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ORIGINAL PAPER

A VALIDATION STUDY OF THE SLOVAK VERSION OF THE HOSPITAL SURVEY ON PATIENT SAFETY CULTURE (WITH SLOVAK NURSES)

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Abstract

Aim: To verify the psychometric properties of the Slovak version of the Hospital Survey on Patient Safety Culture instrument in the Slovak Republic. *Design:* A cross-sectional validation study. *Methods:* The study was conducted according to the STROBE checklist. Data were collected using the Hospital Survey on Patient Safety Culture (HSOPS) between December 2017 and July 2018. Registered nurses (n = 1,427) from 21 hospitals across Slovakia were included in the study. Construct validity and reliability of the instrument were tested using SPSS 25.0. *Results:* Results of the Principal Component Analysis did not replicate the dimensionality or the factor structure of the original U.S. version of the instrument. Resulting from the factor analysis, an eight-factor structure was indicated. We identified two new factors in the HSOPS, namely: "Perception of patient safety, staffing-adequacy and staffing-blaming" and "Management strategy / Safety planning". Some factors of the original version were combined into one, while others were excluded. The Cronbach alpha coefficient of the instrument was 0.88, ranging from 0.42 to 0.86 for particular subscales. *Conclusion:* Psychometric testing of the HSOPS in the Slovak sociocultural context indicated acceptable reliability and construct validity of the tool. It is, therefore, considered promising as an instrument for measuring nurses' perception of patient safety culture.

Keywords: acute care, Hospital Survey on Patient Safety Culture, nurse, patient, safety culture, teaching hospitals.

Introduction

Patient safety represents a difficult challenge for modern healthcare systems. Linked to the continuous effort to improve quality of provided care (Gambashidze et al., 2020; Palmieri et al., 2020), it aims to decrease the incidence and the impact of adverse events on healthcare systems worldwide (Kirwan et al., 2013; Mekonnen et al., 2017; Muftawu & Aldogan, 2020). It has been shown that in European countries adverse events as a result of care provision occur with up to 8–12% of hospitalized patients, and have a significant impact on overall patient morbidity and mortality (Rafter et al., 2015). Up to 50–70% of these events might be prevented if safety procedures are followed (Granel et al., 2020).

The establishment of safety procedures to improve patient safety culture dates from the late 1980s and early 1990s (Kohn et al., 2000). Since then, the level of safety procedures has continuously increased, thus gradually reducing the prevalence of adverse events in health care, and, simultaneously, helping staff to report these events faster and without fear (Habibzadeh et al., 2020; Khosravizadeh et al., 2020). These procedures include the assessment of patient safety culture, which promotes increased patient safety while decreasing the number of adverse events (Khosravizadeh et al., 2020; Quillivan et al., 2016). At the same time, it has been shown that measuring patient safety culture, for example by using the Hospital Survey on Patient Safety Culture (HSOPS) questionnaire, released by the Agency for Healthcare Research and Quality (AHRQ; Sorra & Nieva, 2004) and recommended as one of three tools for measuring the phenomenon, may increase positive patient outcomes (Aletras et al., 2020; Keskinova et al., 2020). Research studies confirm the strong correlation between patient outcomes, safety culture, and the number of adverse events in the HSOPS questionnaire (Palmieri et al., 2020). Given that nurses are the largest group of professionals in health care, the nature of their work concerning safety procedures is essential. Due to the close and intensive contact between patients and nurses, nurses'

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views are essential to efforts to identify the strengths and weaknesses of patient safety culture (Tlili et al., 2020). The questionnaire consists of 42 items reflecting 12 dimensions of patient safety culture. It is widely used, translated, and verified in different countries throughout the world (Nieva & Sorra, 2003). In the Slovak Republic, the questionnaire has been used in several studies (e.g., Gurková et al., 2020; Sováriová Soósová et al., 2017); however, the verification of psychometric properties of the HSOPS questionnaire was not the subject of these studies. Our study aimed to present the psychometric properties of the HSOPS in the Slovak Republic, and to provide a tailored version of the HSOPS to measure Slovak patient safety culture from the perspective of registered nurses.

Aim

The study aimed to verify the psychometric properties of the Slovak version of the Hospital Survey on Patient Safety Culture instrument on a sample of registered nurses from selected general, teaching, and university hospitals in the Slovak Republic, and to validate the instrument in the sociocultural conditions of the Slovak Republic.

Methods

Design

The study has the character of a cross-sectional validation study, and was conducted according to the STROBE checklist.

