Measuring Patient Safety Culture in Hospitals

Psychometric performance issues of translated and adapted instruments in different healthcare systems

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List of Abbreviations

PSC	– Patient Safety Culture
HSPSC	– Hospital Survey on Patient Safety Culture
HSPSC-D	– German version of Hospital Survey on Patient Safety Culture
HSPSC-Ge	– Georgian version of Hospital Survey on Patient Safety Culture
SAQ-S	– Safety Attitudes Questionnaire, short version
SAQ-S-Ge	– Georgian version of Safety Attitudes questionnaire, short version
AHRQ	– the Agency for Healthcare Research and Quality
CI	– confidence interval
EFA	– exploratory factor analysis
CFA	– confirmatory factor analysis
ANOVA	– analysis of variance
MANOVA	– multivariate analysis of variance

1. Abstract

In the past two decades patient safety has become a widely recognized concern of modern healthcare provision. However, the evidence from different healthcare systems, both in developing and developed countries, suggests that the number of patients experiencing adverse events remains unacceptably high. To address the highly complex and ever-adapting nature of healthcare services, and to allow continuous improvement of patient safety at the point of service provision, establishing a patient safety culture (PSC) which supports open communication about safety relevant issues, is blame-free and a supportive environment for individual and organizational learning has been recommended. A number of studies in different clinical areas have provided some evidence of association between positive patient safety culture and various patient outcomes.

In order to establish and promote a positive patient safety culture, hospital managers need to measure it systematically with valid instruments, a number of which have been developed and implemented worldwide. Despite an increasing number of validation studies using different language versions of the same instruments, it is still not clear, to what extend do these instruments perform differently in new environments and to what extent the results of these studies can be compared. The core dimensions of PSC are also not clear, the dimensions that are stable across various instruments and various healthcare systems.

In order to facilitate better conceptualization of PSC, to further the development of PSC instruments, and to support the comparability of results across different healthcare systems, this thesis aimed to study various measurement issues associated with the use of translated and adapted versions of established instruments for measuring patient safety culture in hospitals. The data from German, Swiss and Georgian hospitals were used to evaluate the psychometric properties of two PSC instruments, to reveal the PSC dimensions they measure, as well as to study the effects of various instrument- and sample related factors on the psychometric performance of these instruments and on survey results.

Studies A, C and D found that dimensionality of the instruments may vary between different language versions and/or healthcare systems. Moreover, study B demonstrated a significant effect of participant characteristics such as profession and managerial functions on study results. Interestingly, these effects were found to vary across healthcare systems. The results of study C showed an effect of reverse item bias on the psychometric properties, as well as on the survey results. Overall, the results of the studies included in this thesis show that currently available instruments, although useful for studying patient safety culture locally, may not be valid for international comparative studies. Moreover, as the performance and the outcome of these

instruments may depend on characteristics of the healthcare system, the sample and the participants, interpretation and comparison of results across studies should be made with extreme caution.

All research papers have been published in international peer-reviewed journals: three in BMJ Open (impact factor on 18.02.2020: 2.367) and one in the Journal of Patient Safety (impact factor on 18.02.2020: 3.386) (Appendix, studies A-D).

2. Introduction

2.1. Patient safety culture (PSC) in an international context

In the last few decades, the issue of patient safety has gained considerable attention globally. Many influential national and international organizations have embraced the need for continuous improvements in patient safety. One example of ongoing international collaboration on patient safety is the Global Ministerial Patient Safety Summit series, held annually in different locations. The first summit was held in London in 2016 and resulted in the Patient Safety 2030 report (Yu et al., 2016), which among others, underlined the importance of international collaboration for improving patient safety, especially involving the low- and middle- income countries, “whose citizens cannot afford for quality to fail” (Lancet editorial, 2016). The importance of international collaboration for improvements in patient safety was continuously reaffirmed by the subsequent summits in Bonn (Godschalk et al., 2017), Tokyo (*Tokyo Declaration on Patient Safety, 2018)* and Jeddah (*Jeddah Declaration on Patient Safety*, 2019).

With the constant and dynamic increase in complexity of modern healthcare provision, healthcare managers are confronted with equally dynamic patient safety related risks. To manage these risks, managers and decision makers at different levels of healthcare are implementing a number of patient safety initiatives. Positive PSC is thought to support the effectiveness of these initiatives (Singer & Vogus, 2013). The aforementioned report by Yu et al (2016) described creating the culture of safety as “a necessary condition for lasting improvements in patient safety” (Yu et al. 2016).

PSC is a complex construct, without a commonly used definition among different researchers (Armutlu et al., 2020). Singer and Vogus define it as a set of “shared assumptions, values, attitudes, and patterns of behavior regarding safety that become embedded over time” (Singer & Vogus, 2013). PSC is generally considered to be a relatively stable construct, deeply rooted in organizational culture (Guldenmund, 2000). The complexity of PSC is not limited to its definitions; while PSC is widely regarded as a multidimentional construct, different study groups use different sets of dimensions to operationalize PSC (Alsalem et al., 2018; Pumar-Mendez et al., 2014; The European Network for Patient Safety, 2010), and these variations are reflected in differences between measurement instruments in use. The review by Pumar-Mendez et al underlined the variability in measurement instruments, as well as measurement practices, and called for more comprehensive research “to clarify what dimensions belong to the core of safety culture…”; to strengthen psychometric properties of the available instruments; and to clarify the main sources of variability in safety culture measurements (Pumar-Mendez et al., 2014).

Thus, the objective of this thesis was to study various measurement issues associated with using translated and adapted versions of internationally well-established instruments in diverse healthcare systems. The findings of this thesis facilitate better conceptualization of PSC, further development of study instruments, and improvements in the comparability of results across different healthcare contexts.

2.2. Measuring PSC in hospital context

Managers in healthcare organizations may be interested in assessing PSC for a variety of reasons. They may want to use the results (i) to better understand the current culture and to plan for targeted interventions; (ii) to monitor progress of these interventions and the change of PSC over time; (iii) to satisfy regulatory requirements; or simply (iv) to gain a competitive advantage by demonstrating achievements (or at least activity) in patient safety.

In hospital settings PSC is typically measured by means of self-administered questionnaires (EUNetPaS, 2010; C. Wagner et al., 2013). A number of such instruments have been developed worldwide and validated in diverse healthcare systems. The Hospital Survey on Patient Safety Culture (HSPSC) (Sorra & Nieva, 2004), developed by the Agency for Healthcare Research and Quality (AHRQ) is by far the most frequently translated PSC assessment instrument (Reis et al., 2018; EUNetPaS, 2010; Waterson et al., 2019), followed by the Safety Attitudes Questionnaire, short version (SAQ-S) (Sexton et al., 2006), developed at the University of Texas. These two instruments have demonstrated adequate psychometric properties in a number of language versions (Hammer & Manser, 2014; Reis et al., 2018; Waterson et al., 2019). There is limited evidence indicating the association between measurement results of these instruments and various patient related outcomes (DiCuccio, 2015) (Clay-Williams et al., 2020) but more research is required in this regard.

The HSPSC consists of 42 individual patient safety relevant items, which are grouped into different PSC dimensions. The items measure participants' agreement or the perception of frequency on a 5-point Likert scale. This instrument also contains two single items, the 'Number of events reported' (six-point Likert scale for frequency) and the 'Patient safety grade' (a five-point Likert scale from 'Failing' to 'Excellent'). The twelve dimensions according to the original study by Sorra and Nieva (Sorra & Nieva, 2004), as well as single items are presented in appendix, table A1.

Similarly, the SAQ-S measures participants' agreement to 36 safety relevant items on a 5-point Likert scale. The individual items can be grouped to form PSC dimensions. The six dimensions according to recommendations of the University of Texas (accessed at https://med.uth.edu/chqs/survey/ on 22.02.2020) and corresponding items are presented in appendix, table A3.

3. Objective

The present thesis consists of four publications on different measurement issues associated with using translated and adapted versions of established, widely used instruments for patient safety culture assessment, internationally. In these publications, we used data from German, Swiss and Georgian hospitals to (i) evaluate psychometric properties of translated instruments, (ii) evaluate and compare dimensionality of the instruments, (iii) evaluate the role of negatively worded items in the performance of the instrument, and (iv) evaluate the effect of various participant characteristics on the results.

4. Publications: methods and key findings

In this section the methods and key findings of each publication included in this thesis will be briefly summarized. More detail can be found in corresponding publications in appendices A-D.

1.1. Study A – Evaluation of psychometric properties of the German Hospital Survey on Patient Safety Culture and its potential for cross-cultural comparisons: a cross-sectional study

This study used data from a cross-sectional, multicenter, mixed methods study ”Working conditions, safety culture and patient safety in hospitals – what predicts the safety of the medication process” (WorkSafeMed)(A. Wagner et al., 2019). Across two German university hospitals, a total of 73 units from 37 departments participated in the study, between 2014 and 2017.

The evaluation of psychometric properties and dimensionality of the German HSPSC (HSPSC-D) included descriptive statistics, analysis of internal consistency, analysis of construct validity through evaluation of correlations between hypothesized constructs, Exploratory Factor Analysis (EFA), Confirmatory Factor Analyses (CFA) using original factor structure, as well as the one revealed in the EFA. In order to evaluate the potential of the instrument for cross-national studies, dimensionality of various language versions was studied. Studies using different language versions of HSPSC in different countries and which reported psychometric properties and dimensionality of the adapted instruments were identified from the website of the Agency for Healthcare Research and Quality (AHRQ). We evaluated appearance and composition of each of the 12 original dimensions and those of the 42 corresponding items in all factor models reported by different authors.

The HSPSC-D demonstrated satisfactory psychometric properties for use in German hospitals, with acceptable internal consistency and marginally satisfactory fit to an original 12-factor model. An alternative eight-factor structure resulted in a better model fit and internal consistency. The analysis using ten other language versions revealed limitations concerning cross-national studies. Only eight out of twelve original dimensions appeared relatively stable across different versions and so can be considered better suited for international comparisons.

1.2. Study B – Influence of gender, profession and managerial function on clinicians' perceptions of patient safety culture. A cross-national cross-sectional study

This study aimed to evaluate the effect of participant characteristics on the patient safety culture measurements. To do so, in addition to the data from the WorkSafeMed study, the survey data which had been collected in 2017 from University Hospital Zurich was used. Conducting all analyses separately for the German and Swiss samples allowed for exploring similarities and differences between these two healthcare systems. Only the frontline physicians and nurses were selected from both datasets for the analyses. After exclusion of the cases with excessive missing answers, the remaining missing answers were imputed using an expectation maximization algorithm.

First, the effect of the participant characteristics gender, profession and managerial function on various PSC dimensions in two countries was evaluated. Analyses included multivariate analysis of variance (MANOVA) to evaluate overall effect of participant characteristics on the correlated system of eleven PSC dimensions of the instrument, followed by unbalanced factorial analyses of variance (ANOVA) to evaluate the effect on each individual dimension. The effect size was evaluated using Omega squared (ω^2). Direct and indirect effects of participant characteristics on PSC dimensions were also analyzed.

Next, the study evaluated the effect of the same participant characteristics on the relationship between different aspects of PSC and participants' perceptions of patient safety. The analysis comprised of multiple linear regressions with the outcome dimension Overall Perception of Patient Safety as dependent variable, and ten dimensions of PSC as independent variables. Separate analyses was conducted for the eight groups of participants (gender x profession x managerial function).

The study found that the participants' profession and managerial functions had significant direct effect on PSC, while gender had only indirect effect through affecting profession and managerial functions. Most of these effects were more prominent in the German sample. The multiple regression analyses revealed similarities and differences between participant groups in terms of determinants of Overall Perception of Patient Safety. Four dimensions had no significant effect in any of the groups. The study results indicate that participant characteristics may have an effect on the measurement results, as well as on the relationship between various dimensions.

1.3. Paper C – Psychometric properties of the Georgian version of Hospital Survey on Patient Safety Culture: a cross-sectional study

The primary objective of this study was to evaluate the psychometric properties of the Georgian version of the HSPSC (HSPSC-GE). The analysis used data collected in the cross-sectional study “Patient Safety Culture in Georgian Healthcare (PaSCu.Ge)” in three general hospitals in Georgia between November 2017 and March 2018. Prior to data collection the HSPSC was translated into Georgian, adapted to Georgian healthcare, and back-translated to English to evaluate the discrepancies with the original version. After necessary adjustments, the instrument was pretested with a group of Georgian healthcare professionals to finalize the HSPSC-GE (appendix, table A2).

The analyses included descriptive statistics, analysis of acceptability, analysis of floor and ceiling effects, evaluation of internal consistency and construct validity. To explore dimensionality of the instrument, a split sample validation was employed. Fit of the data to the original 12 factor model was also evaluated in CFA.

Results of the preliminary analysis, as well as outcome of EFA revealed divergent performance of positively- and negatively-worded items, which could have indicated the presence of reversed-item bias, meaning that participants may respond inconsistently to positively- and negatively-worded items. To check for the presence of this bias, CFA of an extended model was conducted, by adding method-factors with effects on the positively- or negatively-worded items.

The analysis of HSPSC-GE using original 12-factor model resulted in limited internal consistency (Cronbach’s alpha 0.35–0.87), and poor model fit. Accounting for reversed-item bias resulted in improved fit indices. The EFA resulted in an alternative factor model with acceptable fit indices, however with only 19 items remaining out of 42, grouped in 5 factors.

The results indicated poor psychometric properties of the HSPSC-GE in total, and underlined the parts of the instrument with relatively reliable performance. The possible presence of reversed-item bias was also demonstrated.

1.4. Paper D – Psychometric properties of the Georgian version of the Safety Attitudes Questionnaire. A cross-sectional study

The objective of this study was to evaluate the psychometric properties of SAQ-S-GE. Data were collected in three Georgian hospitals between June and August 2017 as part of the cross-sectional study Patient Safety Culture in Georgian Healthcare (PaSCu.Ge). SAQ-S-GE was prepared after translating it from the original English version, adapting it to local healthcare, back-translating to English by professional translators, and then cognitive pretesting in a group of professionals working in Georgian healthcare. An effort was made to maintain the overall composition and item wording of the original SAQ-S in order to support comparability of the results. Hospital representatives were trained to act as local study coordinators and facilitate employee participation in data-gathering.

Analyses included the descriptive statistics, analysis of acceptability, floor and ceiling effects, evaluation of internal consistency, construct validity, convergent and discriminant validity. CFA was used to evaluate the fit of the data to the original 6 factor model, and a possible alternative factor model was explored in EFA.

SAQ-S-GE demonstrated acceptable construct validity and internal consistency (Cronbach's alpha 0.61–0.91), but limited model fit. EFA resulted in an alternative 4-factor model with acceptable model fit. Overall, the instrument demonstrated adequate psychometric properties to be used in Georgian hospitals. However, the dimension Working Conditions should be interpreted with caution.

5. Discussion

This thesis focused on measurement issues associated with using translated and adapted instruments for measuring PSC in hospitals across different healthcare systems. Two internationally widely used instruments that originated in the USA were used to explore various aspects of their performance in diverse healthcare systems. Comparing results between two neighboring (German and Swiss) healthcare systems emphasized possible similarities and differences between these two. Studying psychometric properties of the same instrument in a different, developing healthcare system (Georgian) further demonstrated specifics of the instrument's performance. And finally, evaluating the performance of a different instrument (SAQ-S-GE) in the same developing environment further revealed issues associated with the instrument design.
The results of the individual studies were discussed in the publications (Appendix, studies A-D). The following discussion is focused on the overall findings, and is organized according to the messages that can be considered as what this work contributes to the scientific knowledge.

5.1. Translated and adapted instruments can reliably measure PSC locally

Studies from all over the world are being published reporting acceptable to good psychometric properties of translated and adapted instruments for measuring patient safety culture in different healthcare systems. Even though some parts of the instruments may not perform as intended, overall performance of the instruments are continuously deemed as satisfactory (Hammer & Manser, 2014; Jackson et al., 2010; Waterson et al., 2019). This thesis demonstrates similar results once again in our studies using German (study A) and Georgian (studies C and D) data. This finding, though not new, confirms, that translated and adapted instruments, after appropriate validation, can be used in a different healthcare system to reliably measure PSC. Moreover, because there may be local variations in the instrument's performance, without adequate validation studies, the results of the PSC instruments cannot be reliably interpreted, and thus cannot be used to advance the understanding of PSC in general (Pumar-Mendez et al., 2014).

