-defined factors representing their respective domains. Cross loadings occurred for eight of the 20 competency standards. The PAF results do not support the theoretical structure of the ACCCN competency standards and their domains. The ACCCN competency standards were therefore further examined using confirmatory factor analysis.

Figure 2: Competency construct components



Note: C = Competency standards

Table 2: Confirmatory Factor Analysis Phi Index of competency factors (ϕ)

	Factor correlations (ϕ)																			
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20
C1	1																			
C2	0.91	1																		
C3	0.66	0.68	1																	
C4	0.64	0.50	0.49	1																
C5	0.56	0.56	0.50	0.58	1															
C6	0.71	0.73	0.66	0.68	0.81	1														
C7	0.63	0.67	0.59	0.50	0.65	0.85	1													
C8	0.44	0.49	0.47	0.42	0.48	0.62	0.79	1												
C9	0.63	0.64	0.58	0.65	0.71	0.89	0.85	0.69	1											
C10	0.70	0.76	0.60	0.61	0.73	0.91	0.86	0.69	0.82	1										
C11	0.61	0.67	0.56	0.54	0.54	0.72	0.70	0.50	0.66	0.74	1									
C12	0.68	0.76	0.60	0.54	0.54	0.75	0.66	0.45	0.68	0.78	0.87	1								
C13	0.53	0.52	0.62	0.62	0.59	0.76	0.70	0.52	0.76	0.72	0.73	0.79	1							
C14	0.65	0.76	0.58	0.51	0.54	0.67	0.65	0.49	0.60	0.81	0.91	0.87	0.71	1						
C15	0.65	0.64	0.60	0.52	0.56	0.73	0.72	0.53	0.69	0.73	0.72	0.71	0.80	0.76	1					
C16	0.43	0.41	0.37	0.37	0.43	0.42	0.58	0.46	0.44	0.53	0.59	0.53	0.46	0.67	0.61	1				
C17	0.66	0.68	0.56	0.63	0.64	0.73	0.69	0.54	0.71	0.79	0.67	0.77	0.79	0.74	0.76	0.59	1			
C18	0.45	0.50	0.40	0.38	0.57	0.62	0.58	0.43	0.52	0.62	0.63	0.61	0.53	0.61	0.62	0.45	0.64	1		
C19	0.64	0.66	0.55	0.55	0.66	0.77	0.75	0.55	0.69	0.82	0.78	0.75	0.75	0.81	0.88	0.70	0.81	0.75	1	
C20	0.50	0.54	0.46	0.56	0.61	0.71	0.68	0.56	0.71	0.71	0.70	0.67	0.73	0.76	0.71	0.70	0.74	0.59	0.93	1

Note: All coefficients are presented in standardised format. All factor correlations greater than 0.2 are statistically significant (p<0.01)

Confirmatory factor analysis of the competency model

The results of the CFA demonstrated target loadings greater than 0.5 for most competency standards (table 3). The target loadings are highest for the domain of Clinical Problem Solving (0.74 to 0.75) although no proposed factor revealed consistently high loadings of >0.75. The domain of Reflective Practice revealed low target loadings ranging from 0.43 to 0.58.

The correlations among the domains as seen in the Phi Index (table 4), represent a concerning array of results. All domains appear correlated >0.79 with several over 0.90, suggesting that there is no statistical differences between these factors. Again, the results have not supported the proposed factor structure of the ACCCN competency factors.

The domain of Reflective Practice was highly problematic, revealing correlations to other domains greater than one. Given that a factor cannot correlate greater than one, the Phi Index results represent an improper solution. It is possible that the two-competency domains are problematic, although they may not necessarily result in improper solutions. In order to counteract this difficulty, the factor loadings for two-competency domains can be constrained to be equal in the initial analysis or the problematic domains may be collapsed into larger domains.

Confirmatory Factor Analysis testing of the ACCCN Competency Model in this sample showed borderline model fit (χ^2=567.31, df=155; TLI=0.89; RNI=0.91; RMSEA=0.071). The effects of an improper solution from the Phi Index for the factor of Reflective Practice may or may not have influenced the results of model fit that is below accepted standards. There is now strong evidence for the attempt of model respecification based on these results.

