

Abstract

The purpose of this study was to test the psychometric properties of the *Nursing Teamwork Survey-Icelandic (NTS-Icelandic)*, which was translated from US English to Icelandic. The *NTS*, with 33 items, measures overall teamwork and five factors of teamwork: trust, team orientation, backup, shared mental models, and team leadership. The psychometric testing of the *NTS-Icelandic* was done on data from a pilot study and a national study. The sample for a pilot study included 123 nursing staff from five units and the sample for a national study included 925 nursing staff from 27 inpatient units. The overall test–retest intraclass correlation coefficient in the pilot study was 0.693 (lower bound=0.498, upper bound=0.821) ($p<0.001$). The Cronbach’s alpha reliability for the total scale and subscales ranged from 0.737-0.911. A confirmatory factor analysis indicated a good fit of the data from the national study with the five-factor model for nursing teamwork. The *NTS-Icelandic* tested valid and reliable in this study. Study findings support further use of the *NTS* internationally.

Keywords: hospitals, nursing, reliability, teamwork, validity

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INTRODUCTION

The importance of teamwork in health care has gained increased attention in recent years. Influential organizations such as the World Health Organization¹ and the Institute of Medicine^{2,3} have identified teamwork and team-based care as one of the key contributors to patient safety. Former studies on teamwork have mainly involved interdisciplinary teams, without identifying nursing teams specifically. The nursing care team, however, plays a pivotal role in patient and staff outcomes^{4,5} and proficient teamwork is identified as one of the premises of a healthy work environment in nursing⁶. Effective teamwork in nursing supports optimal use of the knowledge and skills of clinical nurses and their co-workers. To secure future quality nursing care, teamwork has been identified as one of the cornerstones in nursing education^{7,8}.

This study was carried out in order to successfully measure nursing teamwork in Icelandic hospitals using a reliable and valid instrument. No former studies on nursing teamwork in Iceland were identified and therefore no questionnaires on the matter available in Icelandic. This paper presents the findings of the psychometric testing of the *Nursing Teamwork Survey-Icelandic*. Albeit Icelandic is not widely spoken in the world, and therefore the *NTS-Icelandic* not applicable outside Iceland, the results of this study are nonetheless of importance to the discipline of nursing worldwide.

Background

A team is defined as two or more people working interdependently towards a common goal⁹. For the purpose of this study a nursing team is defined as all nursing staff members working on a given inpatient hospital care unit¹⁰. The nursing team members provide direct and

indirect day-to-day patient care to a defined group of patients located in one geographically demarcated area of the hospital.

The conceptual framework of the *NTS* is based on the teamwork model from Salas⁹. The Salas conceptual framework identifies five core components of teamwork: 1) team leadership, 2) collective orientation, 3) mutual performance monitoring, 4) backup behaviour, and 5) adaptability. The framework presumes interrelationships between the components fostered by three coordinating mechanisms: 1) shared mental models, 2) closed loop communication, and 3) mutual trust^{9,11}.

In a qualitative study, nursing staff from 5 patient care units in one hospital in the US were interviewed to determine what nursing teamwork looks like using the Salas framework. The study findings supported the Salas model as a good fit to acute care nursing teams¹¹. Based on the Salas model⁹, the *NTS* was developed for the purpose of measuring nursing teamwork at the individual and unit level in acute care hospital settings¹⁰. The psychometrics of the *NTS* in the US were tested in a large study with a sample of 1,758 nursing staff members with a response rate of 56.9%. The *NST* tested accessible, reliable and valid. Over 80% of participants omitted no item. The overall test-retest coefficient was 0.92. The overall alpha coefficient was 0.94, indicating good internal consistency. Factor analysis resulted in a five-factor model where the five factors explained 53.11% of the variance¹⁰.

Purpose of study

The purpose of this study was to test the psychometric properties of the *NTS-Icelandic* and in specific to found the acceptability, reliability and validity of this questionnaire.