5.2. The dimensionality and performance of PSC instruments vary across language versions

Each individual language version of an instrument may independently perform acceptably; however, our analysis (paper A) demonstrates that the instrument's dimensionality may vary significantly across different language versions. Out of twelve originally proposed dimensions of HSPSC, eight dimensions, including Teamwork within units, Nonpunitive response to error, Staffing, Supervisor/manager expectations/actions, Frequency of event reporting, Feedback and communication about error, Hospital management support for patient safety and Teamwork across hospital units, were relatively stable in studies from different healthcare systems. The meaning and relevance of the items representing these dimensions may be more stable across different language translations and/or different healthcare systems. The items from other dimensions, namely Organizational Learning—Continuous improvement, Overall Perceptions of Safety, Communication Openness and Hospital Handoffs & Transitions, were either removed, or migrated to other dimensions. The analysis using the SAQ-S-GE (paper D) similarly revealed the dimensions with stabile composition, and the dimensions which likely do not have the same composition and meaning in translated version.

The dimensions that demonstrate relative stability across different language translations and cultural contexts may be better suited for international comparisons, while the items and dimensions with higher variation across studies may need further improvements. Overall, better understanding of whether or not the items and dimensions of different instruments are stable across different contexts and language versions, should be used to better understand and conceptualize PSC on an international level, which may lead to a unified definition of the concept.

5.3. Sample characteristics may influence the results of the measurements, as well as the relationships between different dimensions of PSC

The study using German and Swiss data (paper B) demonstrated a significant direct effect of participants’ profession and managerial functions, and an indirect effect of participants’ gender on various aspects of PSC. This finding emphasizes the importance of accounting for the sample composition while interpreting the study results. This is becoming especially important, as the results of PSC surveys are usually presented, analyzed and interpreted as aggregated data at unit or hospital level. For example, if a sample from one unit or a hospital has more than average proportions of physicians, and if the physicians tend to assess a certain aspect of PSC more positively than nurses, then the first unit will have more positive scores, simply because of higher concentration of physicians in the sample. The recent meta-analysis by Okuyama et al demonstrated, that the proportion of physicians in the study had significant effect on the outcomes of three dimensions of HSPSC, namely Overall perceptions of patient safety, Feedback and communication about error, and the Frequency of events reported (Okuyama et al., 2018). To make matters more complicated, in the analysis reported in study B, the effect of participant characteristics was not constant across samples, as almost all between-group differences were considerably more prominent in the German sample, compared to Swiss data.

Further analysis showed that the same participant characteristics may affect, not only the results of the measurements (i.e. descriptive statistics), but also the relationships between PSC dimensions (correlations, regression coefficients); hence effecting the psychometric properties of the instrument.

The finding, that the participant characteristics may influence measurement results, as well as psychometric properties of an instrument, once again underlines the significance of local validation studies before using a new instrument, and of the careful interpretation of results whilst considering the sample composition.

To aid in better interpretation of the results, various authors have proposed alternative scoring and visualization (Jeong et al., 2019), and consider climate strength as an additional measurement of congruency of PSC within a group (Afsharian et al., 2018; Ginsburg & Gilin Oore, 2016; Mascherek & Schwappach, 2017). Interestingly, climate strength has been associated with team performance (Gonzalez-Roma & Hernandez, 2014).

5.4. The instrument design may influence the measurement results, as well as the performance of the instrument

The analysis of HSPSC-GE data from Georgian hospitals (paper C) demonstrated the effect of item wording on the study results, as well as on the outcomes of factor analysis. Out of 42 items considered in factor analysis, the instrument includes 18 negatively worded items. In the case of positive wording, higher scores corresponds to better PSC (e.g. F1:”*The actions of hospital management*”), whilst for negatively-worded items, higher scores correspond to less desirable PSC (e.g. F2:”*Hospital units do not coordinate well with each other*”). The negatively worded items are not equally distributed in different dimensions of the instrument, ranging from none, to all four of the items in a dimension. Experimental study using HSPSC demonstrated the effect of item wording on the survey results (Moghri et al., 2013). Our analysis demonstrated that the item wording could not only have an effect on measurement results (i.e. mean scores, standard deviation), but also effect the psychometric properties of the instrument.

SAQ-S-GE, the second instrument we used in Georgian hospitals (paper D), has only 3 out of 36 negatively worded items, only two of which were part of the factor analysis. Both items were removed in the EFA, reaffirming that in the Georgian sample, negatively worded items perform differently.

6. Conclusions

Currently available instruments seem adequate to measure PSC in local hospital settings. Each new version of the instrument needs to be validated in order to establish characteristics of its performance. The survey results should be interpreted with caution, taking into account multiple factors, including but not limited to sample composition and characteristics, and characteristics of the chosen instrument.

The same instruments have considerable limitations when considering studies on an international level. Variations in instrument performance should be taken into account when contrasting the results from different healthcare systems and in different language versions.

Future research should concentrate on consolidating the vast experience accumulated in the past two decades of using the same instruments in diverse environments to form a unified instrument, better suited for international and intercultural studies, to further our understanding of patient safety culture.

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8. Appendix

10.1. Study A

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BMJ Open

Evaluation of psychometric properties of the German Hospital Survey on Patient Safety Culture and its potential for cross-cultural comparisons: a cross-sectional study

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ABSTRACT

Objective To study the psychometric characteristics of German version of the Hospital Survey on Patient Safety Culture and to compare its dimensionality to other language versions in order to understand the instrument's potential for cross-national studies.

Design Cross-sectional multicentre study to establish psychometric properties of German version of the survey instrument.

Setting 73 units from 37 departments of two German university hospitals.

Participants Clinical personnel (n=995 responses, response rate 39.6%).

Primary and secondary outcome measures Psychometric properties (eg, model fit, internal consistency, construct validity) of the instrument and comparison of dimensionality across different language translations.

Results The instrument demonstrated acceptable to good internal consistency (Cronbach's alpha 0.64–0.88). Confirmatory factor analysis of the original 12-factor model resulted in marginally satisfactory model fit (root mean square error of approximation (RMSEA)=0.05; standardised root mean residual (SRMR)=0.05; comparative fit index (CFI)=0.90; goodness of fit index (GFI)=0.88; Tucker-Lewis Index (TLI)=0.88). Exploratory factor analysis resulted in an alternative eight-factor model with good model fit (RMSEA=0.05; SRMR=0.05; CFI=0.95; GFI=0.91; TLI=0.94) and good internal consistency (Cronbach's alpha 0.73–0.87) and construct validity. Analysis of the dimensionality compared with models from 10 other language versions revealed eight dimensions with relatively stable composition and appearance across different versions and four dimensions requiring further improvement.

Conclusions The German version of Hospital Survey on Patient Safety Culture demonstrated satisfactory psychometric properties for use in German hospitals. However, our comparison of instrument dimensionality across different language versions indicates limitations concerning cross-national studies. Results of this study can be considered in interpreting findings across national contexts, in further refinement of the instrument for cross-national studies and in better understanding the various facets and dimensions of patient safety culture.

Strengths and limitations of this study

- ► Our study supports the development of a more uniform factor structure for the Hospital Survey on Patient Safety Culture across language versions in order to facilitate its use in cross-national research.
- ► By evaluating commonalities and variations in different language versions of the Hospital Survey on Patient Safety Culture, we identify relatively stable factors, as well as those in need for improvement.
- ► This is the first study to validate the German version of the Hospital Survey on Patient Safety Culture for clinical personnel.
- ► The considerable diversity in study methodology and reporting of studies with different language versions of the Hospital Survey on Patient Safety Culture presents an obstacle for cross-national use of the instrument that has yet to be overcome.

INTRODUCTION

All healthcare organisations face specific sets of risks and challenges regarding patient safety. These challenges change dynamically over time, reflecting developments within the organisation as well as in its operating environment such as changes in demographics and epidemiology or in patient behaviour. To effectively manage these challenges, it is recommended for healthcare organisations to develop a culture of safety that prioritises safety and organisational learning among other organisational goals.[1] Safety culture is generally considered to be a relatively stable construct, rooted in organisational culture.[2]

A number of instruments for measuring safety culture in healthcare organisations have been developed. These instruments enable researchers and decision makers to evaluate and compare results on different levels of the healthcare system.[3] Comparing results across units and hospitals and establishing benchmarks can drive continuous patient safety improvement. One of the most widely used instruments for evaluating healthcare providers' perception of safety culture in hospital setting is the Hospital Survey on Patient Safety Culture (HSPSC).[4] The instrument has been translated into many languages and used in different countries around the world.[5–16]

There are two gaps that this study aims to address. First, so far, no German version of HSPSC has been validated for healthcare personnel in Germany. Second, despite some attempts at comparing safety culture at the international level,[17 18] the comparability of the different language versions of the instrument has not been studied systematically. While satisfactory psychometric properties were reported for the original North-American version[4] with 12 dimensions of patient safety culture, alternative factor structures have been reported for other language versions, with the number of dimensions ranging from 8 to 12.[5–7 9–12 14–16] Because an instrument's dimensionality determines the interpretation of results, similarities and differences in dimensionality across different language versions should be considered for cross-national studies of patient safety culture.

Therefore, the aim of this study is twofold: (1) validation of German version of HSPSC (HSPSC-D) by evaluation of its psychometric properties and (2) evaluation of the instrument's potential for cross-national studies, by comparative analysis of instrument's dimensionality as reported for different language versions.

METHODS

Setting

This study was based on data from the cross-sectional, multicentre study 'Working conditions, safety culture and patient safety in hospitals: what predicts the safety of the medication process (WorkSafeMed),' conducted between 2014 and 2017. In this article, we focus on HSPSC-D data to evaluate its psychometric properties. The WorkSafeMed study with all its components has been approved by the responsible ethics committees of the medical faculties of the project partners in Bonn (#350/14) and Tubingen (#547/2014BO1). Each partner complied with confidentiality requirements according to German law.

Sample

Safety culture data were collected in two German university hospitals from April to July 2015. We included staff from inpatient units with ≥500 patients a year. Intensive care and psychiatric units were excluded. Across the two hospitals, a total of 73 units from 37 departments participated in the study. The HSPSC-D questionnaire was distributed to 2512 healthcare professionals. All participants received an initial invitation to participate in the study, followed by two reminders. Study material included all required information regarding the study and data handling. Participation in the study was anonymous, and participants' consent was implied by returning completed questionnaires. Non-responder analysis was not performed.

Measure

In order to develop a version of the HSPSC for German healthcare professionals (HSPSC-D), we used two previous German language versions as a starting point. A first translation of the HSPSC for hospital staff in the German speaking part of Switzerland[7] had been culturally and linguistically adapted for use in Swiss hospitals. Hammer *et al.*[19] used the Swiss version as a starting point for developing a management version of HSPSC to study perceptions of safety culture among medical directors in German hospitals. In our study, the instrument was adapted to be used with healthcare personnel in German hospitals.

The resulting HSPSC-D questionnaire follows the structure of the original North-American version[4] and includes 44 items, 42 of which compose 12 dimensions (10 safety culture dimensions and 2 outcome dimensions). These 42 items use a five-point Likert scale to measure agreement ranging from 'strongly disagree' (1) to 'strongly agree' (5) or frequency ranging from 'never' (1) to 'always' (5). The remaining two single item measures are 'Number of events reported' (measured on six frequency groups from 'No event reports' to '21 event reports or more') and 'Patient safety grade' (measured on five-point scale from 'Failing' to 'Excellent').

ANALYSIS

Data processing and preliminary analysis

After excluding responses with more than 30% missing values in HSPSC-D items, we conducted multiple imputations based on the expectation maximisation (EM) algorithm using the statistical software NORM V.2.03[20 21] to replace remaining missing values. Negatively worded items were reverse coded before further analysis.

Several indices were taken into account to ensure that our study sample, as well as every subset used in further analysis, was appropriate for factor analysis. Kaiser-Meyer-Olkin (KMO) indicates if the sample of items is adequate for factor analysis, while Measure of Sampling Adequacy (MSA) indicates if an individual item is adequate for factor analysis. For both indices, the value >0.7 is desired, and the value of >0.9 is considered perfect.[22] A significant p-value (<0.05) of Bartlett's test of sampling adequacy indicates that it is possible to extract more than one factor.[22] The analyses were performed using SAS V.9.4.

Descriptive statistics

We calculated composite scores for each dimension suggested by Sorra and Nieva[4] by calculating the average of corresponding items. We also calculated percentages of positive responses for each dimension by dividing the number of positive responses on corresponding items by the number of non-missing answers in the dimension. Descriptive statistics for each item and dimension were evaluated, including range, mean and SD.

Exploratory factor analysis

We used exploratory factor analysis (EFA) to evaluate the factor structure emerging from the study data. In general, EFA and confirmatory factor analysis (CFA) should be performed using different subsets.[23] Thus, we performed the split-half cross validation, by randomly splitting our sample in two: 'Exploring' (for EFA) and 'Testing' subsets (for subsequent CFA). EFA using maximum likelihood was conducted using the 'Exploring' subset. We used Varimax orthogonal pre-rotation, and Promax oblique rotation to aid with interpretation of factor model.[23] We used scree plot and Kaiser Criterion (Eigenvalues >1) for factor extraction. Factor loadings ≥0.4 were considered significant, and factor cross loading <0.4 was considered acceptable.[22 23] Applying these criteria, we gradually eliminated problematic items until EFA resulted in a satisfactory factor structure.

Confirmatory factor analysis

We evaluated the model fit of the factor structure resulting from the EFA by conducting CFA using the 'Testing' subset. By conducting a series of CFA using the complete dataset, we evaluated model fit of original 12-factor model,[4] as well as other factor models reported by studies of different language versions of HSPSC. From the official website of the Agency for Healthcare Research and Quality (AHRQ),[24] we retrieved a list of studies including psychometric evaluation of the instrument and identified those reporting a different factor structure.

Internal consistency

Internal consistency was evaluated by calculating Cronbach's alpha as an indicator of correlation between each item and the factor. In their exploratory study, Sorra and Nieva[4] considered Cronbach's alpha ≥0.6 as acceptable. We used Cronbach's alpha ≥0.7, as it is typically used in later studies using the HSPSC[5 6 9 11 14 15 17 19] and is well supported by the literature.[22 23] Cronbach's alphas were calculated for all factor models considered in the CFA, including the factor model that emerged from EFA.

Construct validity

By calculating average of corresponding non-missing items, we calculated mean values for each dimension for the original 12-factor model and for the new model that emerged from EFA. Pearson's correlations were evaluated between dimensions in each model. We expected low to moderate correlations between dimensions. However, correlations >0.85 would indicate possible multicollinearity.[4 22] We also evaluated the correlations between dimensions of both models with two single item outcome variables – 'Patient safety grade' and 'Number of incidents reported.'

Table 1 Characteristics of study sample

Variables	N	%
Study site	995	100.0
Hospital A	575	57.8
Hospital B	420	42.2
Gender	995	100.0
Female	656	65.9
Male	291	29.2
Missing	48	4.8
Professional groups	995	100.0
Physician	183	18.4
Physicians' assistant	198	19.9
Nurse	552	55.5
Other	34	3.4
Missing	28	2.8
Managerial functions	995	100.0
Yes	195	19.6
No	759	76.3
Missing	41	4.1
Contact with patients	995	100.0
Yes	965	97.0
No	7	0.7
Missing	23	2.3
Age (years)	995	100.0
<25	61	6.1
25–34	360	36.2
35–44	230	23.1
45–54	170	17.1
>54	84	8.4
Missing	90	9.0

Evaluation of common dimensionality

In order to evaluate the potential of the instrument for cross-national studies, we evaluated its dimensionality as reported for different language versions. We evaluated appearance and composition of each of the 12 dimensions proposed by Sorra and Nieva[4] and of the 42 corresponding items in all factor models identified from AHRQ web page.[24]

RESULTS

Study sample and descriptive statistics

Out of 2512 distributed questionnaires, 995 were completed, resulting in a response rate of 39.6%. Sample characteristics are presented in table 1.