Re-specification of the competency model

After careful assessment of the previous competency model and specifically taking into account correlation results at item and factor level as well as modification indices in Structural Equation Modelling (SEM), a decision was made to collapse the six-factor model into four domains. The domains of Reflective Practice and Team Work were collapsed, with competency items 15 and 17 moving to the factor of Clinical Problem Solving, and competency items 16 and 18 moving to Leadership. The following results assess the viability of the re-specified model using internal consistency scores, factor analyses and model fit indices. At this point, in order to test the re-specified model a new sample would be valuable.

Internal consistencies for the four-factor model

After collapsing the model, reliability analysis was performed on all competencies and domains. The results reveal an improvement in overall reliabilities for the new domains. Alpha scores were reasonable and demonstrated good internal consistency at both the competency (ranging from 0.62 to 0.82) and domain (ranging from 0.76 for Leadership to 0.84 for Enabling and Clinical Problem Solving) levels.

Factor analyses

An EFA (PAF with Oblimin rotation) revealed that most competencies still show a tendency to load onto the first factor rather than into the four proposed factors. The four-factor model accounted for 50% of the variance, which is a slight drop from the 56% of the current six-factor model.

The results of the CFA revealed reasonable target loadings (>0.5) for all of the competency standards (table 5). Two competency standards (1 and 16) demonstrated factor loadings <0.6. The factor loading for item 15 has

Table 3: Confirmatory Factor Analysis for the ACCCN Competency Standards

	Factor Loadings					
	Enabling	Clinical Problem Solving	Professional Practice	Reflective Practice	Teamwork	Leadership
C1	0.56	0	0	0	0	0
C2	0.61	0	0	0	0	0
C3	0.66	0	0	0	0	0
C4	0.69	0	0	0	0	0
C5	0.64	0	0	0	0	0
C6	0.67	0	0	0	0	0
C7	0.73	0	0	0	0	0
C8	0	0.75	0	0	0	0
C9	0	0.75	0	0	0	0
C10	0	0.74	0	0	0	0
C11	0	0	0.63	0	0	0
C12	0	0	0.70	0	0	0
C13	0	0	0.68	0	0	0
C14	0	0	0.68	0	0	0
C15	0	0	0	0.58	0	0
C16	0	0	0	0.43	0	0
C17	0	0	0	0	0.72	0
C18	0	0	0	0	0.71	0
C19	0	0	0	0	0	0.74
C20	0	0	0	0	0	0.66

Note: All coefficients are presented in standardised format. All factor correlations greater than 0.2 are statistically significant (p<0.01)

risen from the previous Reflective Practice loading of 0.58 to the current 0.64. The other Reflective Practice competency (16) added to the Leadership factor demonstrated an improved factor loading from a previous score of 0.43 to 0.50 in the current model.

The results of factor correlations from the Phi Index of the CFA for the re-specified four-factor model still demonstrated high correlations, most factors reveal scores >0.80 (table 6).

While the revised model has determined improved correlations to the previous six-factor model where an improper solution was revealed, the high scores demonstrate that statistically there is little difference between domains.

Model fit indices for the re-specified model revealed a TLI score of 0.91, a RNI score of 0.92, a RMSEA of 0.068 and a χ^2 of 564.46 with 164 df. The new model is a substantial improvement from the previous six-factor model based on these results. Overall, the results of SEM have provided good evidence for the re-specified model.

CONCLUSION

The sampling strategy used in this study has created the effect of non-normal data distribution. The use of the ACCCN membership database for the sampling frame has led to high item scores and low item variance. This reflects the high level of experience (mean = 11.54 years; SD=6.05) and critical care qualifications (92.3%) of the sample. As the purpose of data analyses was to examine the statistical model, non-normal data has a minimal effect on these results. In light of this, it is recommended that another study using a more diverse sample be conducted to determine if the re-specified model can be substantiated.

Exploratory and confirmatory factor analyses for the elements model revealed no discernable pattern between elements at the competency level. The elements are not discrete and linear where an element fits uniquely to one competency but are multidimensional and load across several competencies. These results are of considerable concern as they provide strong statistical evidence that there is no match with the proposed theoretical structure.