METHODS

Design and settings

This was a descriptive cross-sectional study using a paper-and-pencil questionnaire for data collection. Participants in this study were registered nurses (RNs), practical nurses (PNs), assistive personnel, unit clerks, nurse managers, and assistant managers in inpatient hospital units in Iceland. In Iceland, the majority of RNs have a four-year baccalaureate degree in nursing and most PNs have a three-year vocational-level education. PNs are licensed personnel working under the supervision of RNs in acute health care. Health care in Iceland is nationalised and all participating hospitals are run by the government.

Sample

The psychometric testing of the *NTS-Icelandic* was done on data from a pilot study and a national study. The *NTS-Icelandic* pilot study was completed in November-December 2011, with all nursing staff (N=123) from five inpatient units at the university hospital in Iceland: one gynaecology unit, one paediatric unit and three geriatric units. These units were utilised in the pilot study so as not to expose the nursing staff in medical, surgical and intensive care units, who made up the target population for a national study, to the survey. In the pilot study, data were collected twice with a two-week interval for test-retest purposes (intra-rater reliability). The response rate at time 1 was 58.5% (72/123) and 63.9% (46 out of the 67) answered again at time 2.

For the national study, data were collected in March-April 2012. The sample consisted of all (N=925) nursing staff in all inpatient medical, surgical and intensive care units in the

country. The units were in 8 different health care facilities: 17 units in a university hospital (9 medical, 6 surgical and 2 intensive care units), 3 units in a teaching hospital (1 medical, 1 surgical, 1 intensive care unit), and 7 units from 6 regional hospitals (1 medical unit, 1 surgical unit, 5 mixed medical-surgical units). The response rate was 67% (623/925).

Measures

Data were collected on background variables and teamwork using the *NTS-Icelandic*. All questions were multiple-choice or categorical, with the exception of one question that asked about the number of patients on the respondent's last shift (the only continuous variable). The *NTS-Icelandic* is a translation of the US version of the *Nursing Teamwork Survey (NTS)*¹⁰. The *NTS* underwent a rigorous testing process of its acceptability, reliability and validity. Exploratory factor analysis of the *NTS* in the US, indicated a 33-item model fit with five factors (five subscales): 1) trust with 7 items, 2) team orientation with 9 items, 3) backup with 6 items, 4) shared mental model with 7 items, and 5) team leadership with 4 items. The trust factor measures whether team members trust that their team members will complete their responsibilities on a consistent basis. The team orientation factor measures the extent to which the team's needs are more important than the individual. The backup factor measures the willingness of team members to help one other when they identify that someone is busy or overloaded with work. The shared mental model factor measures the extent to which team members understand their roles and responsibilities so that all team members work toward the common goal. The team leadership factor measures the presence of guidance, support, and coordination for the team¹⁰.

The items in the *NTS* are put forward as statements. To answer the *NTS*, participants are asked to mark on a 5-point Likert-type scale to what extent each statement applies to their team. The five values on the scale are: (1) rarely, (2) 25% of the time, (3) 50% of the time, (4) 75% of the time, and (5) always. Higher scores indicate better teamwork¹⁰.

The translation of the *NTS-Icelandic*

Prior to data collection and psychometric testing, the *NTS-Icelandic* was translated using a modified version of the back-translation method derived from Brislin¹²⁻¹⁴. The back-translation process included four steps: 1. Forward translation, 2. Revision, 3. Back-translation, 4. Revision. The translation process was rigorous and included, clinicians, scholars and linguists, as it followed the same procedure as the one described by Bragadóttir et al.¹⁵. During the translation process, the back-translated version of the *NTS-Icelandic* was compared to the original version in US English by three doctoral nursing students in the US. None of the items or other text in the survey was determined to have different wording or meaning, indicating a satisfactory translation to Icelandic. Following the pilot study, minor changes were made to a few of the items as well as the instructions to participants and interface (layout) of the questionnaire¹⁵.

Data collection

In each unit there was a liaison responsible for distributing the surveys to all nursing staff on their unit. Data collection material included a questionnaire, an information letter and a marked prepaid envelope to return the survey by mail. One and two weeks following the data

collection material, reminders were sent out via e-mail to nurse managers and the liaisons who distributed them to all participants.