Out of our sample of n=995, 766 responses (76.98%) had no missing values on HSPSC items. Twenty-one responses (2.1%) contained more than 30% missing values on HSPSC items and were thus not included in the analysis. Remaining missing values were imputed using multiple imputations based on the EM algorithm. As a result, n=974 cases were available for further analysis. Descriptive statistics of HSPSC-D items and dimensions after imputing remaining missing answers and reverse coding of the negatively worded items are presented in table 2.

KMO for the complete sample was 0.93, and MSA for individual items ranged from 0.87 to 0.96. For 'Exploring' and 'Testing' subsets, KMO was 0.91 and 0.92, respectively, and MSA of individual items in both subsets ranged from 0.84 to 0.96. Bartlett's test was highly significant (p<0.001) for the dataset, as well as for both subsets. Preliminary analyses indicated that our sample and the subsets were adequate for factor analysis.

Exploratory factor analysis

We conducted EFA using the 'Exploring' subset. We considered factor loadings ≥0.4 as significant, as this cut-off value was typically used in similar studies[4–6 10–12 14–16] and was supported by the literature.[22 23] Fourteen items not meeting the criteria (factor loading ≥0.4, cross loading <0.4) were excluded from the model, resulting in an eight-factor model with 28 items. The dimension 'Organisational learning – continuous improvement' was completely removed. The dimensions 'Staffing' and 'Overall perceptions of safety' were merged together, as were the dimensions 'Feedback and communication about error' with 'Communication openness', and 'Teamwork across hospital units' with 'Handoffs and transitions'. The resulting eight-factor model is presented in table 3.

Confirmatory factor analysis

CFA using the 'Testing' subset demonstrated a satisfactory model fit of the factor structure that emerged from EFA (see table 4). The model satisfied desired thresholds of most analysed indices (root mean square error of approximation (RMSEA)=0.05; standardised root mean residual (SRMR)=0.05; goodness of fit index (GFI)=0.90; comparative fit index (CFI)=0.93; Tucker-Lewis Index (TLI)/non-normed fit index (NNFT)=0.91).

From the official website of AHRQ,[24] we retrieved the list of 23 articles reporting psychometric analyses on international level. From these articles, we extracted 10 factor models that differed from the original North-American version. These factor models were from the following countries: England (UK),[9] Scotland (UK),[5] France,[15] Switzerland (French[14] and German[7]), the Netherlands,[10] Sweden,[11] Slovenia,[6] Turkey[12] and Palestine.[16] The 11 factor model considered in the analysis was the original 12-factor model.[4]

Subsequent series of CFA revealed satisfactory fit of the models from England (UK)[9] (RMSEA=0.05; SRMR=0.05; GFI=0.92; CFI=0.93; TLI/NNFT=0.91) and Palestine[16] (RMSEA=0.05; SRMR=0.05; GFI=0.90; CFI=0.91; TLI/NNFT=0.90) to our data. The original 12-factor model resulted in marginally satisfactory model fit (RMSEA=0.05; SRMR=0.05; GFI=0.88; CFI=0.90; TLI/NNFT=0.88). The models from Scotland (UK), France, Switzerland, the Netherlands and Slovenia resulted in suboptimal values of CFA indices (table 4). Models from Sweden and Turkey demonstrated unsatisfactory model fit in CFA.

Internal consistency

The original 12-factor model demonstrated good Cronbach's alpha for all dimensions except 'Organisational learning – continuous improvement' (0.68) and 'Communication openness' (0.64). Cronbach's alpha for dimensions of the eight-factor model were between 0.73 and 0.87. Two dimensions, 'Teamwork within units' and 'Communication openness,' demonstrated consistently low alphas in other factor models analysed. Three dimensions, 'Non-punitive response to error,' 'Staffing' and 'Handoffs and transitions,' had lower than 0.7 values only in one or two of analysed models. Cronbach's alpha for the remaining seven dimensions in all analysed models was ≥0.7, if present in the model (table 5).

Construct validity

Correlation between dimensions of original 12-factor model was between 0.10 and 0.61 (p<0.01). All 12 dimensions were positively correlated with the outcome variable 'Patient safety grade' (correlations between 0.26 and 0.70, p<0.01). Dimensions of eight-factor model from EFA were also positively inter-correlated (0.18–0.54, p<0.01) and positively correlated with the outcome variable 'Patient safety grade' (0.29–0.58, p<0.01). All dimensions in both factor models resulted in no or week correlation (<0.2) with the outcome variable 'Number of events reported.' All correlations are presented in the online supplementary appendix 1.

Evaluation of common dimensionality

We analysed the appearance and role of each individual item and dimension from the original 12-factor model in factor model from EFA and in 10 models reported by studies from different language versions. Table 3 presents 42 items of the original 12-factor model and their appearance in all 12 analysed models. The uncoloured cells represent no change, where the item retains its original role in the factor model. Changes are represented by coloured boxes, which indicate elimination of the questionnaire item (N) or moving it to a different dimension (labelled from 1 to 12).

Fourteen items were eliminated from analysis in EFA. Of these 14 items, 11 demonstrated significant inconsistency, since in at least half of 10 analysed factor models, they were also eliminated, moved or merged with another dimension. All of the remaining 28 items of our eight-factor model demonstrated relative stability by retaining a similar role in at least 50% of the 10 analysed factor models; 23 items maintained their role in 80% or more of the models.

Eight dimensions, including 'Teamwork within units,' 'Non-punitive response to error,' 'Supervisor expectations and actions promoting patient safety,' 'Frequency of events reported,' 'Staffing,' 'Feedback and communication about error,' 'Management support for patient safety' and 'Teamwork across hospital units' demonstrated

Table 2 Descriptive statistics of HSPSC-D items and dimensions

Dimension/item*†‡	Percentage of positive responses§	Mean	SD
01. Teamwork within hospital units	42.3%	3.32	0.61
A1. People support one another in this unit.	58.3%	3.65	0.78
A3. When a lot of work needs to be done quickly, we work together as a team to get the work done.	51.2%	3.50	0.84
A4. In this unit, people treat each other with respect.	40.9%	3.36	0.78
A11. When one area in this unit gets really busy, others help out.	18.8%	2.79	0.91
02. Organisational learning—continuous improvement	32.7%	3.06	0.70
A6. We are actively doing things to improve patient safety.	50.1%	3.40	0.91
A9. Mistakes have led to positive changes here.	23.5%	2.88	0.89
A13. After we make changes to improve patient safety, we evaluate their effectiveness.	24.4%	2.90	0.89
03. Non-punitive response to error	50.2%	3.38	0.80
A8. (R) Staff feel like their mistakes are held against them.	40.1%	3.19	0.96
A12. (R) When an event is reported, it feels like the person is being written up, not the problem.	48.3%	3.33	0.99
A16. (R) Staff worry that mistakes they make are kept in their personnel file.	62.1%	3.62	0.99
04. Staffing	24.9%	2.57	0.79
A2. We have enough staff to handle the workload.	7.5%	2.01	0.97
A5. (R) Staff in this unit work longer hours than is best for patient care.	23.1%	2.57	1.18
A7. (R) We use more agency/temporary staff than is best for patient care.	58.2%	3.57	1.20
A14. (R) We work in ‘crisis mode,’ trying to do too much, too quickly.	10.9%	2.13	1.02
05. Overall perceptions of safety	34.4%	3.03	0.79
A10. (R) It is just by chance that more serious mistakes don’t happen around here.	41.1%	3.08	1.20
A15. Patient safety is never sacrificed to get more work done.	25.4%	2.75	1.04
A17. (R) We have patient safety problems in this unit.	43.9%	3.29	0.97
A18. Our procedures and systems are good at preventing errors from happening.	27.2%	3.00	0.89
06. Supervisor/manager expectations & actions promoting safety	48.5%	3.34	0.71
B1. My supervisor/manager says a good word when he/she sees a job done according to established patient safety procedures.	33.7%	3.03	1.02
B2. My supervisor/manager seriously considers staff suggestions for improving patient safety.	55.9%	3.51	0.87
B3. (R) Whenever pressure builds up, my supervisor/manager wants us to work faster, even if it means taking shortcuts.	42.8%	3.19	0.98
B4. (R) My supervisor/manager overlooks patient safety problems that happen over and over.	61.7%	3.61	0.89
07. Frequency of event reporting	38.0%	3.00	1.03
D1. When a mistake is made, but is caught and corrected before affecting the patient, how often is this reported?	39.0%	3.03	1.17
D2. When a mistake is made, but has no potential to harm the patient, how often is this reported?	30.1%	2.77	1.14
D3. When a mistake is made that could harm the patient, but does not, how often is this reported?	45.0%	3.19	1.13
08. Feedback and communication about error	48.0%	3.36	0.85
C1. We are given feedback about changes put into place based on event reports.	40.0%	3.18	1.04
C3. We are informed about errors that happen in this unit.	50.1%	3.41	0.99
C5. In this unit, we discuss ways to prevent errors from happening again.	53.9%	3.50	0.95
09. Communication openness	58.6%	3.60	0.68

Continued

Table 2 Continued

Dimension/item*†‡	Percentage of positive responses§	Mean	SD
C2. Staff will freely speak up if they see something that may negatively affect patient care.	66.2%	3.74	0.87
C4. Staff feel free to question the decisions or actions of those with more authority.	45.4%	3.35	0.89
C6. (R) Staff are afraid to ask questions, when something does not seem right.	64.1%	3.71	0.91
10. Hospital management support for patient safety	23.4%	2.79	0.86
F1. Hospital management provides a work climate that promotes patient safety.	22.4%	2.83	0.94
F8. The actions of hospital management show that patient safety is a top priority.	21.1%	2.74	0.97
F9. (R) Hospital management seems interested in patient safety only after an adverse event happens.	26.8%	2.79	1.04
11. Teamwork across hospital units	29.0%	3.03	0.61
F2. (R) Hospital units do not coordinate well with each other.	14.7%	2.57	0.91
F4. There is good cooperation among hospital units that need to work together.	22.6%	3.03	0.73
F6. (R) It is often unpleasant to work with staff from other hospital units.	49.1%	3.39	0.82
F10. Hospital units work well together to provide the best care for patients.	29.7%	3.14	0.77
12. Hospital handoffs and transitions	35.3%	3.07	0.64
F3. (R) Things 'fall between the cracks' when transferring patients from one unit to another.	13.2%	2.50	0.88
F5. (R) Important patient care information is often lost during shift changes.	37.1%	3.16	0.89
F7. (R) Problems often occur in the exchange of information across hospital units.	29.3%	3.04	0.81
F11. (R) Shift changes are problematic for patients in this hospital.	61.5%	3.59	0.82
E1. Please give your work area/unit in this hospital an overall grade on patient safety.	35.5%	3.22	0.76

Note: Answers 4 and 5 ('Agree' and 'Strongly agree' or 'Most of the time' and 'Always') were considered as positive. Prior to analysis, negatively worded items were reverse coded.
*01–12, corresponding dimension according to original North-American 12-factor model.
†A1–A18; B1–B4; C1–C6; D1–D3; E1; F1–F11: Codes of questionnaire items.
‡(R), negatively worded items, which were reverse coded prior to the analysis.
§n=974.

relative stability over the different language models, appearing in 80% or more of the 10 analysed models. The dimension 'Communication openness' was merged with the dimension 'Feedback and communication about error' in seven models.[5–7 11 12 14 16] Similarly, the dimension 'Hospital handoffs and transitions' was merged with the dimension 'Teamwork across hospital units' in four models,[6 7 14 15] and the dimension 'Overall perceptions of safety' with the dimension 'Staffing' in five models.[5–7 9 11] The items from the dimension 'Organisational learning – continuous improvement' were shown to be highly inconsistent across various models. In five models, the items from this dimension were either removed from the model[9] or merged with other dimensions[7 10 11 15] (eg, with 'Feedback and communication about error').

DISCUSSION

The aim of this study was to evaluate the psychometric properties of the HSPSC-D and compare its dimensionality with factor structures derived from different language versions of the HSPSC. Our split-half validation resulted in an alternative eight-factor model with good psychometric properties. Most parts of the instrument demonstrate relative stability over different language versions and appear suitable for cross-national studies. However, items of four safety culture dimensions require further improvement to support a common structure for comparison across language versions.

In our study, HSPSC-D demonstrated marginally satisfactory psychometric properties, allowing for its use in German hospitals. HSPSC-D demonstrated a somewhat unsatisfactory model fit in CFA with the original 12-factor model. EFA resulted in an alternative eight-factor model, with good model fit. Nevertheless, the instrument demonstrated satisfactory to good internal consistency in both models. Studies with other language versions of the HSPSC have repeatedly reported similar results—good model fit of different factor structure and mostly good internal consistency.[5–7 9 11 12 14 15] These findings indicate that the HSPSC is a useful instrument for measuring and comparing patient safety culture within a healthcare system for which the particular HSPSC version has previously been validated.

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Table 3 Appearance of HSPSC items in 12 analysed factor models (8-factor EFA model, original 12-factor model and 10 different versions)

HSPSC items*†	Germany (exploratory factor analysis)	USA (Sorra and Nieva 2004)	England (UK) (Waterson *et al.*, 2010)	Scotland (UK) (Sarac *et al.*, 2011)	France (Occelli *et al.*, 2013)	Switzerland (Perneger, 2013)	Switzerland (Pfeiffer and Manser 2010)	Netherlands (Smits *et al.*,2008)	Sweden (Hedsköld *et al.*, 2013)	Slovenia (Robida, 2013)	Turkey (Bodur, 2010)	Palestine (Najjar *et al.*, 2013)
01. Teamwork within units												
A1	1	1	1	1	1	1	1	1	1	1	1	1
A3	1	1	1	1	1	1	1	1	1	1	1	1
A4	1	1	1	1	1	1	1	1	1	1	1	1
A11	(N)	1	(N)	1	(N)	1	(N)	1	1	1	1	1
02. Organisational learning												
A6	(N)	2	(N)	2	8	2	1	8	8	2	2	2
A9	(N)	2	(N)	2	8	2	(N)	8	8	2	3	2
A13	(N)	2	(N)	2	8	2	6	8	8	(N)	2	2
03. Non-punitive response to error												
A8	3	3	3	3	3	3	3	3	3	3	3	3
A12	3	3	(N)	3	3	3	3	3	3	3	3	3
A16	3	3	3	3	3	3	3	3	3	3	3	3
04. Staffing												
A2	4	4	4	4	4	4	4	4	4	4	4	4
A5	4	4	(N)	4	4	4	4	4	4	4	2	4
A7	(N)	4	(N)	4	(N)	4	(N)	4	4	4	4	(N)
A14	4	4	4	4	4	4	4	5	4	4	4	4
05. Overall perceptions of safety												
A10	4	5	4	4	5	5	4	5	4	4	5	(N)
A15	(N)	5	(N)	4	5	5	(N)	(N)	4	4	5	5
A17	(N)	5	4	4	5	5	4	5	4	4	5	5
A18	(N)	5	(N)	(N)	5	5	7	5	8	4	5	5
06. Supervisor/manager expectations/actions												
B1	6	6	6	6	6	6	6	6	6	6	6	6
B2	6	6	6	6	6	6	6	6	6	6	6	6
B3	(N)	6	(N)	6	6	6	6	6	6	6	6	6
B4	6	6	(N)	6	6	6	6	6	6	6	6	6
07. Frequency of event reporting												
D1	7	7	7	7	7	7	7	7	7	7	7	7
D2	7	7	7	7	7	7	7	7	7	7	7	7
D3	7	7	7	7	7	7	7	7	7	7	7	7
08. Feedback and communication about error												

Continued

Table 3 Continued

HSPSC items*†	Germany (exploratory factor analysis)	USA (Sorra and Nieva 2004)	England (UK) (Waterson *et al.*, 2010)	Scotland (UK) (Sarac *et al.*, 2011)	France (Occelli *et al.*, 2013)	Switzerland (Perneger, 2013)	Switzerland (Pfeiffer and Manser 2010)	Netherlands (Smits *et al.*,2008)	Sweden (Hedsköld *et al.*, 2013)	Slovenia (Robida, 2013)	Turkey (Bodur, 2010)	Palestine (Najjar *et al.*, 2013)
C1	8	8	8	8	8	8	8	8	8	8	8	(N)
C3	8	8	8	8	8	8	8	8	8	8	8	8
C5	8	8	8	8	8	8	8	8	8	8	8	8
09. Communication openness												
C2	8	9	9	8	9	8	8	9	8	8	8	8
C4	(N)	9	9	8	9	8	8	9	8	8	8	8
C6	(N)	9	9	8	9	8	(N)	9	3	(N)	8	(N)
10. Hospital management support for patient safety												
F1	10	10	(N)	10	10	10	10	10	10	10	10	10
F8	10	10	(N)	10	10	10	10	10	10	10	10	10
F9	10	10	(N)	10	10	10	10	10	10	10	10	10
11. Teamwork across hospital units												
F2	11	11	11	11	11	11	11	11	10	11	10	11
F4	11	11	11	11	11	11	11	11	10	11	10	11
F6	11	11	(N)	(N)	11	11	11	(N)	12	11	12	11
F10	11	11	11	11	10	11	11	11	10	11	10	11
12. Hospital handoffs and transitions												
F3	(N)	12	12	(N)	11	11	11	(N)	12	11	12	12
F5	(N)	12	12	12	11	11	(N)	12	12	11	12	12
F7	11	12	12	12	11	11	11	(N)	12	11	12	12
F11	(N)	12	12	12	(N)	11	(N)	12	12	(N)	12	12

Note: The uncoloured cells represent 'No change' compared with original 12-factor model.
Coloured boxes indicate items that were deleted (N) or moved to different dimension (dimension numbers 1–12); (N): items removed from factor model.
*01–12, corresponding dimension according to original North-American 12-factor model.
†A1–A18; B1–B4; C1–C6; D1–D3; F1–F11: Codes of the questionnaire items.
HSPSC, Hospital Survey on Patient Safety Culture.