Sample

In our study, 21 hospitals from eight regions of the Slovak Republic were included. Written permission was granted by fourteen general hospitals, two university hospitals, and five teaching hospitals across the Slovak Republic. The convenience sample consisted of registered nurses from participating hospitals. The nurses were selected by the method of purposive selection, according to predefined criteria. Registered nurses were included if they: a) worked in acute care facilities; b) provided care to adult patients; c) worked on standard care units (medical-surgical care units, elderly care units) and intensive care units; d) worked in rotating shifts; and e) had at least one year of work experience. Registered nurses were excluded if they: a) had a managerial position; or b) worked on gynecology-obstetrics care units. The sample size was calculated using an online sample size calculator (Qualtrics®). The number of registered nurses stood at 40,885 in February 2018. We applied a confidence interval of 95%, and a margin of error of ± 5%. The sample size was set at a minimum of 381 respondents.

Data collection

Data collection was conducted between December 2017 and July 2018. Overall, 2,100 questionnaire were distributed, of which 1,428 were returned. One incomplete questionnaire was excluded. Altogether, 1,427 questionnaires were analyzed (a return rate of 65.05%). Data collection was realized using an instrument specifically designed for measuring patient safety culture – the HSOPS, which was created by the AHRQ (Sorra & Nieva, 2004) and translated into Slovak by the authors Gurková and Žiaková (2017, unpublished personal communication), using the forward-backwards translation method. The instrument consists of 42 items composed of nine dimensions (A–I). The main parts of the instrument (A–D, and F) reflect twelve dimensions of patient safety culture, together with two assigned items representing nurse-reported patient safety grade (E), and the number of events reported during the past twelve months (G). Part H contains six items of demographic data, and part I allows respondents the opportunity to add comments. Dimensions of patient safety culture include: *"Teamwork within units"; "Teamwork across units"; "Supervisor / Manager expectations and actions promoting patient safety"; "Management support for patient safety"; "Organizational learning and continuous improvement"; "Feedback and communication about errors"; "Communication openness"; "Non-punitive response to errors"; "Handoffs and transitions"; "Staffing"; "Frequency of events reported"; and "Overall perception of patient safety"*. Responses in the questionnaire are recorded using a five-point Likert scale: 1 (strongly disagree), 2 (disagree), 3 (neither disagree nor agree), 4 (agree), and 5 (strongly agree); or 1 (never), 2 (rarely), 3 (sometimes), 4 (most of the time) and 5 (always). Part E is assessed on a scale from A (perfect) to E (failing), and part G contains six response options (a = no report; b = 1–2 reports; c = 3–5 reports; d = 6–10 reports; e = 11–20 reports; f = 21 or more reports).

Data analysis

Analysis of the psychometric properties of the HSOPS instrument (parts A–D, and F) was conducted in the statistical program SPSS 25.0). The primary characteristics (SD, mean) were analyzed by descriptive statistics. In addition, the KMO (Kaiser-Meyer-Olkin) test of sampling adequacy and Bartlett's test of sphericity (χ^2) were applied to our sample to explore if further analysis

was warranted. The factor structure of the HSOPS was analyzed by exploratory factor analysis, namely Principal Component Analysis (PCA) with Varimax rotation method, and Kaiser Normalization, using the criteria of eigenvalues. The calculation of the Cronbach alpha coefficient verified the reliability of the instrument for the particular subscales, as well as for the instrument as a whole. Results were tested on the level of statistical significance of $p \leq 0.05$.

Results

The sample consisted of 1,427 nurses from fourteen general hospitals, two university hospitals, and five teaching hospitals. Most nurses worked in medical care units (34%) and surgical care units (30%). The remainder worked in intensive care units (22.3%), elderly care units (3.7%) or unspecified healthcare units (10%). Almost all nurses were female (98%), with a mean age of 42.42 years (± 9.84) and had a baccalaureate or higher degree in nursing (45.6%). Sample characteristics are fully reported in Table 1.

Psychometric properties

According to the result of the Kaiser-Meyer-Olkin test of sampling adequacy (KMO = 0.900) and Barlett's test of sphericity (χ^2 = 15374.80; df = 0.861; p = 0.000), the sample was sufficient, warranting further analysis of the sample. In addition, we used PCA with Varimax rotation method, involving Kaiser Normalization (ten iterations were converged). The results indicated nine HSOPS dimensions, differing from the original version of the HSOPS, which includes 12 dimensions (Sorra & Nieva, 2004).