Data analysis

Data from participants who spent most of their working time on the unit and answered at least 70% of the *NTS-Icelandic* were included in the data study. The unit of analysis in this study is the individual participant. Acceptability, an indication of ease of use¹⁶ measured by frequency of missing data¹⁷, was evaluated with the pilot study data and the national study data.

Reliability testing of the *NTS-Icelandic* included test-retest of the pilot study data and a Cronbach's alpha coefficient calculation for the total scale, as well as for each of the five subscales for the pilot study and the national study data. Concurrent validity was tested by comparing the *NTS* mean score to the answers to a single 5-point Likert-type question in the demographic section on overall rating of satisfaction with teamwork on the unit, using the national data. Construct validity testing was done with confirmatory factor analysis (CFA) using the national study data. Based on former studies on the *NTS*¹⁰ a theory-driven approach guided the use of CFA¹⁸⁻²⁰.

All statistical calculations were done in IBM SPSS 20, except the CFA where LISREL 8.8 was used.

Ethical considerations

Prior to data collection, the study was approved by the Institutional Review Board in each hospital, or analogous body in the smaller hospitals, as well as the Data Protection Authorities

of Iceland (S5388/2011). Participants in the pilot study gave their written informed consent prior to participation. In the national study, participation equalled a written informed consent.

RESULTS

The majority of the participants were women (98.5% in both the pilot study and the national study) aged 35-64 (85.5% in the pilot study and 69.3% in the national study), RNs (54.8% in the pilot study and 56.3% in the national study) and PNs (22.6% in the pilot study and 34.6% in the national study). Most came from the teaching hospitals (100% in the pilot study and 79.3% in the national study) and worked rotating shifts (67.2% in the pilot study and 81.9% in the national study). The characteristics of participants can be seen in Table 1.

Acceptability

Acceptability in the pilot study was based on data from 62 participants answering at time 1 and 43 participants answering at time 2. At time 1 in the pilot study, 72.3% answered all the items at time 1 and 72.1% at time 2. Missing items in the pilot study ranged from 1 to 7.

Acceptability in the national study was based on data from 584 participants. From these, 80.8% answered all the items in the *NTS-Icelandic* and 9.4% only omitted one item. Missing items in the national study ranged from 1-10. Acceptability of the measures can be seen in Table 2.

Reliability

The test-retest reliability for the pilot study was based on data from 43 participants. At time 2, 53.8% chose the exact same answer and 31.3% chose the next closest answer they had chosen at time 1. The overall intraclass correlation coefficient for the 33 items was 0.693 (lower

bound=0.498, upper bound=0.821) ($p<0.001$), and the five subscales had the test–retest coefficient ranging from 0.55 to 0.712 ($p<0.001$). The Cronbach’s alpha reliability for the pilot study data for the total scale was 0.852 at time 1 and 0.747 at time 2, and for the subscales it was 0.767 to 0.851 at time 1 and from 0.756 to 0.872 at time 2. For the national data, the Cronbach’s alpha reliability for the total scale was 0.911 and for the subscales it ranged from 0.737-0.814. These results indicate satisfactory reliability.

Validity

For concurrent validity testing, a one-way ANOVA showed that nursing staff that were satisfied with the level of teamwork on their unit had a significantly higher overall teamwork mean score than did dissatisfied staff ($F=35.94$, $p<0.001$). The overall nursing teamwork mean score for those who were very satisfied with the level of teamwork on their unit was 4.2 on the *NTS* compared to 3.2 for those who were very dissatisfied. The overall nursing teamwork mean score correlated significantly with participants’ satisfaction with teamwork on the unit ($r=.445$, $p<0.001$).

The five subscales for nursing teamwork that emerged in the study by Kalisch, Lee and Salas¹⁰ were used when performing a confirmatory factor analysis (CFA). The model was a good fit (comparative fit index [CFI] = 0.981, root-mean-square error of approximation [RMSEA] = 0.0506, incremental fit index [IFI] = 0.981, standardised root mean square residuals [SRMR] = 0.0583). The factor loadings can be seen in Table 3.