Table 4 Results of confirmatory factor analysis (CFA) of all 12 factor models analysed

Variables/ indices analysed in CFA	Criteria	Germany (exploratory factor analysis)	USA (Sorra and Nieva 2004)	England (UK) (Waterson *et al.*, 2010)	Scotland (UK) (Sarac *et al.*, 2011)	France (Occelli *et al.*, 2013)	Switzerland (Perneger, 2013)	Switzerland (Pfeiffer and Manser 2010)	Netherlands (Smits *et al.*, 2008)	Sweden (Hedsköld *et al.*, 2013)	Slovenia (Robida, 2013)	Turkey (Bodur, 2010)	Palestine (Najjar *et al.*, 2013)
Observations (n)	NA	487	974	974	974	974	974	974	974	974	974	974	974
Variables (n)	NA	28	42	27	39	39	42	35	38	42	39	42	38
Factors (n)	NA	8	12	9	10	10	10	8	11	8	9	10	11
Root mean square error of approximation	<0.07	0.05	0.05	0.05	0.05	0.06	0.05	0.06	0.05	0.06	0.05	0.06	0.05
Standardised root mean residual	<0.08	0.05	0.05	0.05	0.06	0.06	0.05	0.08	0.06	0.06	0.06	0.06	0.05
Root mean square residual	NA	0.04	0.05	0.04	0.05	0.05	0.05	0.07	0.05	0.06	0.05	0.06	0.04
Goodness of fit index (GFI)	>0.90	0.91	0.88	0.92	0.88	0.87	0.86	0.86	0.89	0.83	0.87	0.84	0.90
Adjusted GFI	>0.90	0.90	0.86	0.90	0.86	0.85	0.84	0.84	0.86	0.81	0.85	0.81	0.87
Normed fit index	>0.95	0.90	0.86	0.90	0.86	0.85	0.84	0.84	0.86	0.80	0.85	0.81	0.88
Comparative fit index	≥0.90	0.95	0.90	0.93	0.89	0.88	0.88	0.87	0.90	0.84	0.89	0.85	0.91
Tucker-Lewis Index/non-normed fit index	≥0.90	0.94	0.88	0.91	0.88	0.87	0.87	0.85	0.88	0.83	0.87	0.83	0.90

Note: Coloured cells contain values that do not meet requirements.

Table 5 Internal consistency (Cronbach's alpha of all 12 models analysed

Dimensions (from original 12-factor model)	Germany (EFA)	USA (Sorra and Nieva 2004)	England (UK) (Waterson *et al.*, 2010)	Scotland (UK) (Sarac *et al.*, 2011)	France (Occelli *et al.*, 2013)	Switzerland (Perneger, 2013)	Switzerland (Pfeiffer and Manser, 2010)	Netherlands (Smits *et al.*, 2008)	Sweden (Hedsköld *et al.*, 2013)	Slovenia (Robida, 2013)	Turkey (Bodur, 2010)	Palestine (Najjar *et al.*, 2013)
01. Teamwork within units	0.78	0.74	0.79	0.74	0.79	0.74	0.75	0.74	0.74	0.74	0.74	0.74
02. Organisational learning – continuous improvement		0.68		0.68		0.68				0.51	0.53	0.68
03. Non-punitive response to error	0.73	0.74	0.61	0.74	0.74	0.74	0.74	0.74	0.72	0.74	0.72	0.74
04. Staffing	0.79	0.70	0.80	0.80	0.73	0.70	0.80	0.53	0.80	0.82	0.65	0.73
05. Overall perceptions of patient safety		0.77			0.77	0.77		0.79			0.77	0.71
06. Supervisor expectations and actions promoting patient safety	0.75	0.75	0.72	0.75	0.75	0.75	0.74	0.75	0.75	0.75	0.75	0.75
07. Frequency of events reported	0.87	0.88	0.88	0.88	0.88	0.88	0.80	0.88	0.88	0.88	0.88	0.88
08. Feedback and communication about error	0.83	0.81	0.81	0.82	0.83	0.82	0.83	0.83	0.86	0.83	0.82	0.80
09. Communication openness		0.64	0.64		0.64			0.64				
10. Management support for patient safety	0.83	0.84		0.84	0.82	0.84	0.84	0.84	0.84	0.84	0.84	0.84
11. Teamwork across units	0.79	0.75	0.75	0.75	0.79	0.83	0.82	0.75		0.82		0.75
12. Handoffs and transitions		0.75	0.75	0.68				0.66	0.76		0.76	0.75

<0.7, not satisfactory (cells coloured in dark grey); ≥0.7, good[23]; empty cell (coloured in light grey), dimension is not present in the model.

Our analysis of instrument dimensionality across language versions revealed that while some dimensions maintain relative stability of appearance and composition across language versions, others vary significantly. When analysing 12 different factor models, including the original North American 12-factor model and the 8-factor model resulting from our EFA, we found that items from eight dimensions maintain relative stability in appearance and composition over different cultural adaptations. These dimensions were 'Teamwork within units,' 'Non-punitive response to error,' 'Staffing,' 'Supervisor/manager expectations/actions,' 'Frequency of event reporting,' 'Feedback and communication about error,' 'Hospital management support for patient safety' and 'Teamwork across hospital units.' The items from these dimensions seem to maintain their coherence and measure one common factor in different language adaptations and different healthcare systems. In contrast the remaining four dimensions, namely 'Organisational learning – continuous improvement,' 'Overall perceptions of safety,' 'Communication openness' and 'Hospital handoffs and transitions' appeared in only ≤60% of analysed models, since corresponding items were either removed, or migrated to or merged with other dimensions. Similarly, Hedskoeld et al.[7] revealed a nine-factor model but argues against removing items and dimensions from the instrument, stating that they can still be used to understand and improve patient safety. Even though these dimensions and corresponding items may be very important in studies of patient safety culture, they need to be refined in order to support their stability over different cultural adaptations.

Evaluation of psychometric properties of a translated version of the instrument is important, as only the results of validated instruments can be properly interpreted and used for comparison in local contexts. A number of studies reported that the original 12-factor model did not fit the data well, and alternative factor models were suggested.[5–7 9–12 14–16] Variation in the factor structure may be partially attributed to the differences between study samples and study populations. These studies differ by setting, sample size, representation of different professional groups and other characteristics, which can have influence on the performance of the instrument, hence should be considered in analysis. Finally, the specific characteristics of study population's culture, as well as of local healthcare system influences how the respondents perceive, understand and respond to each individual item in the questionnaire, ultimately altering the factor structure and interpretation of the results.

Concerning the international use of the instrument, several articles highlight the importance of a common factor structure. For example, Occelli et al. [15] underline the need to adapt the tool to each country's environment while stating that 'for international comparison purposes, a core set of dimensions consistently assessed as valid should be defined and measured in all countries.' Perneger et al. [14] further argue that local improvements to a translated version can be ineffective, due to several unresolved issues inherent in the instrument, such as limited internal consistency of some dimensions, different dimensionality found in various language versions and the lack of external validation of study results.

LIMITATIONS

The data analysis and results in the study were limited to two German university hospitals. Also, our findings should not be generalised to all hospital employees, as the study sample mainly consists of nurses and physicians. However, our findings regarding psychometric properties of the instrument, as well as its dimensionality, are in line with those of similar studies from other countries. While exploring the common dimensionality of various language versions, our analysis was limited to research articles retrieved from the official web page of AHRQ.[24] Taking into account more studies that report a different factor structure based on a systematic review could improve the analysis. Lastly, the diversity of study methodology and reporting of studies with different language versions of HSPSC may be considered an additional obstacle for cross-national use of the instrument.

CONCLUSIONS

Overall, the German version of the HSPSC demonstrated acceptable psychometric properties for surveying clinical personnel in German hospitals. We found that most safety culture dimensions were relatively stable across different language models. However, other dimensions demonstrate high variability and inconsistency. Such inconsistencies need to be refined in order to support a more uniform factor structure across language versions in order to facilitate the use of HSPSC at the cross-national level.

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Contributors Data were collected by the WorkSafeMed Consortium. Data analysis was carried out by NG under the supervision of TM and AH. NG and AH wrote the manuscript that was then revised by MB and TM. The final version of the manuscript has been approved by all authors.

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Competing interests None declared.

Ethics approval Ethics committees of the medical faculties in Bonn (#350/14) and Tubingen (#547/2014B01).

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement Because of data security aspects, data from the WorkSafeMed study will not be made available in the public domain. However, data will be used by students of both project partners for their theses. Data will be stored in accordance with national and regional data security standards.

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10.2. Study B

Gambashidze N, Hammer A, Brösterhaus M, Wagner A, Rieger MA, Brösterhaus M, Van Vegten A, Manser T, and on behalf of the WorkSafeMed Consortium; Influence of Gender, Profession, and Managerial Function on Clinicians' Perceptions of Patient Safety Culture: A Cross-National Cross-Sectional Study. J Patient Saf 2019;00: 00–00. doi: 10.1097/PTS.0000000000000585

OPEN

Influence of Gender, Profession, and Managerial Function on Clinicians' Perceptions of Patient Safety Culture: A Cross-National Cross-Sectional Study

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Objectives: In recent years, several instruments for measuring patient safety culture (PSC) have been developed and implemented. Correct interpretation of survey findings is crucial for understanding PSC locally, for comparisons across settings or time, as well as for planning effective interventions. We aimed to evaluate the influence of gender, profession, and managerial function on perceptions of PSC and on the interplay between various dimensions and perceptions of PSC.

Methods: We used German and Swiss survey data of frontline physicians and nurses (n = 1786). Data analysis was performed for the two samples separately using multivariate analysis of variance, comparisons of adjusted means, and series of multiple regressions.

Results: Participants' profession and managerial function had significant direct effect on perceptions of PSC. Although there was no significant direct effect of gender for most of the PSC dimensions, it had an indirect effect on PSC dimensions through statistically significant direct effects on profession and managerial function. We identified similarities and differences across participant groups concerning the impact of various PSC dimensions on *Overall Perception of Patient Safety. Staffing* and *Organizational Learning* had positive influence in most groups without managerial function, whereas *Teamwork Within Unit*, *Feedback & Communication About Error*, and *Communication Openness* had no significant effect. For female participants without managerial functions, *Management Support for Patient Safety* had a significant positive effect.

Conclusions: Participant characteristics have significant effects on perceptions of PSC and thus should be accounted for in reporting, interpreting, and comparing results from different samples.

Key Words: patient safety culture, gender, profession, healthcare, patient safety

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Internationally, healthcare organizations increasingly strive to develop and support patient safety culture (PSC).[1] Therefore, reliable instruments to measure PSC are needed. Only then can results accurately describe the state of PSC and be compared across different healthcare settings or used to evaluate changes in PSC over time. Various PSC instruments have been developed and validated worldwide. These instruments typically consist of questionnaires, designed to capture the perceptions of frontline clinicians, mainly physicians and nurses.[2–4] The results of these surveys inform hospital management regarding various aspects of PSC, such as teamwork or communication, point to problematic areas, and drive targeted interventions.

Studies from various countries have shown that staff perceptions may vary significantly by different participant characteristics, such as gender,[5,6] profession,[7,8] and managerial function.[8–12] Although the concept of safety culture is considered to be shared among team/organization members,[13] staff perceive different aspects of shared culture from the viewpoint of their individual characteristics and team roles. A recent meta-analysis found that the proportion of physicians in the study sample was significantly associated with outcomes in various PSC dimensions.[7] To interpret the results of PSC studies properly, it is extremely important to understand and quantify the effect of participant characteristics on staff perceptions of PSC.

The ultimate goal behind conducting PSC surveys is to measure and gradually improve overall patient safety. To strategically plan interventions, it is important to understand not only how team members perceive different aspects of PSC but also how these aspects contribute to an understanding of the general state of patient safety. There is some evidence that different characteristics of team members may also influence how perception of the overall state of patient safety is formed. For example, Richter et al.[10] demonstrated that for managerial staff and frontline workers, different dimensions of PSC determined the perceived frequency of events reported.[10] A better understanding of these variations can inform decision-makers to plan effective interventions targeted to specific employee groups, to improve safety culture and, eventually, patient safety in general.

In this study, we set out to investigate (1) the influence of participant characteristics of gender, profession, and managerial function on clinicians' perceptions of PSC and (2) the effect of these characteristics on the relationships between different aspects of PSC and clinicians' perceptions of patient safety.

METHODS

Setting

We used data from two survey studies. The first collected data between April and July 2015 in two German university hospitals. The second study occurred in June and July 2017 in one Swiss university hospital. Both studies were approved by relevant ethics committees (#350/14, #547/2014BO1, #160/17).

Sample

For the analysis, we used the samples from both studies. Because frontline physicians and nurses are the largest staff categories and also the staff categories included most frequently in PSC studies, we selected physicians and nurses who indicated having daily contact with patients. We excluded all cases with missing answers on any of our key variables: gender, profession, and managerial function.

Measure

One of the most frequently used instruments for studying PSC in the hospital setting is the Hospital Survey on Patient Safety Culture (HSPSC).[14] It has been translated, adapted, and validated in many languages and used around the globe[3] including Germany[15] and Switzerland.[16]

The items of the HSPSC elicit employees' perceptions on various aspects of PSC using five-point Likert scale. The 42 individual items of the instrument form 12 dimensions of PSC. Figure 1 presents the model used in our analysis. It comprises 11 dimensions of PSC: three hospital level dimensions, seven department level dimensions, and an outcome dimension *Overall Perception of Patient Safety.* The outcome dimension, *Frequency of Error Reporting*, was not part of our research question and thus not included in the model. The three hospital level dimensions are *Hospital Management Support for Patient Safety*, *Teamwork Across Hospital Units*, and *Hospital Handoffs & Transitions*. The seven dimensions on the department level are *Teamwork Within Units*, *Organizational Learning – Continuous Improvement*, *Nonpunitive Response to Error*, *Supervisor Expectations & Actions Promoting Patient Safety*, *Feedback & Communication About Error*, *Communication Openness*, and *Staffing*.[14]

In both studies, we also collected demographic information, such as participants' department, gender, profession, direct patient contact, and managerial function.