Given the large sample size (n = 1,427 nurses), and the convergence of the screen plot and Kaiser's criterion on eight dimensions, an eight-factor solution was used in the final analysis. Factor 9, with two items (A7 – *"We use more agency / temporary staff than is best for patient care"*; A10 – *"It is just by chance that more serious mistakes don't happen around here"*) from the initial nine-factor solution was difficult to interpret from a theoretical viewpoint; it was, therefore, excluded. Three other items were also removed according to the following criteria: a) factor loadings were < 0.40 on any of the factors (i.e.: B3 – *"Whenever pressure builds up, my supervisor / manager wants us to work faster, even if it means taking shortcuts"*; and A12 – *"When an event is reported, it feels like the person is being written up, not the problem"*); or b) cross-loading (F10 – *"Hospital units work well together to provide the best care for patients"*). Finally, we identified the following eight dimensions in the Slovak HSOPS: *"Feedback and communication about errors and communication openness"* (C1–C6, B1–B2); *"Organizational learning and management support"* (A6, A9, A11, A13, A18, F1, F8); *"Perception of patient safety, staffing-adequacy and staffing-blaming"* (A2, A5, A8, A14, A16, A17); *"Handoffs and transitions"* (F3, F5–F7, F11); *"Frequency of events reported"* (D1–D3); *"Teamwork within units"* (A1, A3, A4); *"Management strategy / Safety planning"* (A15, B4, F9); *"Teamwork across units"* (F2, F4).

The complete results from the PCA are reported in Table 2. Total deviation, with the inclusion of eigenvalues (ranging from 1.035 to 8.457), and communalities (ranging from 0.327 to 0.837), are also described in Table 2. Eight factors explained 51.88% of total deviance. Variance extracted by

Table 1 Sample characteristics (n = 1,427)

Variable	mean ± SD	n	%
Nurse age	42.42 ± 9.84		
Nurse experience of nursing (years)	20.25 ± 11.19		
Gender	female	1,389	98.0
	male	29	2.0
Nurse education level	secondary vocational education	385	27.3
	higher education in nursing	382	27.1
	bachelor's degree	313	22.2
	master's degree and higher	330	23.4
Unit type	surgical care unit	426	30.0
	medical care unit	483	34.0
	intensive care unit	317	22.3
	elderly care unit	52	3.7
	others	141	9.9

SD – standard deviation

Factor 1 (*"Feedback and communication about errors and communication openness"*) was the highest (the value was 8.45 before rotation and 4.13 after rotation), and this factor also explained the most significant amount of variance (20.13% before rotation and 9.82% after rotation). Factor loading of the items in an existent factor was in a range between 0.54 and 0.69. In the Slovak version, three originally individual factors – *"Feedback and communication about errors"*; *"Supervisor / Manager expectations and actions promoting patient safety"*; and *"Communication openness"* – were merged into one new factor – *"Feedback and communication about errors and communication openness"*. Variance extracted by Factor 2 (*"Organizational learning and management support"*) had an eigenvalue of 2.37 (2.95 after Varimax rotation), which accounted for a response variance of 5.64% (or 7.03% after rotation). In the Slovak version three originally independent factors – *"Organizational Learning-continuous improvement"* (items A6, A9, A13); *"Management support for patient safety"* (F1, F8) and an item from the dimension *"Teamwork within units"* (A11) – were combined into a single factor: *"Organizational learning and management support"*. Variance extracted by Factor 3 (*"Perception of patient safety, staffing-adequacy and staffing-blaming"*) had an eigenvalue of 2.13 (2.59 after Varimax rotation), which accounted for a response variance of 5.08% (or 6.17% after rotation). In the Slovak version, some items from three originally separate factors – *"Overall perceptions of patient safety"*; *"Staffing"*; *"Non-punitive response to errors"* – were merged into a single new factor – *"Perception of patient safety, staffing-adequacy and staffing-blaming"*. Only two factors were formulated as in the original US HSOPS questionnaire: *"Handoffs and transitions"* (Factor 4) and *"Frequency of events reported"* (Factor 5). Three items from the domain *"Teamwork within units"* had factor loadings > 0.4 in Factor 6 (*"Teamwork within units"*) and only two items from the domain *"Teamwork across units"* had factor loadings > 0.4 in Factor 9 (*"Teamwork across units"*). In addition, a new dimension of the HSOPS in the context of the Slovak Republic was created: *"Management strategy / Safety planning"* (Factor 7). Variance extracted by Factor 7 had an eigenvalue of 1.65 after Varimax rotation, which accounted for a response variance of 3.92% after rotation.

Table 2 Descriptive statistics, reliability and factor structure of the Slovak version of HSOPS questionnaire (Part 1)

Dimensions with their statements from the HSOPS in Slovak context		mean	SD	Cronbach alpha	Factor loadings	Communalities	Eigenvalues
Handoffs and transitions				0.651			2.03 before and 2.56 after rotation
F3	Things "fall between the cracks" when transferring patients from one unit to another	3.20	0.99		0.484	0.347	
F7	Problems often occur in the exchange of information across hospital units	3.21	0.87		0.750	0.623	
F6	It is often unpleasant to work with staff from other hospital unit	3.18	0.91		0.720	0.557	
F5	Important patient care information is often lost during shift changes	3.72	0.93		0.533	0.410	
F11	Shift changes are problematic for patients in this hospital	3.45	0.92		0.464	0.412	
Teamwork within units				0.723			1.51 before and 2.28 after rotation
A1	People support one another in this unit	3.59	0.94		0.660	0.569	
A3	When a lot of work needs to be done quickly, we work together as a team to get the work done	3.91	0.90		0.752	0.622	
A4	In this unit, people treat each other with respect	3.49	0.91		0.763	0.665	