DISCUSSION

The *NTS-Icelandic* was shown to have good psychometric properties for a new tool.

Acceptability was satisfactory, with 80.8% answering all items in the *NTS-Icelandic* with a national sample. This is comparable to the results in the study from Kalisch et al. from the US where 80.4% of participants answered all items in the questionnaire¹⁰. Acceptability of the *NTS-Icelandic* is indicated to be no less for the Icelandic population of nursing staff than the original version was in US hospitals, demonstrating equal ease of use in both countries¹⁷.

The overall test–retest intraclass correlation coefficient for the whole scale and subscales in the pilot study was 0.55 to 0.712 ($p < 0.001$). Although acceptable, this indicates weaker correlations between measures than was seen with the US data where the correlation coefficient was 0.92 and 0.77-0.92 for the subscales¹⁰. The sample sizes differed significantly between countries which may have influenced the test-retest in our study, and the question remains whether there was any reactivity in the Icelandic pilot study population, but reactivity refers to the influence measure one has on measure two, in the way that participants start to think differently about the phenomenon being studied after getting exposed to it¹⁸. To our knowledge teamwork has not previously been studied in the population of Icelandic nursing staff.

The Cronbach's alpha reliability for the total scale and subscales ranged from 0.737-0.911, indicating satisfactory internal consistency. These results are quite comparable to the ones with US data where the alpha coefficient for the overall scale and subscales ranged from 0.74-0.94¹⁰.

The overall nursing teamwork mean score correlated significantly with participants' satisfaction with teamwork on the unit ($r = 0.445$, $p < 0.001$), indicating satisfactory concurrent

validity. A confirmatory factor analysis indicated a good fit of the data with the five-factor model for nursing teamwork. These results are in concordance with the results of Kalisch et al. in the US when testing the *NTS* on a large group of nursing staff¹⁰, indicating equal applicability of the theoretical and empirical framework of the instrument in both countries¹⁸. These findings show that the Salas theory on teamwork⁹ as presented in the *NTS* applies to teams in Icelandic as well as US hospitals, indicating that nursing teamwork may be a universal phenomenon.

This study has both strengths and limitations. The strengths of the study are the high response rate and the stringent process of translation and testing of data. The main limitations are the first use of an instrument developed in another language and country as well as the small population, which however is a methodological issue as Icelanders are only about 330,000 in total.

Conclusion

In conclusion, the *NTS-Icelandic* demonstrates sound psychometric properties for a new tool and can be used to assess teamwork in these settings. Translating an instrument to obtain cross-cultural reliability and validity in a new language and culture is always challenging^{15,21,22}. Using a rigorous process of translation and testing, as was done in this study, is crucial. The final step in any instrument translation, the psychometric testing of reliability and validity, really differentiates between sound and weak instruments²³. Study findings support further use of the *NTS* in Iceland and internationally. The *NTS* is based on a solid theory and has shown to be applicable in more than one country and language.

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Table 1. The characteristics of participants in the pilot-study (N=60-62) at time 1 and the national study (N=574-582).

	Pilot-study		National study	
	N	%	N	%
Gender	62		582	
Female	61	98.4	573	98.5
Male	1	1.6	9	1.5
Age	62		579	
<25	2	3.2	35	6.0
25-34	5	8.1	131	22.6
35-44	15	24.2	143	24.7
45-54	20	32.3	163	28.2
55-64	18	29.0	95	16.4
≥65	2	3.2	12	2.1
Role	62		581	
Registered nurse (RN)	34	54.8	327	56.3
Practical nurse (PN)	14	22.6	201	34.6
Nursing assistant	2	3.2	4	0.7
Nurse manager / assistant manager	8	12.9	19	3.3
Unit Clerk/Secretary/Other	4	6.5	30	5.1
Experience in role	62		577	
Up to 6 months	1	1.6	6	1.0
Greater than 6 months to 2 years	0	0.0	75	13.0
Greater than 2 years to 5 years	4	6.5	90	15.6
Greater than 5 years to 10 years	16	25.8	100	17.3
Greater than 10 years	41	66.1	306	53.0
Experience on current unit	62		579	
Up to 6 months	6	9.7	32	5.5
Greater than 6 months to 2 years	5	8.1	104	18.0
Greater than 2 years to 5 years	17	27.4	128	22.1
Greater than 5 years to 10 years	17	27.4	115	19.9
Greater than 10 years	17	27.4	200	34.5
Number of working hours per week	61		579	
Less than 30 hours per week	17	27.9		24.9
30 hours or more each week	44	72.1		75.1
Work hours	61		581	
Days	12	19.7	60	10.3
Evenings	5	8.2	18	3.1
Nights	3	4.9	27	4.6
Rotating shifts	41	67.2	476	81.9
Overtime in the past 3 months	60		574	
None	20	33.3	149	26.0
1-12 hours	23	38.3	256	44.6
More than 12 hours	17	28.3	169	29.4
Absenteeism in the past 3 months	60		581	