Statistical Analysis

Data Processing

Before analysis, negatively coded items were reversed. To maintain high data quality, we removed participants with more than 30% missing answers on PSC items. Remaining missing values were imputed separately for each study sample using multiple imputation with expectation maximization algorithm.[17,18] We calculated mean scores for the 11 PSC dimensions by averaging the corresponding items.

Data Analysis

To evaluate the effects of gender, profession, and managerial function and their interactions on different aspects of PSC, we conducted 11 unbalanced factorial analyses of variance (ANOVAs), one for each PSC dimension in our model.[19] We used ω^2 to estimate the effect size. To analyze the overall effect of the three participant characteristics on the correlated system of the 11 PSC dimensions, we used multivariate ANOVA.[19] To account for nested data, we included department as a control variable. Using the three variables gender (female/male), profession (nurse/physician) and managerial function (yes/no) resulted in eight groups for comparison. To explore the respective group differences, we used least squares means (LS means) post hoc test with Tukey-Kramer adjustment accounting for unbalanced groups.[19]

Direct effects analyzed in our model are visualized in Figure 1. In addition, we considered an indirect effect of gender through profession and managerial function, as well as an indirect effect of profession through managerial function. To reflect the fact that the PSC dimensions refer to different organizational levels, we included Hospital PSC and Department PSC as latent constructs. We used confirmatory factor analysis to test model fit in both samples. The following indices with corresponding cutoff values were

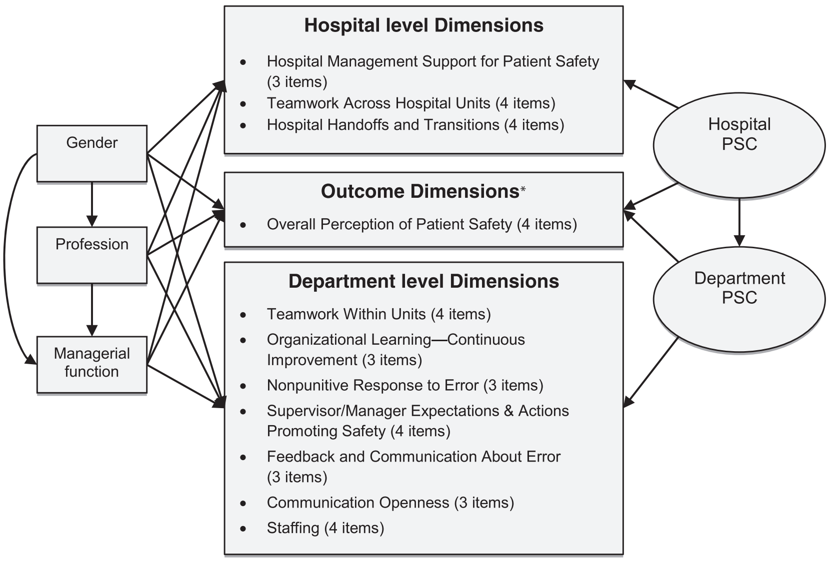

FIGURE 1. Model used in the analysis. Research model based on the original structure of the HSPSC.[14] Individual items of the questionnaire are grouped in PSC dimensions. We expanded the model by adding the latent constructs Hospital PSC and Department PSC, as well as the effects of participants' gender, profession, and managerial function. *The HSPSC includes one more outcome dimension, *Frequency of Error Reporting*, which was not part of our research question so was not included in the model.

considered: standardized root mean residual (SRMR) < 0.08, goodness-of-fit index (GFI) > 0.90, comparative fit index (CFI) > 0.90, and normed fit index (NFI) > 0.95.[18]

To evaluate how participant characteristics affect the relationship between different aspects of PSC and participants' perceptions of patient safety, we used multiple linear regressions with the outcome dimension *Overall Perception of Patient Safety* as a dependent variable, and 10 dimensions of PSC as independent variables. We conducted separate analyses for the eight groups of participants (gender × profession × managerial function). We used confidence intervals of the estimated parameters to compare them across different groups. Conducting all analyses separately for the German and Swiss samples allowed for exploring similarities and differences between these two countries. All analyses were performed using SAS 9.4.

RESULTS

Study Samples and Descriptive Statistics

Response rate was 39.6% and 33.4%, respectively. The complete data set consisted of 1943 physicians and nurses with regular patient contact. We excluded 135 cases because of missing answers on gender and managerial function, and another 22 cases with more than 30% missing answers on PSC items. A combined sample of 1786 physicians and nurses from two countries was used for analysis.

The two samples were of comparable size ($n_A = 896$ and $n_B = 890$). In both samples, there were more females than males, more nurses than physicians, and more participants without managerial function. Most participants in both samples reported more than 5 years of professional experience. Table 1 presents comparable characteristics of the two samples.

TABLE 1. Descriptive Characteristics of the Two Samples

	Sample A		Sample B	
	n_A	%	n_B	%
Total participants	896	100.0	890	100.0
Gender				
Female	612	68.30	665	74.72
Male	284	31.70	225	25.28
Profession				
Nurse	542	60.49	691	77.64
Physician	354	39.51	199	22.36
Managerial function				
No	709	79.13	628	70.56
Yes	187	20.87	262	29.44
Years in department				
<1	54	6.03	135	15.17
1–5	296	33.04	335	37.64
>5	432	48.21	409	45.96
Missing	114	12.72	11	1.24
Years in profession				
<1	22	2.46	32	3.60
1–5	192	21.43	199	22.36
>5	662	73.88	655	73.60
Missing	20	2.23	4	0.45

Effects of Participant Characteristics on Perceptions of PSC

The main effects of profession and managerial function, along with the direction of statistically significant differences, based on the results of the post hoc tests comparing the LS means for effects of participant characteristics in the two samples, are presented in Table 2. Gender was omitted from Table 2 because it had no significant effect. In addition, apart from the interaction effect of managerial function × gender in sample B ($P = 0.01$, $\omega^2 = 0.006$), none of the interaction effects were significant.

Respondents with managerial function reported more positive perceptions in 10 of the 11 PSC dimensions in sample A (all dimensions except *Hospital Handoffs & Transitions)* and in five of seven department level dimensions in sample B. In both samples, nurses' perceptions were more positive compared with those of physicians for dimensions *Handoffs & Transitions* and *Communication Openness* and less positive for *Overall Perception of Patient Safety* and *Teamwork Across Hospital Units*. In addition in sample A, nurses' perceptions were less positive for the dimensions *Hospital Management Support for Patient Safety* and *Staffing*. Overall, we identified more statistically significant differences in sample A, compared with sample B.

The overall effect of the three participant characteristics gender, profession, and managerial function on the correlated system of PSC dimensions (multivariate ANOVA including department as a control) was statistically significant for profession and managerial function ($P < 0.001$ in both samples for both variables). The overall effect of gender, as well as that of all interactions between the three participant characteristics, was not statistically significant.

The research model established in Figure 1 had acceptable model fit for the data from the two samples (sample A: SRMR = 0.05, GFI = 0.91, CFI = 0.88, NFI = 0.87; sample B: SRMR = 0.04, GFI = 0.95, CFI = 0.93, NFI = 0.92).

Direct and indirect effects of the three participant characteristics were analyzed using path analysis based on our research model (Fig. 1). Similar to the ANOVA results, managerial function had statistically significant direct effects on 10 of 11 PSC dimensions (all except *Hospital Handoffs and Transitions*) in sample A and on five of seven department level dimensions in sample B. All these effects were positive, meaning that participants with managerial functions reported more positive perceptions. Profession had statistically significant direct effects on eight and five PSC dimensions in two samples, respectively. A significant direct effect of gender was found for only two dimensions in sample A: *Feedback & Communication About Error* and *Staffing*. In our model, we also evaluated the indirect effects of gender on PSC dimensions through profession and managerial function, as well as the indirect effect of profession through managerial function. Indirect effects of gender and profession are presented in Table 3.

Profession had significant effect on managerial function in both samples, with physicians being more likely to report managerial functions compared with nurses. Similarly, in both samples, gender had significant direct effect on profession and managerial function, indicating that males were more likely to be physicians and more likely to have managerial functions. Through affecting managerial function, profession had significant indirect effect on all PSC dimensions that managerial function had significant direct effect on. Similarly, by effecting both profession and managerial function, gender had significant indirect effect on nine and five PSC dimensions, respectively.

Effect of Participant Characteristics on How Different PSC Dimensions Influence Overall Perception of Patient Safety

The eight separate multiple linear regressions for the eight groups of participants (gender × profession × managerial function) in two samples revealed variation in regression coefficients across the different employee groups. Table 4 presents the results for the 16 regression models.

TABLE 2. Comparisons Based on LS Means and Main Effects (ω^2) Based on Unbalanced Factorial Three-Way ANOVAs for Managerial Function and Profession Across the Two Study Samples

	Profession*		**Managerial Function***	
	Sample A	**Sample B**	**Sample A**	**Sample B**
Outcome				
Overall Perception of Patient Safety	**Nurse < physician** **$P < 0.0001$, $\omega^2 = 0.017$**	**Nurse < physician** **$P < 0.0001$, $\omega^2 = 0.016$**	**No < yes** **$P = 0.004$, $\omega^2 = 0.007$**	No effect $P = 0.32$
Hospital PSC				
Management Support for Patient Safety	**Nurse < physician** **$P = 0.001$, $\omega^2 = 0.009$**	No effect $P = 0.07$	**No < yes** **$P < 0.0001$, $\omega^2 = 0.019$**	No effect $P = 0.18$
Teamwork Across Units	**Nurse < physician** **$P = 0.003$, $\omega^2 = 0.008$**	**Nurse < physician** **$P = 0.001$, $\omega^2 = 0.011$**	**No < yes** **$P = 0.001$, $\omega^2 = 0.009$**	No effect $P = 0.063$
Handoffs & Transitions	**Physician < nurse** **$P < 0.0001$, $\omega^2 = 0.023$**	**Physician < nurse** **$P < 0.0001$, $\omega^2 = 0.019$**	No effect $P = 0.38$	No effect $P = 0.17$
Department PSC				
Teamwork Within Units	No effect $P = 0.97$	No effect $P = 0.48$	**No < yes** **$P = 0.023$, $\omega^2 = 0.004$**	**No < yes** **$P = 0.013$ $\omega^2 = 0.006$**
Organizational Learning—Continuous Improvement	No effect $P = 0.19$	No effect $P = 0.94$	**No < yes** **$P < 0.0001$, $\omega^2 = 0.030$**	**No < yes** **$P = 0.028$, $\omega^2 = 0.004$**
Nonpunitive Response to Error	No effect $P = 0.15$	No effect $P = 0.92$	**No < yes** **$P < 0.0001$, $\omega^2 = 0.020$**	**No < yes** **$P = 0.001$, $\omega^2 = 0.010$**
Supervisor Expectations & Actions Promoting Patient Safety	No effect $P = 0.41$	No effect $P = 0.41$	**No < yes** **$P = 0.009$, $\omega^2 = 0.006$**	**No < yes** **$P = 0.012$, $\omega^2 = 0.006$**
Feedback & Communication About Error	No effect $P = 0.61$	No effect $P = 0.07$	**No < yes** **$P < 0.0001$, $\omega^2 = 0.028$**	**No < yes** **$P = 0.012$, $\omega^2 = 0.005$**
Communication Openness†	**Physician < nurse** **$P < 0.0001$, $\omega^2 = 0.016$**	**Physician < nurse** **$P = 0.002$, $\omega^2 = 0.010$**	**No < yes** **$P < 0.0001$, $\omega^2 = 0.019$**	No effect $P = 0.36$
Staffing	**Nurse < physician** **$P < 0.0001$, $\omega^2 = 0.013$**	No effect $P = 0.57$	**No < yes** **$P = 0.011$, $\omega^2 = 0.005$**	No effect $P = 0.80$

Main effect and group difference for gender were not significant for any of the PSC dimensions. All interaction effects except one were not significant in both samples.

*Effects with $P < 0.05$ are presented in bold.

†Significant interaction effect of managerial function × gender in sample B ($P = 0.01$, $\omega^2 = 0.006$).

In both samples, the PSC dimensions *Organizational Learning – Continuous Improvement* and *Staffing* most frequently had strong effects on *Overall Perception of Patient Safety*, especially for participant groups without managerial functions. The dimension *Hospital Management Support for Patient Safety* more often had a significant effect in female groups compared with male groups. The four dimensions *Teamwork Across Hospital Units*, *Hospital Handoffs & Transitions*, *Nonpunitive Response to Error*, and *Supervisor Expectations & Actions Promoting Patient Safety* had only limited effect on *Overall Perception of Patient Safety* in some participant groups. Finally, three PSC dimensions did not have significant effects for any of the employee groups. All statistically significant effects were positive, meaning that more positive perceptions in these PSC dimensions were associated with more positive *Overall Perception of Patient Safety*.

DISCUSSION

Our findings demonstrate that participant characteristics may not only have significant influence on perceptions of PSC and its different aspects but also on how employees evaluate patient safety. In our study, managerial function and profession had significant effects on perceptions of PSC. Participants' gender had very limited significant direct effect on the PSC dimensions but demonstrated considerable indirect effect through influencing profession and managerial function. Regression analyses demonstrated similarities and differences between various employee groups regarding which aspects of PSC influence *Overall Perception of Patient Safety* of staff.

Based on our analysis, employees with managerial function reported more positive perceptions on PSC dimensions in both samples. Similar findings were reported by several PSC studies.[8–11] However, in our study, this difference was more prevalent in one sample indicating that the divergence of attitudes of managerial and nonmanagerial staff may not be the same in different countries.

In both samples, participants' profession had significant effect on perceptions of PSC. This is in line with other studies reporting different perceptions of physicians and nurses regarding PSC.[7,8,20] A recent study of measurement equivalence found that these interprofessional differences can represent true difference in the underlying concept.[21] This difference may be explained by the fact that nurses and physicians in the same team have different management structures. Similar effects have been observed for perceptions of teamwork and collaboration.[22] In contrast to managerial function, the difference between physicians and nurses did not always have the same direction pointing at potentially different priorities and professional values with regard to patient safety. Interestingly, the effect of participants' profession was relatively similar in two samples.