Table 2 Descriptive statistics, reliability and factor structure of the Slovak version of HSOPS questionnaire (Part 2)

Dimensions with their statements from the HSOPS in Slovak context		mean	SD	Cronbach alpha	Factor loadings	Communalities	Eigenvalues
Feedback and communication about the error and communication openness				0.827			8.46 before and 4.12 after rotation
C3	We are informed about errors that happen in this unit	4.07	0.91		0.543	0.468	
C2	Staff will freely speak up if they see something that may negatively affect patient care	3.66	0.97		0.669	0.571	
C1	We are given feedback about changes put into place based on event reports	3.50	1.08		0.559	0.479	
C5	In this unit, we discuss ways to prevent errors from happening again	3.67	1.05		0.669	0.572	
C4	Staff feel free to question the decisions or actions of those with more authority	2.47	1.13		0.560	0.484	
C6	Staff are afraid to ask questions when something does not seem right	3.52	1.08		0.565	0.424	
B1	My supervisor / manager says a good word when he / she sees a job done according to established patient safety procedures	3.58	1.04		0.690	0.574	
B2	My supervisor / manager seriously considers staff suggestions for improving patient safety	3.73	0.92		0.685	0.589	
Frequency of events reported				0.865			1.76 before and 2.52 after rotation
D3	When a mistake is made that could harm the patient, but does not, how often is this reported?	3.36	1.23		0.870	0.806	
D2	When a mistake is made, but has no potential to harm the patient, how often is this reported?	3.35	1.23		0.893	0.837	
D1	When a mistake is made, but is caught and corrected before affecting the patient, how often is this reported?	3.34	1.24		0.814	0.718	
Organizational learning and management support				0.746			2.37 before and 2.95 after rotation
A13	After we make changes to improve patient safety, we evaluate their effectiveness	3.55	0.91		0.595	0.531	
A6	We are actively doing things to improve patient safety	3.87	0.91		0.453	0.492	
A18	Our procedures and systems are good at preventing errors from happening	3.61	0.88		0.495	0.402	
A9	Mistakes have led to positive changes here	3.51	0.91		0.500	0.432	
A11	When one area in this unit gets really busy, others help out	3.37	1.14		0.416	0.327	
F1	Hospital management provides a work climate that promotes patient safety	3.46	0.88		0.618	0.567	
F8	The actions of hospital management show that patient safety is a top priority	3.47	0.89		0.611	0.572	

Table 2 Descriptive statistics, reliability and factor structure of the Slovak version of HSOPS questionnaire (Part 3)

Dimensions with their statements from the HSOPS in Slovak context		mean	SD	Cronbach alpha	Factor loadings	Communalities	Eigenvalues
Management strategy / Safety planning				0.422			1.33 before and 1.65 after rotation
A15	Patient safety is never sacrificed to get more work done	3.46	1.12		0.658	0.492	
B4	My supervisor / manager overlooks patient safety problems that happen over and over	3.91	1.06		0.556	0.649	
F9	Hospital management seems interested in patient safety only after an adverse event happens	3.06	1.01		0.432	0.447	
Perception of patient safety, staffing adequacy and staffing blaming				0.661			2.13 before and 2.59 after rotation
A14	We work in "crisis mode" trying to do too much, too quickly	2.89	1.16		0.714	0.560	
A5	Staff in this unit work longer hours than is best for patient care	2.93	1.06		0.592	0.414	
A2	We have enough staff to handle the workload	2.71	1.16		0.576	0.518	
A8	Staff feel like their mistakes are held against them	3.27	1.05		0.461	0.396	
A17	We have patient safety problems in this unit	3.64	1.05		0.466	0.425	
A16	Staff worry that mistakes they make are kept in their personnel file	3.19	1.07		0.483	0.365	
Teamwork across units				0.497			1.02 before and 1.50 after rotation
F2	Hospital units do not coordinate well with each other	3.02	0.92		0.741	0.647	
F4	There is good cooperation among hospital units that need to work together	3.22	0.86		0.637	0.533	
HSOPS				0.884			