None	22	36.7	177	30.5
1 day or shift	14	23.3	137	23.6
2-3 days or shifts	13	21.7	160	27.5
4-6 days or shifts	7	11.7	69	11.9
Over 6 days or shifts	4	6.7	38	6.5
Unit type	62		584	
Paediatric	16	25.8		
Gynaecology	13	21.0		
Geriatric	33	53.2		
Medical			206	35.3
Surgical			182	31.2
Mixed medical-surgical			92	17.8
Intensive care			104	15.8

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Table 2. Acceptability of the *NTS-Icelandic*.

	N	%
Pilot study time 1	62	
No omitted item	45	72.6
1 omitted item	14	22.6
2 omitted items	1	1.6
>2 omitted items	2	3.2
Pilot study time 2	43	
No omitted item	31	72.1
1 omitted item	6	14.0
2 omitted items	1	2.3
>2 omitted items	5	11.6
National study	584	
No omitted item	472	80.8
1 omitted item	55	9.4
2 omitted items	20	3.4
>2 omitted items	37	6.3

Table 3. Confirmatory factor analysis and Cronbach's reliability coefficient for the *NTS-Icelandic*.

Factor	Cronbach's α	Item	Factor loadings				
			1	2	3	4	5
1. Trust	0.814	Trust	0.83				
		Sharing ideas and information	0.74				
		Fair reallocation of responsibilities	0.70				
		Communication of expectation	0.69				
		Engaging in changes to make improvements	0.67				
		Clarifying the intended message with one another	0.64				
		Constructive feedback	0.63				
2. Team Orientation	0.763	Defensive response		0.74			
		complaint by oncoming shift staff about incomplete work		0.71			
		Judgmental feedback		0.59			
		Extra break time		0.58			
		Nursing assistants and nurses not working well together		0.55			
		Focusing on their own work than working		0.54			
		Ignoring mistakes and annoying behavior		0.5			
		Conflict avoidance		0.49			
		Dominated by staff members with strong personalities		0.44			
3. Backup	0.750	Pitching in together to get the work done			0.76		
		Keeping an eye out for each other			0.72		
		Response to other team members' patients			0.71		
		Charge nurses or team leaders assist team members			0.66		
		Knowing when assistance is needed before being asked			0.55		
		Noticing a member falling behind			0.44		
4. Shared Mental Model	0.807	Understanding of others' role and responsibilities				0.84	
		Working together for a quality job				0.78	
		Following through on commitment				0.76	
		Respect				0.73	
		Understanding of own responsibilities throughout the shift				0.65	
		The shift change reports contain necessary information				0.61	
		Awareness of the strengths and weaknesses of other team members				0.51	
5. Team Leadership	0.737	Charge nurses or team leaders give clear and relevant directions				0.79	
		Charge nurses or team leaders give clear and relevant directions				0.76	
		Charge nurses or team leaders monitoring the progress of the team				0.67	
		Extended plan to deal with changes in the workload				0.57	

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Title: The psychometric testing of the *Nursing Teamwork Survey* in Iceland

Running title: The *Nursing Teamwork Survey* in Iceland

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