A strong direct effect of participants' gender on perceptions of PSC was not observed. However, gender had significant direct effects on both profession and managerial function in both samples and consequently demonstrated significant indirect effects on the PSC dimensions. These results may reflect prevalent gender gaps in

TABLE 3. Standardized Direct and Indirect Effects of the 3 Participant Characteristics Based on Path Analysis

		Standardized Direct Effect						Standardized Indirect Effect			
		Gender		Profession		Managerial Function*		Gender		Profession	
		Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B
Profession	St. effect	0.42	0.4	NA	NA	NA	NA	NA	NA	NA	NA
	95% CI	0.36 to 0.47	0.34 to 0.45								
	P	**P < 0.0001**	**P < 0.0001**								
Managerial Function	St. effect	0.18	0.11	0.17	0.25	NA	NA	0.07	0.1	NA	NA
	95% CI	0.11 to 0.25	0.05 to 0.18	0.1 to 0.24	0.19 to 0.32			0.04 to 0.1	0.07 to 0.13		
	P	**P < 0.0001**	**P = 0.001**	**P < 0.0001**	**P < 0.0001**			**P < 0.0001**	**P < 0.0001**		
Outcome											
Overall Perception of Patient Safety	St. effect	0.05	0.04	0.20	0.15	0.13	0.03	0.12	0.07	0.02	0.01
	95% CI	−0.02 to 0.12	−0.03 to 0.11	0.13 to 0.27	0.08 to 0.22	0.06 to 0.19	−0.04 to 0.1	0.08 to 0.15	0.04 to 0.1	0.01 to 0.04	−0.01 to 0.02
	P	*P* = 0.17	*P* = 0.23	**P < 0.0001**	**P < 0.0001**	**P < 0.001**	*P* = 0.41	**P < 0.0001**	**P < 0.0001**	**P = 0.002**	*P* = 0.42
Hospital PSC											
Hospital Management Support for Patient Safety	St. effect	−0.05	−0.01	0.17	0.06	0.19	0.02	0.12	0.03	0.03	0.01
	95% CI	−0.12 to 0.02	−0.08 to 0.06	0.10 to 0.24	−0.01 to 0.14	0.13 to 0.26	−0.05 to 0.09	0.08 to 0.15	0 to 0.06	0.02 to 0.05	−0.01 to 0.02
	P	*P* = 0.21	*P* = 0.79	**P < 0.0001**	*P* = 0.09	**P < 0.0001**	*P* = 0.50	**P < 0.0001**	**P = 0.05**	**P < 0.001**	*P* = 0.51
Teamwork Across Hospital Units	St. effect	−0.05	0.01	0.11	0.12	0.15	−0.05	0.08	0.04	0.03	−0.01
	95% CI	−0.13 to 0.02	−0.07 to 0.08	0.04 to 0.18	0.05 to 0.19	0.08 to 0.22	−0.12 to 0.02	0.05 to 0.12	0.01 to 0.07	0.01 to 0.04	−0.03 to 0.01
	P	*P* = 0.14	*P* = 0.89	**P = 0.003**	**P = 0.001**	**P < 0.0001**	*P* = 0.18	**P < 0.0001**	**P = 0.01**	**P < 0.001**	*P* = 0.18
Hospital Handoffs & Transitions	St. effect	−0.02	0.01	−0.18	−0.20	0.06	−0.04	−0.06	−0.09	0.01	−0.01
	95% CI	−0.09 to 0.05	−0.06 to 0.08	−0.25 to −0.11	−0.27 to −0.13	−0.01 to 0.13	−0.11 to 0.02	−0.09 to −0.03	−0.12 to −0.06	0 to 0.02	−0.03 to 0.01
	P	*P* = 0.61	*P* = 0.87	**P < 0.0001**	**P < 0.0001**	*P* = 0.08	*P* = 0.21	**P < 0.001**	**P < 0.0001**	*P* = 0.10	*P* = 0.22
Department PSC											
Teamwork Within Units	St. effect	−0.01	0	0.04	−0.02	0.10	0.08	0.04	0.01	0.02	0.02
	95% CI	−0.08 to 0.07	−0.07 to 0.07	−0.03 to 0.11	−0.09 to 0.06	0.03 to 0.17	0.01 to 0.15	0.01 to 0.07	−0.02 to 0.04	0 to 0.03	0 to 0.04
	P	*P* = 0.84	*P* = 0.94	*P* = 0.31	*P* = 0.64	**P = 0.004**	**P = 0.02**	**P = 0.01**	*P* = 0.47	**P = 0.01**	**P = 0.02**
Organizational Learning – Continuous Improvement	St. effect	−0.06	0.06	0.02	0.0	0.23	0.09	0.07	0.02	0.04	0.02
	95% CI	−0.13 to 0.01	−0.01 to 0.13	0.05 to 0.09	−0.08 to 0.07	0.16 to 0.29	0.02 to 0.16	0.03 to 0.1	−0.01 to 0.05	0.02 to 0.06	0 to 0.04
	P	*P* = 0.10	*P* = 0.11	*P* = 0.53	*P* = 0.90	**P < 0.0001**	**P = 0.01**	**P < 0.001**	*P* = 0.25	**P < 0.0001**	**P = 0.02**
Nonpunitive Response to Error	St. effect	−0.01	−0.05	0.08	−0.02	0.18	0.12	0.08	0.02	0.03	0.03
	95% CI	−0.08 to 0.06	−0.12 to 0.02	0.01 to 0.16	−0.09 to 0.06	0.11 to 0.25	0.05 to 0.19	0.05 to 0.11	−0.01 to 0.05	0.01 to 0.05	0.01 to 0.05
	P	*P* = 0.74	*P* = 0.17	**P = 0.02**	*P* = 0.67	**P < 0.0001**	**P < 0.001**	**P < 0.0001**	*P* = 0.21	**P < 0.001**	**P = 0.002**
Supervisor Expectations & Actions Promoting Patient Safety	St. effect	0.05	0.07	−0.07	−0.03	0.13	0.09	0.00	0.01	0.02	0.02
	95% CI	−0.02 to 0.12	0.0 to 0.14	−0.15 to 0	−0.1 to 0.04	0.07 to 0.2	0.03 to 0.16	−0.03 to 0.04	−0.02 to 0.04	0.01 to 0.04	0.01 to 0.04
	P	*P* = 0.19	*P* = 0.06	**P = 0.045**	*P* = 0.42	**P < 0.0001**	**P = 0.007**	*P* = 0.84	*P* = 0.59	**P = 0.002**	**P = 0.01**
Feedback & Communication About Error	St. effect	−0.08	0.03	−0.06	−0.09	0.20	0.11	0.03	−0.01	0.04	0.03
	95% CI	−0.15 to −0.01	−0.04 to 0.1	−0.13 to 0.01	−0.16 to −0.01	0.14 to 0.27	0.04 to 0.17	−0.01 to 0.06	**−0.04 to 0.02**	0.02 to 0.05	0.01 to 0.05
	P	**P = 0.02**	*P* = 0.46	*P* = 0.11	**P = 0.02**	**P < 0.0001**	**P = 0.002**	*P* = 0.12	*P* = 0.44	**P < 0.001**	**P = 0.005**
Communication Openness	St. effect	−0.05	0.04	−0.21	−0.12	0.17	0.02	−0.05	−0.05	0.03	0.00
	95% CI	−0.12 to 0.02	−0.03 to 0.11	−0.28 to −0.14	−0.2 to −0.05	0.1 to 0.23	−0.05 to 0.09	−0.08 to −0.01	−0.08 to −0.02	0.01 to 0.05	−0.01 to 0.02
	P	*P* = 0.18	*P* = 0.25	**P < 0.0001**	**P < 0.001**	**P < 0.0001**	*P* = 0.60	**P = 0.009**	**P = 0.003**	**P < 0.001**	*P* = 0.60
Staffing	St. effect	0.07	−0.03	0.19	**−0.06**	0.11	0.02	0.11	−0.02	0.02	0.00
	95% CI	0 to 0.14	−0.11 to 0.04	0.12 to 0.26	−0.13 to 0.02	0.04 to 0.17	−0.05 to 0.08	0.07 to 0.14	−0.05 to 0.01	0.01 to 0.03	−0.01 to 0.02
	P	**P = 0.04**	*P* = 0.34	**P < 0.0001**	*P* = 0.13	**P = 0.001**	*P* = 0.65	**P < 0.0001**	*P* = 0.20	**P = 0.007**	*P* = 0.65

Statistically significant effects ($P < 0.05$) are presented in bold.

*For managerial function only direct effect is presented, as its indirect effect was not included in the model.

CI indicates confidence interval; NA, effect not included in the research model; St. effect, standardized effect.

TABLE 4. Results of Multiple Linear Regression in Eight Participant Groups Using Overall Perception of Patient Safety as Dependent Variable, and ten PSC Dimensions as Independent variables

Sample		**Sample A**								**Sample B**							
Managerial function		**No managerial functions**				**With managerial functions**				**No managerial functions**				**With managerial functions**			
Profession		**Nurse**		**Physician**		**Nurse**		**Physician**		**Nurse**		**Physician**		**Nurse**		**Physician**	
Gender		**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**
Employee group		1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
n		406	67	121	115	49	20	36	82	458	80	49	41	122	31	36	73
R^2		0.55	0.76	0.58	0.66	0.69	0.76	0.83	0.61	0.59	0.67	0.68	0.67	0.48	0.68	0.82	0.76
RMSE		0.48	0.43	0.52	0.49	0.46	0.49	0.40	0.50	0.43	0.45	0.40	0.46	0.51	0.43	0.36	0.44
Intercept	Estimate	−0.05	−0.76	−0.30	−0.06	−0.36	1.32	−0.19	0.44	−0.41	−0.83	0.00	0.25	−0.03	−0.43	−1.20	−0.07
	95% CI	−0.45 to 0.35	−1.56 to 0.04	−1.07 to 0.46	−0.68 to 0.56	−2 to 1.27	−1.61 to 4.24	−1.07 to 0.69	−0.41 to 1.29	−0.78 to −0.03	−1.87 to 0.21	−1.09 to 1.08	−1.12 to 1.62	−0.96 to 0.91	−2.42 to 1.56	−2.37 to −0.04	−0.86 to 0.73
	P	*P* = 0.80	*P* = 0.06	*P* = 0.43	*P* = 0.85	*P* = 0.66	*P* = 0.33	*P* = 0.66	*P* = 0.30	***P* = 0.033**	*P* = 0.12	*P* = 0.99	*P* = 0.71	*P* = 0.96	*P* = 0.66	***P* = 0.044**	*P* = 0.87
Hospital PSC																	
Hospital Management Support for Patient Safety	β	0.19	−0.10	0.21	0.07	0.10	0.21	0.38	0.20	0.17	0.06	0.16	−0.05	0.28	0.31	−0.13	0.00
	95% CI	0.11 to 0.27	−0.27 to 0.08	0.03 to 0.40	−0.09 to 0.24	−0.15 to 0.35	−0.23 to 0.64	0.08 to 0.69	0.00 to 0.41	0.10 to 0.24	−0.11 to 0.23	−0.08 to 0.40	−0.32 to 0.22	0.13 to 0.43	0.06 to 0.56	−0.43 to 0.17	−0.19 to 0.19
	P	***P* < 0.0001**	*P* = 0.27	***P* = 0.023**	*P* = 0.37	*P* = 0.41	*P* = 0.31	***P* = 0.016**	***P* = 0.050**	***P* < 0.0001**	*P* = 0.49	*P* = 0.18	*P* = 0.71	***P* < 0.001**	***P* = 0.017**	*P* = 0.39	*P* = 0.98
Teamwork Across Hospital Units	β	0.06	0.28	0.07	−0.13	0.01	−0.27	−0.23	−0.01	0.02	0.06	−0.20	0.32	−0.07	−0.16	0.39	−0.07
	95% CI	−0.05 to 0.18	0.01 to 0.55	−0.15 to 0.29	−0.32 to 0.06	−0.34 to 0.36	−1.57 to 1.02	−0.60 to 0.13	−0.31 to 0.30	−0.09 to 0.12	−0.22 to 0.34	−0.51 to 0.10	−0.14 to 0.77	−0.32 to 0.18	−0.50 to 0.19	0.02 to 0.76	−0.39 to 0.25
	P	*P* = 0.29	***P* = 0.043**	*P* = 0.54	*P* = 0.17	*P* = 0.95	*P* = 0.64	*P* = 0.20	*P* = 0.97	*P* = 0.72	*P* = 0.67	*P* = 0.19	*P* = 0.17	*P* = 0.60	*P* = 0.36	***P* = 0.037**	*P* = 0.66
Hospital Handoffs & Transitions	β	0.08	0.08	0.14	0.07	0.18	−0.25	0.06	−0.02	0.08	0.19	0.37	0.30	0.24	−0.01	0.08	0.15
	95% CI	−0.03 to 0.18	−0.15 to 0.31	−0.07 to 0.35	−0.11 to 0.26	−0.11 to 0.47	−1.12 to 0.63	−0.21 to 0.33	−0.26 to 0.22	−0.01 to 0.17	−0.07 to 0.46	0.10 to 0.63	−0.07 to 0.68	0.01 to 0.47	−0.38 to 0.36	−0.25 to 0.41	−0.05 to 0.34
	P	*P* = 0.17	*P* = 0.50	*P* = 0.20	*P* = 0.44	*P* = 0.22	*P* = 0.54	*P* = 0.65	*P* = 0.88	*P* = 0.09	*P* = 0.15	***P* = 0.008**	*P* = 0.11	***P* = 0.045**	*P* = 0.96	*P* = 0.62	*P* = 0.13
Department PSC																	
Teamwork Within Units	β	0.03	0.06	−0.08	−0.07	−0.05	−0.07	0.04	−0.07	0.04	0.11	0.03	−0.22	0.02	0.29	0.16	0.10
	95% CI	−0.06 to 0.13	−0.19 to 0.30	−0.28 to 0.12	−0.24 to 0.10	−0.35 to 0.24	−0.83 to 0.68	−0.27 to 0.35	−0.32 to 0.18	−0.05 to 0.13	−0.14 to 0.36	−0.24 to 0.29	−0.68 to 0.24	−0.2 to 0.24	−0.25 to 0.83	−0.17 to 0.48	−0.12 to 0.31
	P	*P* = 0.48	*P* = 0.64	*P* = 0.42	*P* = 0.42	*P* = 0.72	*P* = 0.83	*P* = 0.80	*P* = 0.60	*P* = 0.38	*P* = 0.40	*P* = 0.84	*P* = 0.34	*P* = 0.85	*P* = 0.27	*P* = 0.34	*P* = 0.38
Organizational Learning – Continuous Improvement	β	0.25	0.52	0.23	0.45	0.48	−0.39	0.30	0.12	0.30	0.33	0.23	0.41	0.19	0.07	0.31	0.18
	95% CI	0.15 to 0.35	0.30 to 0.75	0.02 to 0.45	0.24 to 0.66	0.18 to 0.78	−1.29 to 0.51	−0.05 to 0.66	−0.09 to 0.33	0.21 to 0.40	0.08 to 0.57	−0.09 to 0.56	0.02 to 0.79	−0.05 to 0.42	−0.35 to 0.49	−0.21 to 0.83	−0.07 to 0.42
	P	***P* < 0.0001**	***P* < 0.0001**	***P* = 0.034**	***P* < 0.0001**	***P* = 0.002**	*P* = 0.35	*P* = 0.09	*P* = 0.25	***P* < 0.0001**	***P* = 0.009**	*P* = 0.15	***P* = 0.04**	*P* = 0.12	*P* = 0.73	*P* = 0.23	*P* = 0.15
Nonpunitive Response to Error	β	−0.01	0.05	0.05	0.21	0.12	0.29	−0.16	0.14	0.13	0.15	0.04	0.02	0.05	0.32	0.07	0.05
	95% CI	−0.08 to 0.06	−0.09 to 0.18	−0.12 to 0.23	0.07 to 0.36	−0.13 to 0.36	−0.53 to 1.11	−0.52 to 0.20	−0.07 to 0.34	0.06 to 0.20	0.02 to 0.28	−0.17 to 0.26	−0.25 to 0.29	−0.16 to 0.26	−0.05 to 0.69	−0.20 to 0.33	−0.13 to 0.24
	P	*P* = 0.81	*P* = 0.51	*P* = 0.53	***P* = 0.005**	*P* = 0.33	*P* = 0.45	*P* = 0.37	*P* = 0.19	***P* < 0.001**	***P* = 0.028**	*P* = 0.67	*P* = 0.87	*P* = 0.65	*P* = 0.09	*P* = 0.61	*P* = 0.57
Supervisor Expectations & Actions Promoting Patient Safety	β	0.05	0.07	−0.01	0.20	0.10	−0.05	0.11	0.18	0.08	0.08	0.04	0.13	0.06	0.10	0.41	0.22
	95% CI	−0.04 to 0.13	−0.12 to 0.26	−0.20 to 0.19	0.02 to 0.39	−0.19 to 0.40	−0.57 to 0.48	−0.20 to 0.43	−0.04 to 0.39	0.01 to 0.15	−0.13 to 0.28	−0.29 to 0.37	−0.19 to 0.44	−0.11 to 0.23	−0.39 to 0.59	0.01 to 0.80	0.00 to 0.43
	P	*P* = 0.30	*P* = 0.45	*P* = 0.95	***P* = 0.034**	*P* = 0.49	*P* = 0.84	*P* = 0.46	*P* = 0.11	***P* = 0.017**	*P* = 0.48	*P* = 0.82	*P* = 0.43	*P* = 0.50	*P* = 0.68	***P* = 0.043**	***P* = 0.050**
Feedback & Communication About Error	β	0.04	0.03	0.13	0.05	0.02	0.66	−0.08	0.10	0.00	0.12	0.10	−0.02	−0.02	0.21	0.04	0.13
	95% CI	−0.04 to 0.12	−0.21 to 0.26	−0.04 to 0.30	−0.12 to 0.21	−0.24 to 0.28	−0.08 to 1.39	−0.41 to 0.26	−0.13 to 0.34	−0.07 to 0.06	−0.04 to 0.28	−0.10 to 0.29	−0.29 to 0.25	−0.22 to 0.17	−0.06 to 0.48	−0.26 to 0.34	−0.10 to 0.37
	P	*P* = 0.31	*P* = 0.82	*P* = 0.14	*P* = 0.59	*P* = 0.87	*P* = 0.07	*P* = 0.65	*P* = 0.38	*P* = 0.90	*P* = 0.15	*P* = 0.31	*P* = 0.87	*P* = 0.82	*P* = 0.13	*P* = 0.77	*P* = 0.27

Communication Openness	β	0.00	−0.11	0.05	0.02	−0.13−0.45	−0.06	0.34	−0.02	0.05	−0.14	0.22	−0.11	0.06	−0.23	−0.10	0.04
	95% CI	−0.10 to 0.09	−0.34 to 0.12	−0.12 to 0.21	−0.17 to 0.21	to 0.20	−0.74 to 0.61	0.0 to 0.69	−0.27 to 0.23	−0.03 to 0.13	−0.35 to 0.06	−0.04 to 0.49	−0.55 to 0.32	−0.16 to 0.29	−0.72 to 0.25	−0.52 to 0.32	−0.21 to 0.28
	P	*P* = 0.97	*P* = 0.35	*P* = 0.60	*P* = 0.84	*P* = 0.43	*P* = 0.84	*P* = 0.052	*P* = 0.88	*P* = 0.21	*P* = 0.17	*P* = 0.10	*P* = 0.60	*P* = 0.57	*P* = 0.33	*P* = 0.62	*P* = 0.77
Staffing	β	0.35	0.44	0.38	0.21	0.28	0.43	0.34	0.28	0.24	0.30	0.08	0.25	0.21	0.18	0.16	0.33
	95% CI	0.28 to 0.43	0.28 to 0.59	0.22 to 0.54	0.05 to 0.37	0.06 to 0.49	−0.15 to 1.02	0.10 to 0.57	0.10 to 0.46	0.18 to 0.30	0.13 to 0.47	−0.09 to 0.25	0.00 to 0.50	0.08 to 0.34	−0.15 to 0.50	−0.07 to 0.40	0.17 to 0.49
	P	***P* < 0.0001**	***P* < 0.0001**	***P* < 0.0001**	***P* = 0.012**	***P* = 0.014**	*P* = 0.13	***P* = 0.007**	***P* = 0.003**	***P* < 0.0001**	***P* = 0.001**	*P* = 0.36	*P* = 0.051	***P* = 0.003**	*P* = 0.27	*P* = 0.16	***P* < 0.001**

Statistically significant effects ($P < 0.05$) are presented in bold.