SD – standard deviation

The structure of the original version HSOPS factors and selected European versions (e.g. the Czech version) are reported in Table 3. Individual items have not been changed from the original version. Regarding the structure of individual items, Unit-level dimensions in Slovakia comprise: *"Teamwork within units"* (three items); *"Feedback and communication about errors and communication openness"* (eight items); *"Organizational learning and management support"* (seven items); *"Perception of patient safety, staffing-adequacy and ataffing-blaming"* (six items). Hospital-level dimensions comprise: *"Teamwork across units"* (two items), and *"Handoffs and transitions"* (five items). The layout in the unit and hospital level dimensions is the same as in the original version, although items are distributed between different dimensions. With regard to outcome variables, the original version contains two dimensions in this area: *"Frequency of events reported"* and *"Overall perceptions of patient safety"*. In our research, *"Frequency of events"* (three items) and *"Management strategy / Safety planning"* (three items) were reported as outcome variables. However, since it consisted mainly of statements about management, it fell more naturally into the area of the hospital-level dimension, and only one item in this area (A10) can realistically be used as an outcome variable.

Internal consistency (the Cronbach alpha coefficients) of the original 12 domains in the Slovak version ranged between 0.46 (*"Staffing"*) and 0.86 (*"Frequency of events reported"*). Reliability of the individual dimensions was compared with results for the original version of the HSOPS questionnaire (Sorra & Nieva, 2004), which delineated an acceptable level for Cronbach's alpha measurements as ≥ 0.60. In our study, acceptable values for

Cronbach's alpha coefficients were determined as follows: *"Feedback and communication about errors and communication openness"* (0.827); *"Organizational learning and management support"* (0.746); *"Perception of patient safety, staffing-adequacy and staffing-blaming"* (0.661); *"Handoffs and transitions"* (0.651); *"Frequency of events reported"* (0.865); and *"Teamwork within units"* (0.723). Two dimensions did not have acceptable Cronbach alpha coefficient values: *"Management strategy / Safety planning"* (0.422); and *"Teamwork across units"* (0.497).

Table 3 Factor structure of the HSOPS after PCA in the US version, and selected European versions (Part 1)

Dimensions of the HSOPS	US version	Slovak version	Czech version	Croatian version	Dutch version
Unit – level dimensions					
Teamwork within units	**Factor 1** (4 items)	**Factor 1** (3 items)	**Factor 1** (4 items)	**Factor 1 and 3** (7 items) The dimension was merged with *"Organizational learning-continuous improvement"*	**Factor 1** (4 items)
Supervisor / Manager's expectations and actions promoting patient safety	**Factor 2** (4 items)	**Factor 2 and 6 and 7*** (8 items) *"Feedback and communication about errors and communication openness"*	**Factor 2** (4 items)	**Factor 2** (4 items)	**Factor 2** (4 items)
Organizational learning – continuous improvement	**Factor 3** (3 items)	**Factor 3 and 4 and 5**** (7 items) *"Organizational learning and management support"*	**Factor 3** (3 items)	**Factor 1 and 3** (7 items) The dimension was merged with *"Teamwork within units"*	**Factor 3 and 6** The dimension was merged with *"Feedback and communication about errors"*
Feedback and communication about errors	**Factor 6** (3 items)	**Factor 2 and 6 and 7*** (8 items) *"Feedback and communication about errors and communication openness"*	**Factor 6** (3 items)	**Factor 6***** (5 items)	**Factor 3 and 6** (6 items) New dimension *"Feedback about and learning from errors*"
Communication openness	**Factor 7** (3 items)	**Factor 2 and 6 and 7*** (8 items) *"Feedback and communication about errors and communication openness"*	**Factor 7** (3 items)	**Factor 6 and 7***** Two items (C2; C4) from this domain together with *"Feedback and communication about errors"*	**Factor 7** (3 items)
Non-punitive response to errors	**Factor 12** (3 items)	**Factor 2 and 5 and 10**** (6 items) *"Perception of patient safety, staffing-adequacy and staffing-blaming*"	**Factor 12** (3 items)	**Factor 12** (4 items) Two items (C4; C6) from *"Communication openness"* together with items from *"Non-punitive response to errors"*	**Factor 12** (3 items)
Staffing	**Factor 10** (4 items)	**Factor 2 and 5 and 10**** (6 items) *"Perception of patient safety, staffing-adequacy and staffing-blaming"*	**Factor 10** (4 items)	**New factor F10** (2 items – A7, A2)	**Factor 10** (3 items)

Table 3 Factor structure of the HSOPS after PCA in the US version, and selected European versions (Part 2)