An assessment of the competency model results has revealed a number of difficulties relating to the 'a priori' model. Specifically, the two item domains (Reflective Practice and Team Work) have proven to be problematic in exploratory and confirmatory factor analyses. The factor of Reflective Practice performed poorly in all analyses. Firstly, correlations between the items and item to factor were low. CFA factor loadings for the

Table 4: Competency factor correlations in CFA Phi Index

Phi Index	Enabling	Clinical Problem Solving	Professional Practice	Reflective Practice	Teamwork	Leadership
EN	1					
CPS	0.96	1				
PP	0.90	0.86	1			
RP	0.95	1.01	1.01	1		
TW	0.88	0.89	0.90	1.09	1	
Lead	0.79	0.84	0.82	1.14	0.96	1

Note: EN=Enabling; CPS =Clinical Problem Solving; PP= Professional Practice; RP= Reflective Practice; TW= Teamwork; Lead= Leadership.

Table 5: Confirmatory factor analysis for the four-factor model

	ACCCN four factors			
	Enabling	Clinical Problem Solving	Professional Practice	Leadership
C1	0.56	0	0	0
C2	0.61	0	0	0
C3	0.66	0	0	0
C4	0.69	0	0	0
C5	0.64	0	0	0
C6	0.67	0	0	0
C7	0.73	0	0	0
C8	0	0.74	0	0
C9	0	0.73	0	0
C10	0	0.73	0	0
C15	0	0.64	0	0
C17	0	0.71	0	0
C11	0	0	0.63	0
C12	0	0	0.70	0
C13	0	0	0.68	0
C14	0	0	0.69	0
C16	0	0	0	0.50
C18	0	0	0	0.74
C19	0	0	0	0.76
C20	0	0	0	0.67

Table 6: Competency factor correlations Phi Index for the re-specified model

Phi Index	Enabling	Clinical Problem Solving	Professional Practice	Leadership
Enabling	1			
Clinical Problem Solving	0.96	1		
Professional Practice	0.90	0.90	1	
Leadership	0.78	0.85	0.81	1

competencies within Reflective Practice were also low (<0.6). Lastly, factor correlations between Reflective Practice and the other domains led to an improper solution with correlations >1.00. These results are of concern, as they provided no statistical support for the model.

Problematic statistical issues have improved somewhat with the re-specified model. However, the issue of high correlations between proposed domains continue, albeit less than the theoretical model of six domains. Another important issue that should not become subsumed by the results of the statistical analyses is the fact that as yet there is no theoretical support for a four-domain model. In the original study (CACCN 1996) the domains were configured based on version 1 of the National Competency Standards for the Registered Nurse (Nursing Competencies Assessment Project 1990). None of the competency standards developed for nurses in Australia have had their construct validity established so it may be that the problems highlighted in the current study are present in all.

The competency model, be it six or four domains, as a higher order model remains dependent on the model performance at the elements level. Given that construct validity support at the statistical level was poor for the elements model, it is not surprising that difficulties continue to arise with the current educational reliance on the competency model as a framework for the purposes of assessment. Having said this, the analyses for the respecified model with four domains do represent an improvement at the statistical level.

The elements model and competency model have been examined for internal consistency, item and factor correlations, factor structure and model fit with the data. Several issues have been highlighted, resulting in concerns regarding the validity of the ACCCN Competency Elements and Standards as a tool with which to assess nurses' work skills and knowledge. Marsh points out that 'theory building and instrument construction are inexorably intertwined and that each will suffer if the two are separated' (1987, p.19). Marsh's warnings are specifically applicable here. It is acknowledged that the development of these competencies standards is based on the direct observation of clinical practice. While this is important for their development, empirical research such as described here should be included in the development process. Furthermore the content and construct validity of competency standards should not be static, but should be in a constant state of development and refinement.

The competencies do not appear to lend themselves readily to statistical assessment and any changes to the competency factor structure based on construct validity and reliability analyses present a danger of being conducted without theoretical substantiation. Similarly, it would be unwise to continue with the use of these and similar competency standards to measure clinical performance without the exploration of their construct validity. It is strongly recommended that all future work in developing competency standards for nurses include SEM prior to being used to assess clinical practice.

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