β – an estimated change in *Overall Perception of Patient Safety* in response to one-point change in independent variable.

CI indicates confidence interval; RMSE, root mean squared error.

healthcare, especially in managerial functions. A study in four European countries found that although gender representation is relatively balanced among medical students and medical doctors in general, females are less well represented in leadership positions.[23]

Our results further demonstrate that for various employee groups different aspects of PSC may be significantly related to their *Overall Perception of Patient Safety.* In both samples, the PSC dimensions *Staffing* and *Organizational Learning – Continuous Improvement* most frequently had a strong significant effect. For female nurses and physicians without managerial functions, perceptions of *Hospital Management Support for Patient Safety* had a stronger effect on *Overall Perception of Patient Safety* than for males, where this effect was not statistically significant. Three dimensions, *Teamwork Within Units, Feedback & Communication About Error*, and *Communication Openness*, did not have significant influence on *Overall Perception of Patient Saf*ety. Another Swiss study reported no effect of the same dimensions on *Overall Perception of Patient Safety*, neither for physicians nor for nurses.[16] This result is unexpected and difficult to explain, because better teamwork and communication have been found to be associated with safety outcomes[1,24] and thus are targets of many interventions designed to improve safety culture and ultimately patient safety. Perhaps precisely because of continuous interventions in these areas, we find relatively homogenous rates in these dimensions, causing diminished effects in regression analyses. A study by Najjar et al.[25] reported similar results for Belgium—*Feedback and Communication Openness About Error* (combined dimension) and *Teamwork Within Units* had a relatively low effect on *Overall Perception of Patient Safety*, whereas *Staffing* and *Hospital Management Support for Patient Safety* had the strongest effects. For the Palestinian sample in the same study, the effect of these dimensions was stronger but there was no significant effect of *Staffing*.[25]

Patient safety culture studies often provide benchmarks for healthcare managers.[3–5,20] Our results demonstrate that when comparing results across different settings, the sample composition should be accounted for. The results of this study underline the significance of participant characteristics for perceptions of PSC and consequently the importance of fully reporting sample characteristics when publishing results. However, the differences in PSC among different employee groups may not be just a matter of transparent reporting and interpretation. In a recent article, Mannion and Davies[26] discussed the existence, sources, and influence of divergent subcultures within healthcare organizations, underlining the importance of understanding and appreciating these for further improvement in PSC.

Our results support evidence on differences in perceptions of PSC between professional groups, and they should be acknowledged to adequately evaluate, understand, and affect hospitals' PSC. However, these differences in our two study samples were not the same. Thus, further research is required to discover whether or not the presence and magnitude of the differences between employee groups influences hospital PSC or even safety outcomes. Moreover, our results support the recommendation to routinely study PSC to support hospital managers in effectively planning interventions to improve PSC while considering the current needs of specific members of clinical team.

Limitations

Although we analyzed large samples from two European healthcare systems, our results should not be generalized for all hospital employees because we only included physicians and nurses. Our inclusion and exclusion criteria, together with the somewhat low response rate among study participants, may have introduced a selection bias. This study is also subject to common method bias.

Future studies should aim to confirm our findings with objectively measured safety outcomes, because the direct association between PSC and objective safety outcomes is still being debated. However, a number of studies have demonstrated correlations between PSC dimensions and objective outcomes such as mortality or readmissions.[27] Finally, when establishing the path analysis model we assumed that gender may influence profession and managerial function and that profession may influence managerial function. Analyses using different conceptual models may obtain different results.

CONCLUSIONS

We demonstrated that participant characteristics have significant effects on clinical staff perceptions of different aspects of PSC and thus should be accounted for in reporting, interpreting, and comparing results obtained in different samples. Moreover, employee characteristics may also modulate the influence of specific PSC dimensions on *Overall Perception of Patient Safety*. However, the effects of participant characteristics in different settings may not be the same. Thus, these effects should be locally studied to better plan targeted improvement initiatives. Further studies are required to determine what effects these dissimilarities between perceptions of different employee groups have on objective patient safety outcomes and, if so, whether or not they can be influenced through targeted interventions.

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10.3. Study C

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Psychometric properties of the Georgian version of Hospital Survey on Patient Safety Culture: a cross-sectional study

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ABSTRACT

Objectives To study the psychometric properties of the Georgian version of the Hospital Survey on Patient Safety Culture (HSPSC-GE).
Design Cross-sectional study.
Setting Three Georgian hospitals.
Participants Staff of participating hospitals (n=579 responses, response rate 41.6%).
Primary and secondary outcome measures Psychometric properties (Model fit, internal consistency, construct validity) of the instrument, factor structure derived from the data.
Results HSPSC-GE demonstrated acceptable construct validity but highly limited internal consistency (Cronbach's alpha 0.35–0.87). Confirmatory factor analysis with the original 12-factor model resulted in poor model fit (root mean square error of approximation (RMSEA)=0.06; standardised root mean square residuals (SRMR)=0.08; comparative fit index (CFI)=0.74; goodness of fit index (GFI)=0.81; Tucker-Lewis Index (TLI)=0.70). Accounting for reversed item bias resulted in improved fit indices. Exploratory factor analysis resulted in an alternative five-factor model including only 19 items, but with satisfactory model fit (RMSEA=0.07; SRMR=0.07; CFI=0.90; GFI=0.89; TLI=0.88).
Conclusions The HSPSC-GE as a whole demonstrated poor psychometric properties. However, a number of dimensions demonstrated acceptable internal consistency and reliability. Our results indicated presence of reversed item bias, which may be inherent to the original instrument design of the HSPSC and should be taken into account while interpreting or comparing results, as well as in analyses of psychometric properties of the instrument. Nevertheless, the HSPSC-GE provides first insights in hospital patient safety culture (PSC) in Georgia and we recommend using it in its full form to facilitate deeper analysis and further development of PSC in Georgian healthcare.

Strengths and limitations of this study

- The first study to validate the Georgian version of the Hospital Survey on Patient Safety Culture (HSPSC), an instrument to identify available strengths in local patient safety climate, and to demonstrate aspects that may require improvement.
- A comprehensive analysis of psychometric properties of the survey instrument, including analysis of the original 12-factor model and an alternative model based on the exploratory factor analysis.
- The analysis of the role of reversed item bias in psychometric evaluation of HSPSC provides additional insight into the instruments' performance.
- Study findings are limited by the study sample, which included general hospitals with n>100 hospital beds, and thus should not be directly generalised to smaller and specialised hospitals.

INTRODUCTION

Patient safety is an essential component of healthcare quality and, in order to improve patient safety, continuously developing the culture of safety is recommended.[1] Patient safety culture (PSC) represents a set of values and beliefs regarding safety, shared within the organisation, and it has been found to be associated with patient outcomes.[2 3] In hospital settings, PSC is mostly measured by means of self-administered questionnaires that typically capture a number of factors associated with PSC such as teamwork and communication, management and leadership, error reporting and organisational learning, and so on. Even though PSC is generally thought to be a multifaceted construct, there is no unified understanding of its composition.[4 5] Thus, various instruments measure slightly different factors. Moreover, studies have shown that performance of the same survey instrument in different settings may vary significantly.[6] Consequently, an increasing number of validation studies of PSC instruments are being conducted in many low/middle-income countries and developed countries, to validate the instruments for further research, and to study and report local expressions of PSC and the various elements it comprised.[5–7]

The Hospital Survey on Patient Safety Culture (HSPSC)[8] is one of the most frequently used instruments for measuring PSC in hospital settings internationally.[7 9] It has been translated into different languages and validated in many countries.[7 9] The HSPSC covers 12 different dimensions of PSC providing a wide spectrum of details useful to measure and improve PSC locally, and to analyse and understand its composition.

To date there are no data available on PSC in Georgian healthcare and no instrument has been adapted and validated for Georgian healthcare. Healthcare services in Georgia are mostly provided by private organisations, with increasing oversight of quality and safety by the state through state-funded programmes (including the Universal Health Care Program) and through regulatory agencies committed to ensuring accessible, safe and high-quality care for all citizens.[10 11] Georgian hospitals are increasingly required to have dedicated personnel and processes for ensuring patient safety and continuous quality improvement.[10 11] However, health services research in Georgia is still very limited, especially in the field of patient safety and safety culture.

With no validated PSC instruments available in Georgia, we aim to validate the Georgian version of the HSPSC (HSPSC-GE), more specifically to explore its psychometric properties and dimensionality. This will provide a foundation for further PSC research in Georgian healthcare. Moreover, studying the local variation of PSC in an emerging, relatively less regulated environment can provide additional insight into the composition of PSC and mechanisms of how it is developing.

METHODS

Setting

This study is based on data from a cross-sectional study *Patient Safety Culture in Georgian Healthcare (PaSCu.Ge)*. Data were gathered in three Georgian hospitals between November 2017 and March 2018. Data gathering in each hospital lasted 1 month. Two follow-up reminders were sent on the 10th and 20th days after initial invitation. Participants were offered either an electronic or a paper-based questionnaire to complete.

Patient and public involvement

Representatives of patient and public groups were not involved in the study design and implementation. Dissemination of study findings includes making the final results publicly available online (in Georgian and in English).

Sample

We included general hospitals with at least 100 hospital beds. All personnel of the participating hospitals, employed for more than 1 month, were invited to participate in the study. Participation was voluntary and anonymous, and all participants provided informed consent before completing the questionnaire.

Measure

The HSPSC[8] is a self-administered questionnaire for capturing the perceptions of hospital employees concerning PSC. The questionnaire consists of 44 items, 42 of which are grouped in 12 dimensions. On a 5-point Likert scale these 42 items measure agreement (from 'strongly disagree' to 'strongly agree') or frequency (from 'never' to 'always'). The remaining two items are the Patient Safety Grade (5-point quality scale from 'Excellent' to 'Failing') and the Number of Events Reported (6-point frequency scale from 'No event reports' to '21 or more event reports'). In addition, we collected demographic information on study participants (ie, profession, gender, tenure in the hospital and within the department).

The original US version of the HSPSC was translated from English into Georgian by a native speaker with more than 10 years of experience with the Georgian healthcare context. Next, the Georgian version was back-translated into English by a professional translator. The discrepancies between the original version and back-translation were discussed by the research team and necessary revisions were made. The revised version was pretested in a group of five local healthcare professionals (healthcare researchers, managers, physicians and nurses). The research team discussed the results of the pretest to establish a final version of the HSPSC-GE. In order to ensure better understandability and acceptability, the final version had some linguistic adaptations (eg, '*It is a pure luck that more serious errors do not happen here*' instead of '*It is just by chance that more serious mistakes don't happen around here*'), as well as minor adaptations to account for structural aspects of the Georgian healthcare system (eg, 'department' instead of 'unit'). However, in order to facilitate comparisons with results of other language versions, we maintained the overall structure and composition of the instrument intact, meaning, that all items from original US version were present in the HSPSC-GE.[8] The final version of the instrument is available on request from the corresponding author.

Analysis

Data processing and preliminary analysis

Twenty-four of the 42 items of the HSPSC-GE are positively worded (eg, '*Staff will freely speak up if they see something that may negatively affect patient care*'), with high scores corresponding to more positive PSC, while the remaining 18 are negatively worded (also called reversed coded items), with higher scores corresponding to less desirable PSC (eg, '*Staff are afraid to ask questions when something does not seem right*').[8] The negatively worded items are unequally presented in different PSC dimensions, ranging from none to all items. For consistency of interpretation, as well as for factor analysis, negatively worded items were reversed coded prior to analysis. After calculating the descriptive statistics of the sample, in order to maintain the high quality of the data, we excluded cases with more than 10% missing answers on the 42 HSPSC-GE items used in the factor analysis. The remaining missing values were imputed using multiple imputations based on the expectation maximisation (EM) algorithm.[12–14]

Before conducting exploratory factor analysis (EFA) and confirmatory factor analysis (CFA), we evaluated Kaiser-Meyer-Olkin (KMO), measure of sampling adequacy (MSA) and Bartlett's test of sampling adequacy. The value >0.7 is desired (>0.9 perfect) for both KMO and MSA, which indicate that a sample of items, and each individual item are respectively adequate for factor analysis.[13 15] A significant p value (<0.05) of Bartlett's test indicates that it is possible to extract more than one factor.[15] We conducted all preliminary and further analyses using SAS V.9.4.

Descriptive statistics

We calculated mean scores for all 12 HSPSC-GE dimensions by averaging the corresponding items. We calculated range, mean and 95% CI for each item and dimension. We calculated the percentage of positive responses of each item and dimension by dividing the number of positive responses (4 and 5) by the total number of all non-missing responses and multiplying this value by 100%[8] and provided 95% CIs. We report percentages of positive scores only as a benchmark for comparisons, as it has been demonstrated that various scoring methods may yield different results.[16] All further analyses were conducted using the Likert scale scores.

Acceptability

We evaluated the acceptability of individual items, dimensions, as well as the complete questionnaire by means of per cent of missing answers. To further study the performance of the instrument, we calculated the floor and ceiling effects (the per cent of lowest and highest available answers, respectively). For PSC dimensions we considered 15% floor or ceiling effect as significant.[17]

Internal consistency

We evaluated the internal consistency of the instrument by calculating Cronbach's alpha for each dimension. Cronbach's alpha ≥0.6 was considered adequate[8] and alpha ≥0.7 good.[13 15] We assessed the internal consistency of the instrument using both the original 12-factor model and the alternative model resulting from the EFA.

Construct validity

We assessed construct validity by calculating Spearman's correlations between dimensions of HSPSC-GE with the single item outcome variable *Patient Safety Grade*. Because these dimensions all measure constructs related to PSC, we expected low to moderate statistically significant positive correlations. However, excessive correlation (>0.90)[13] between PSC dimensions could indicate possible collinearity.[8 13 15] To evaluate item validity, we calculated item-total correlations, expecting moderate to high positive correlations (>0.3),[15] as all the items of the instrument contribute to the common construct of PSC.