Dimensions of the HSOPS	US version	Slovak version	Czech version	Croatian version	Dutch version
Hospital-level dimensions					
Management support for patient safety	**Factor 4** (3 items)	**Factor 3 and 4 and 5** ** (7 items) *"Organizational learning and management support"*	**Factor 4** (3 items)	**Factor 4** (3 items and item A11) from "*Handoffs and transitions"*	**Factor 4** (3 items)
Teamwork across units	**Factor 9** (4 items)	**Factor 9** (2 items – F2, F4)	**Factor 9** (4 items)	**Factor 9** (3 items and items F3, F7) from "*Handoffs and transitions"*	**Factor 9** (4 items and items F3, F7) from "*Handoffs and transitions"*
Handoffs and transitions	**Factor 11** (4 items)	**Factor 11** (4 items and item F6) from "*Teamwork across units"*	**Factor 11** (4 items)	**New factor F11** (2 items – F11, F5)	**New factor F11** (2 items – F11, F5) *"Adequate shift changes"*
Outcome variable					
Frequency of events reported	**Factor 8** (3 items)	**Factor 8** (3 items)	**Factor 8** (3 items)	**Factor 8** (3 items)	**Factor 8** (3 items)
Overall perceptions of patient safety	**Factor 5** (4 items)	**Factor 2 and 3 and 7***** (3 items) *"Management strategy / Safety planning"*	**Factor 5** (4 items)	**Factor 5 and 6** (3 items and item A6) from "*Organizational learning-continuous improvement"*	**Factor 5** (3 items and item F14) from "*Staffing"*

**In the Slovak version formed with two items (B1, B2) from the American factor "Supervisor / Manager expectations and actions promoting patient safety", together with items from the dimension "Feedback and communication about errors" (C1, C3, C5), and items from the dimension "Communication openness" (C2, C4, C6). **Formed with three items (A6, A9, A13) from the American factor "Organizational learning-continuous improvement", together with items (F1, F8) from the dimension "Management support for patient safety", one item from the dimension "Overall perceptions of patient safety" (A18), and one item from the dimension "Teamwork within units" (A11). ***Formed with two items (C2, C4) from the American factor "Communication openness", together with "Feedback and communication about errors". ****Some items from three originally separate factors: "Overall perceptions of patient safety" (A17); "Staffing" (A2, A5, A14); "Non-punitive response to errors" (A8, A16) – were merged into one new factor: "Perception of patient safety, staffing-adequacy and staffing-blaming". *****Some items from three originally separate factors: "Overall perceptions of patient safety" (A10); "Supervisor / Manager expectations and actions promoting patient safety" (B4); "Management support for patient safety" (F9) – were merged into one new factor: "Management strategy / Safety planning".*

Pearson correlation analyses between the eight domains of the HSOPS (Table 4), and the two general items representing nurse-reported patient safety grade (E) and the number of events reported during the past twelve months, were also computed with regard to construct validity. The results of the study revealed that all correlations between nurse-reported patient safety grade and identified factors were statistically significant (the weakest correlation was with *"Frequency of events reported"*, and the strongest correlation was with *"Organizational learning and management support"*). In addition, we conducted a linear regression with *"Patient safety grade"* as the dependent variable and all eight HSOPS domains as the independent variables. In the Slovak version, 19.1% of the variance in *"Patient Safety Grade"* can be attributed to the eight domains (R^2 = 0.191; R^2_{adj} = 0.186). The strongest contribution to *"Patient safety grade"* was made by *"Organizational learning and management support"* (R^2_{adj} = 0.142; Standardized coefficient Beta = 0.264; t = 9.619), followed by *"Perception of patient safety, staffing-adequacy and staffing-blaming"* (R^2_{adj} = 0.043; Standardized coefficient Beta = 0.210; t = 8.103), and *"Management strategy / Safety planning"* (R^2_{adj} = 0.01; Standardized coefficient Beta = 0.103; t = 4.03). Multiple regression with each domain regressed against the item *"Patient safety grade"* revealed that five domains in the Slovak version (*"Feedback and communication about errors and communication openness"; "Handoffs and transitions"; "Frequency of events reported"; "Teamwork within units";* and *"Teamwork across units"*) made no significant unique contribution to explaining the variance of overall patient safety grade.

Table 4 Correlations between overall grade for patient safety for work area / unit, number of events reported, and new domains of the HSOPS

	Number of events reported	Overall grade for patient safety	Feedback and communication about errors / Communication openness	Organizational learning and management support	Perception of patient safety, staffing-adequacy and staffing-blaming	Handoffs and transitions	Frequency of events reported	Teamwork within units	Teamwork across units	Management strategy / Safety planning
Number of events reported		-0.239**	0.133**	0.04	0.002	-0.093**	0.156**	0.07*	0.062*	-0.002
Overall grade for patient safety	-0.129**		0.267**	0.379**	0.341**	0.217**	0.137**	0.204**	0.144**	0.210**
Feedback and communication about errors / Communication openness	0.133**	0.267**		0.542**	0.422**	0.315**	0.335**	0.390**	0.202**	0.228**
Organizational learning, management support	0.04	0.379**	0.542**		0.385**	0.350**	0.286**	0.477**	0.246**	0.264**
Perception of patient safety, staffing-adequacy and staffing-blaming	0.02	0.341**	0.422**	0.385**		0.338**	0.175**	0.250**	0.153**	0.173**
Handoffs and transitions	0.093**	0.217**	0.315**	0.350**	0.338**		0.158**	0.184**	0.295**	0.180**
Frequency of events reported	0.156**	0.137**	0.335**	0.286**	0.175**	0.158**		0.191**	0.083**	0.163**
Teamwork within units	0.07*	0.204**	0.390**	0.477**	0.250**	0.184**	0.191**		0.093**	0.105**
Teamwork across units	0.062*	0.144**	0.202**	0.246**	0.153**	0.295**	0.083**	0.093**		0.243**
Management strategy / Safety planning	-0.002	0.210**	0.288**	0.264**	0.173**	0.180**	0.163**	0.105**	0.243**	

*$p < 0.05$; **$p < 0.01$

Discussion

Previously, self-reporting questionnaires have mostly been used for measurement of the safety climate in hospital settings. Safety culture instruments are important for assessing hospital safety climate and for the implementation of safety-relevant interventions. From this point of view, the psychometric properties of available instruments should be examined and reported (Pfeiffer & Manser, 2010).

Considerable variation regarding the reporting of psychometric data of the HSOPS is found across studies. The large variability in terms of the reliability and validity of the HSOPS across several countries might be due to the influence of professional groups and other subcultures within health care (Waterson et al., 2019). Waterson et al. (2019) have emphasized that there is a need to understand the potential impact of national groups and professional groups or subcultures on safety climate in hospitals.

In our study, we aimed to test the psychometric properties of the HSOPS in the context of Slovak nursing practice. The instrument was tested in fourteen general hospitals, two university hospitals, and five teaching hospitals, and included a total of 1,427 questionnaires completed by nurses. The HSOPS instrument, which is commonly used to assess individual dimensions of patient safety culture, especially in America, was first used in Slovakia within the RANCARE project, which started in 2016 in Brussels. Since then, several studies have been published in connection with this project (e.g., Gurková et al., 2020); however, none previously has tested the psychometric properties of the HSOPS in Slovakia. It is quite clear that publication of results concerning the reliability and validity of the instrument is necessary for its further use in practice, by which the whole study was determined.

The results of Barlett's test of sphericity and the Kaiser-Meyer Olkin test proved that the sample size was adequate for testing the instrument; therefore it was possible to proceed to further tests regarding the validity and reliability of the instrument. Based on these results, PCA with Varimax rotation method, involving Kaiser Normalization, was then used. Results of the PCA did not replicate the dimensionality or the factor structure of the original version from the AHRQ. During implementation, it was found that the particular dimensions of safety culture in Slovakia could be summarized by a total of eight dimensions, whereas the original AHRQ version consisted of a total of 12 dimensions (Sorra & Nieva, 2004). An eight-dimension structure was also adopted in previous studies in countries such as Germany (Pfeiffer & Manser, 2010) and Kosovo (Brajshori & Behrens, 2016). Moreover, although other studies have conformed to the AHRQ total of 12 dimensions, individual items of the questionnaire have often been placed in different dimensions to those in the original AHRQ version (e.g. Bartoníčková et al., 2019; Najjar et al., 2013). Many other studies reported various numbers of dimensions, such as five in Georgia (Gambashidze et al., 2020); and nine in the United Kingdom (Waterson et al., 2010), Mexico (Antino et al., 2020), Latin America (Calvache et al., in press), and Norway (Olsen, 2010). Ten dimensions were identified in France (Ocelli et al., 2013), Turkey (Bodur & Filiz, 2010), Scotland (Sarac et al., 2011), Brazil (Reis et al., 2016), and Greece (Kapaki & Souliotis, 2017); while eleven dimensions were adopted in the Netherlands (Smits et al., 2008), Croatia (Brborović et al., 2014), and Bulgaria (Calvache et al., in press). In a Swedish study, as many as fourteen dimensions were identified (Hedsköld et al., 2013; Nordin et al., 2013). The distribution of items based on individual dimensions seems to depend mainly on factors that affect cultural diversity, customs and traditions, organizational structures, management and healthcare policy, as confirmed in the study of Rahimi et al. (2020). This must be anticipated in the context of the diversity of individual nations. Regarding the results for the individual dimensions in our study, complete compliance of the items with the original AHRQ version was indicated in the following dimensions: *"Frequency of events reported"* and *"Handoffs and transitions"*. Sorra and Nieva (2004) state that individual items can be combined and placed in various dimensions, and that new dimensions can be constructed. Accordingly, in some of the eight dimensions we adopted, the number of individual items was increased, and the dimensions *"Feedback and communication about errors"* and *"Communication openness"* were merged into a single new dimension: *"Feedback and communication about errors and communication openness"*. These two items have also been merged in previous studies (Bartoníčková et al., 2019; Blegen et al., 2009; Najjar et al., 2013; Sarac et al., 2011). In addition, *"Supervisor / Manager expectations and actions promoting patient safety"* was subsumed into this dimension. The *"Organizational learning and continuous improvement"* and *"Management support"* dimensions were merged into a single new dimension not previously identified in research studies: *"Organizational learning and management support"*. An item from the dimension *"Teamwork within units"* was also added to this dimension. All items assigned to *"Supervisor / Manager expectations and actions promoting patient safety"* were related theoretically, supporting the development of this new dimension. Finally, two completely new dimensions were created: *"Management strategy / Safety planning",* and *"Perception of patient safety, staffing adequacy, and staffing blaming"*. Newly-developed dimensions were also identified in a study by Rahimi et al. (2020).

The total Cronbach alpha for the questionnaire was $\alpha = 0.884$. which is sufficient, according to the AHRQ (an acceptable level of Cronbach's alpha is defined as ≥ 0.60). Similar total values for Cronbach's alpha were also demonstrated in the Czech Republic in the study by Bartoníčková et al. (2019). Based on the result of the Cronbach alpha coefficient, it was found that, with the exception of two dimensions [*"Management strategy / Safety planning"* (0.422) and *"Teamwork across units"* (0.497)], dimensions had a tolerable level

of reliability (ranging from α = 0.651 for *"Handoffs and transitions"* to α = 0.865 for *"Frequency of events reported"*). In our study, Cronbach's alpha was highest for the dimension *"Frequency of events reported"* (0.865), which was the case in many previous studies (Brajshori & Behrens, 2016; Bodur & Filiz, 2010; Hedsköld et al., 2013; Najjar et al., 2013; Pfeiffer & Manser, 2010; Sarac et al., 2011; Sorra & Nieva, 2004; Sorra & Dyer, 2010; Reis et al., 2016, among others).

There is a need to expand the range of theoretical constructs that influence and shape patient safety climate across national groups and professional groups. Patient safety climate might be affected by values, attitudes, perceptions, competencies, and patterns of behavior that determine the relationship of the organization, its style, and expertise. Our study revealed that the strongest contribution to *"Overall patient safety grade"* from Slovak nurses' perspective was made by *"Organizational learning and management support"*. These results are in line with previous Slovak studies focusing on safety climate in Slovak hospitals (Gurková et al., 2020; Sováriová Soósová et al., 2017).

The study has a number of limitations. The first limitation is the low-reliability coefficient for two dimensions of the HSOPS: *"Teamwork across units",* and the newly-created *"Management strategy / Safety planning"* (low reliability for newly-developed dimensions has been reported in previous studies). In addition, the use of a non-randomized sampling method might have limited the results of our study. The final limitation is the inclusion of only registered nurses in the study, whereas the instrument can be used with all healthcare professionals.

Conclusion

The study aimed to verify the psychometric properties of the Slovak version of the Hospital Survey on Patient Safety Culture instrument in the context of Slovak practice. When testing a tool, it is always necessary to evaluate its validity and reliability, since individual cultural traditions and customs in the field of health care are differ from country to country. The Slovak version of the questionnaire demonstrated good properties in terms of its verification. With the exception of two dimensions, Cronbach alpha coefficients exhibited good values of α ≥ 0.60. The total Cronbach alpha coefficient for the whole questionnaire was α = 0.884. Regarding PCA, an eight-factor structure was identified as most appropriate for the Slovak version of the HSOPS. We recommend that this validated version of the HSOPS be used in Slovakia to avoid inconsistencies caused by new modifications to or translations of the original version of the HSOPS. The use of a single validated version will also facilitate comparison of data across Slovakia. Likewise, we recommend further studies be conducted, using this HSOPS questionnaire in different settings, such as pediatric care or long-term care, and that its psychometric properties be tested using confirmatory factor analysis. The authors will make the Slovak version of the instrument available, and it will also be offered to the AHRQ.

Ethical aspects and conflict of interest

The authors are not aware of any conflict of interest regarding this publication. The psychometric testing of the HSOPS was performed as part of a national research study approved by the institutional board committee (E.C. 30/2017). In all selected hospitals, written permission to carry out the study was granted. Respondents were fully informed about the study, agreed to participation in it by completing and returning the questionnaire, and were assured of anonymity.

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Author contributions

Conception and design (EG, DK, KŽ, RK), data analysis and interpretation (DB, DK, EG), manuscript draft (DB, DK), critical revision of the manuscript (DB, DK, EG, RK, KŽ), final approval of the manuscript (DK, DB, EG, RK, KŽ).

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