Exploratory factor analysis

To investigate the performance of the HSPSC-GE items in details, we conducted EFA and evaluated possible alternative factor structures based on our data. The study sample, stratified by hospitals, was randomly split into 'exploratory' and 'testing' subsamples. The exploratory subsample was used for EFA, and the testing subsample was later used to cross-validate EFA results in the CFA.[13]

In the EFA we used maximum likelihood for factor extraction, with varimax orthogonal prerotation, and promax oblique rotation to aid with interpretation of the factor structure.[13] Factor extraction was based on scree plot and Kaiser criterion (eigenvalues >1). Factor loadings ≥0.4 were considered significant and factor cross-loading <0.4 was considered acceptable.[13 15] We applied these criteria to achieve a satisfactory factor structure based on the exploratory subsample. Next we evaluated the fit of this model to the testing subsample.

Confirmatory factor analysis

We conducted CFA using the complete data set to evaluate the fit of the original 12-factor model with our data. The following indices and respective criteria were considered in the CFA: normed χ^2 (χ^2/df) ≤3.0; comparative fit index >0.90; goodness of fit index (GFI) >0.90; adjusted GFI >0.90; Tucker-Lewis Index/non-normed fit index >0.90; root mean square error of approximation ≤0.08; and standardised root mean square residuals ≤0.07.[13 15]

In the preliminary analysis, as well as in the EFA, we observed divergent performance of positively and negatively worded items. The use of 18 negatively worded items in the instrument may pose an additional reversed item bias,[18] meaning that participants may respond inconsistently to positively and negatively worded items. These inconsistencies in responding may affect the descriptive outcomes of the study (mean and 95% CI), and change the interitem associations (eg, correlations) and thus alter results of the CFA. To check for the presence of reversed item bias, we added separate method factors with effects on the positively or negatively worded items,[18] and tested the fit of this extended model to our data in CFA.

Lastly, we conducted CFA using the 'testing' subsample to evaluate the fit of the EFA-based model.

RESULTS

Study sample and descriptive statistics

We collected 579 questionnaires from three hospitals with an estimated total of 1391 employees, resulting in a response rate of 41.4%. Response rates in the three participating hospitals ranged from 33.7% to 50.1%. All participants chose the paper version of the questionnaire rather than using the online version. By profession, our sample was divided into three equal groups—physicians (32.5%), nurses (31.4%) and other clinical and non-clinical personnel (33.5%), all three groups being predominantly female with 61.2%, 94.5% and 85.6%, respectively. Having managerial functions was reported by 22.1% of participants, 30.5% of these were male (considerably higher compared with 18.0% in the overall sample). Descriptive characteristics of the sample are presented in table 1.

Among the 42 items included in the factor analysis, the average missing answer was 2.19%, with a maximum of

Table 1 Demographic characteristics of the study sample

Characteristics	n	%
Gender		
Male	104	18.0
Female	458	79.1
Missing	17	2.9
Profession		
Physician	188	32.5
Nurse	182	31.4
Other	194	33.5
Missing	15	2.6
Contact with patients		
Yes	459	79.3
No	101	17.4
Missing	19	3.3
Managerial functions		
Yes	128	22.1
No	412	71.2
Missing	39	6.7
Average working hours per week		
<20	20	3.5
20–39	106	18.3
40–59	336	58.0
60–79	71	12.3
80–99	18	3.1
100+	18	3.1
Missing	10	1.7
Years in the hospital		
<1	43	7.4
1–5	392	67.7
6–10	45	7.8
11–15	24	4.1
16–20	12	2.1
21+	51	8.8
Missing	12	2.1
Total sample	579	100.0

4.66% on C4 ('Staff feel free to question the decisions or actions of those with more authority'). The single item G1 (Number of Events Reported) had the highest number of missing answers with 6.56%. Most dimensions demonstrated a ceiling effect >15%, which indicates that the instrument may not be able to differentiate effectively at the high end of the construct. We did not observe the floor effect >15% in any of the dimensions. Missing answers as well as mean values and percentage of positive responses, as well as corresponding CIs for 12 dimensions, respective 42 items and 2 additional single items are presented in table 2.

After removing 21 cases with more than 10% missing answers on HSPSC-GE items 558 cases remained for imputation using multiple imputations based on the EM algorithm.

The KMO test resulted in an appropriate value of 0.84, with MSA for the items varying between 0.64 and 0.92; together with a highly significant Bartlett's test (p<0.0001), indicating that the sample was adequate for factor analysis.

Internal consistency

Only four dimensions (O2, H1, H3 and U1) demonstrated acceptable (α>0.60) to good (α>0.70) internal consistency (table 2). The remaining eight dimensions had low scores, with four dimensions (O1, U4, U5 and U7) having Cronbach's alpha scores <0.50, demonstrating extremely poor internal consistency.

Construct validity

Most dimensions demonstrated statistically significant positive correlations with other dimensions of the instrument, as well as with the single item *Patient Safety Grade*. The exception was the dimension *Staffing* (U4), which was not correlated with the single item *Patient Safety Grade*, had limited or no correlation with many other PSC dimensions and was negatively correlated with two dimensions, *Organisational Learning—Continuous Improvement* and *Communication Openness* (U2 and U7, respectively). None of the correlations were higher than 0.90, indicating that there was no collinearity between dimensions. All correlations are presented in online supplementary appendix 1. Most items had standardised item-total correlations >0.3, indicating that these items represent a common construct (ie, PSC). The three items with lowest item-total correlation were A5 ('Staff in this unit work longer hours than is best for patient care', α=–0.03), A14 ('We work in 'crisis mode' trying to do too much, too quickly', α=0.03) and B3 ('Whenever pressure builds up, my supervisor/manager wants us to work faster, even if it means taking shortcuts', α=0.08). All three were negatively worded items.

Exploring dimensions of HSPSC-GE

By conducting EFA with the exploratory sub sample (n=279) and gradually eliminating items with factor loadings <0.40 and with factor cross-loadings >0.4, 23 items were removed from the model, leading to a five factor model with 19 items (see table 3). For four original dimensions (O1, U3, U4 and U6) all items had to beremoved from the model. The negatively worded items from the three hospital-level dimensions (H1, H2 and H3) merged to form one new dimension, *Hospital-wide cooperation and support* (table 3, factor 1). Four positively worded items from three dimensions (U2, U7 and H2) formed one new dimension, *Staff's active role in promoting-patient safety* (table 3, factor 2). The two negatively worded items (B3 and B4) were removed from the model leaving the dimension *Supervisor/Manager Expectations and ActionsPromoting Patient Safety* (U5) with only two items (table 3,

Table 2 HSPSC-GE dimensions and items; missing answers, mean scores and 95% CI, per cent of positive responses and corresponding 95% CI (n=579)

Dimensions/items (Cronbach's alpha)	Missing answers (%)*	Floor effect (%)†	Ceiling effect (%)‡	Mean score (±CI)	Per cent of positive responses (±CI)
Three hospital-level dimensions (H1–H3)					
H1—Management support for patient safety (α=0.65)	1.04	0.86	34.89	4.08 (±0.08)	72.74 (±2.73)
F1. Hospital management provides a work climate that promotes patient safety.	1.55	3.80	64.94	4.35 (±0.09)	82.46 (±3.13)
F8. The actions of hospital management show that patient safety is a top priority.	2.59	7.25	53.71	4.04 (±0.11)	72.52 (±3.69)
F9. Hospital management seems interested in patient safety only after an adverse event happens. (N)	3.11	7.25	47.50	3.83 (±0.11)	63.10 (±4.00)
H2—Teamwork across units (α=0.54)	1.04	0.17	22.45	3.99 (±0.07)	69.94 (±2.40)
F2. Hospital units do not coordinate well with each other. (N)	2.94	9.67	46.46	3.75 (±0.12)	63.35 (±3.99)
F4. There is good cooperation among hospital units that need to work together.	2.42	8.64	51.47	3.94 (±0.11)	68.85 (±3.82)
F6. It is often unpleasant to work with staff from other hospital units. (N)	2.59	4.32	47.15	3.96 (±0.10)	68.44 (±3.84)
F10. Hospital units work well together to provide the best care for patients.	2.07	3.45	63.56	4.32 (±0.09)	79.72 (±3.31)
H3—Handoffs and transitions (α=0.73)	1.73	0.17	25.91	3.95 (±0.08)	66.65 (±2.76)
F3. Things 'fall between the cracks' when transferring patients from one unit to another. (N)	2.25	4.15	47.50	3.91 (±0.11)	67.67 (±3.86)
F5. Important patient care information is often lost during shift changes. (N)	2.76	3.97	55.96	4.10 (±0.10)	72.65 (±3.69)
F7. Problems often occur in the exchange of information across hospital units. (N)	2.59	5.01	34.54	3.51 (±0.11)	50.18 (±4.13)
F11. Shift changes are problematic for patients in this hospital. (N)	1.90	3.28	66.32	4.27 (±0.10)	76.23 (±3.50)
Seven unit-level dimensions (U1–U7)					
U1—Teamwork within units (α=0.70)	0.17	0.17	35.92	4.37 (±0.06)	84.95 (±1.87)
A1. People support one another in this unit.	1.55	2.59	65.11	4.45 (±0.08)	88.07 (±2.66)
A3. When a lot of work needs to be done quickly, we work together as a team to get the work done.	0.86	3.11	73.75	4.57 (±0.07)	90.94 (±2.35)
A4. In this unit, people treat each other with respect.	1.90	2.59	66.32	4.44 (±0.08)	86.27 (±2.83)
A11. When one area in this unit gets really busy, others help out.	2.07	10.19	53.89	4.02 (±0.11)	74.25 (±3.60)
U2—Organisational learning—continuous improvement (α=0.58)	0.86	0.00	23.66	3.93 (±0.08)	68.14 (±2.74)
A6. We are actively doing things to improve patient safety.	1.55	1.55	73.75	4.45 (±0.09)	82.81 (±3.10)
A9. Mistakes have led to positive changes here.	2.94	12.61	33.33	3.58 (±0.11)	56.05 (±4.11)

Continued

Table 2 Continued

Dimensions/items (Cronbach's alpha)	Missing answers (%)*	Floor effect (%)†	Ceiling effect (%)‡	Mean score (±CI)	Per cent of positive responses (±CI)
A13. After we make changes to improve patient safety, we evaluate their effectiveness.	1.90	17.79	50.43	3.73 (±0.13)	64.79 (±3.93)
U3—Non-punitive response to error (α=0.59)	1.38	2.59	12.95	3.40 (±0.09)	49.21 (±2.86)
A8. Staff feel like their mistakes are held against them. (N)	1.90	15.54	28.84	3.14 (±0.12)	40.14 (±4.03)
A12. When an event is reported, it feels like the person is being written up, not the problem.(N)	2.42	11.74	46.46	3.71 (±0.12)	61.95 (±4.01)
A16. Staff worry that mistakes they make are kept in their personnel file. (N)	2.25	13.99	29.19	3.33 (±0.12)	45.05 (±4.10)
U4—Staffing (α=0.45)	0.69	0.00	3.63	3.34 (±0.08)	53.68 (±2.44)
A2. We have enough staff to handle the workload.	1.04	11.40	51.47	3.96 (±0.11)	75.92 (±3.50)
A5. Staff in this unit work longer hours than is best for patient care. (N)	2.94	28.15	29.88	3.01 (±0.13)	42.53 (±4.09)
A7. We use more agency/temporary staff than is best for patient care. (N)	3.28	10.36	42.31	3.61 (±0.12)	54.64 (±4.13)
A14. We work in 'crisis mode' trying to do too much, too quickly. (N)	2.07	33.85	16.58	2.72 (±0.13)	40.21 (±4.04)
U5—Supervisor/manager expectations and actions promoting patient safety (α=0.41)	0.35	0.35	17.96	4.09 (±0.06)	74.13 (±1.99)
B1. My supervisor/manager says a good word when he/she sees a job done according to established patient safety procedures.	0.86	6.04	52.33	4.18 (±0.09)	80.49 (±3.24)
B2. My supervisor/manager seriously considers staff suggestions for improving patient safety.	1.55	3.11	53.89	4.18 (±0.09)	72.11 (±3.68)
B3. Whenever pressure builds up, my supervisor/manager wants us to work faster, even if it means taking shortcuts. (N)	2.25	18.31	40.93	3.46 (±0.13)	55.65 (±4.10)
B4. My supervisor/manager overlooks patient safety problems that happen over and over. (N)	1.55	5.18	77.20	4.51 (±0.09)	87.02 (±2.76)
U6—Feedback and communication about error (α=0.57)	0.52	0.52	27.81	4.08 (±0.07)	71.72 (±2.62)
C1. We are given feedback about changes put into place based on event reports.	2.42	3.63	49.91	4.05 (±0.10)	69.91 (±3.79)
C3. We are informed about errors that happen in this unit.	3.80	3.63	44.73	3.98 (±0.10)	68.04 (±3.88)
C5. In this unit, we discuss ways to prevent errors from happening again.	2.25	3.80	57.51	4.20 (±0.09)	76.33 (±3.51)
U7—Communication openness (α=0.35)	1.04	0.52	9.33	3.51 (±0.07)	55.51 (±2.52)
C2. Staff will freely speak up if they see something that may negatively affect patient care.	2.07	7.25	46.11	3.86 (±0.11)	66.14 (±3.90)

Continued

Table 2 Continued

Dimensions/items (Cronbach's alpha)	Missing answers (%)*	Floor effect (%)†	Ceiling effect (%)‡	Mean score (±CI)	Per cent of positive responses (±CI)
C4. Staff feel free to question the decisions or actions of those with more authority.	4.66	25.22	14.51	2.70 (±0.12)	31.88 (±3.89)
C6. Staff are afraid to ask questions when something does not seem right. (N)	1.55	6.74	45.94	3.92 (±0.10)	66.67 (±3.87)
Two outcome dimensions (O1–O2)					
O1—Overall perceptions of patient safety (α=0.40)	1.04	0.17	21.24	3.94 (±0.07)	69.34 (±2.25)
A10. It is just by chance that more serious mistakes do not happen around here. (N)	2.59	9.84	54.92	3.95 (±0.12)	68.79 (±3.83)
A15. Patient safety is never sacrificed to get more work done.	2.76	10.02	57.17	4.15 (±0.11)	79.40 (±3.34)
A17. We have patient safety problems in this unit. (N)	1.90	12.95	50.95	3.77 (±0.12)	62.50 (±3.98)
A18. Our procedures and systems are good at preventing errors from happening.	1.38	8.46	47.84	3.88 (±0.11)	67.08 (±3.86)
O2—Frequency of events reported (α=0.87)	0.35	4.66	21.07	3.39 (±0.10)	47.21 (±3.54)
D1. When a mistake is made, but is caught and corrected before affecting the patient, how often is this reported?	0.69	9.84	30.05	3.34 (±0.11)	46.26 (±4.08)
D2. When a mistake is made, but has no potential to harm the patient, how often is this reported?	1.90	10.36	24.70	3.23 (±0.11)	40.49 (±4.04)
D3. When a mistake is made that could harm the patient, but does not, how often is this reported?	2.42	9.84	40.07	3.61 (±0.12)	55.04 (±4.11)
Two single item outcomes (E1, G1)					
E1. Patient safety grade	0.52	0.17	11.74	3.64 (±0.06)	54.69 (±4.07)
G1. Number of events reported	6.56	78.07	1.04	NA	16.45 (±3.13)§

(N) denotes negatively worded items; total sample n=579.

*Percentage of missing answers before imputation.
†Percentage of participants indicating lowest answer category.
‡Percentage of participants indicating highest answer category.
§Percentage of participants reporting one or more errors in the past 12 months.
HSPSC-GE, Georgian version of the Hospital Survey on Patient Safety Culture; NA, not applicable.

factor 5). Two dimensions, *Frequency of Events Reported* and *Teamwork within Units* (O2 and U1), were independently present in the model (table 3, factors 3 and 4).

Fit of the data with different factor models

CFA of the EFA-based five-factor model using the testing subsample (n=279) resulted in acceptable fit indices. In contrast, CFA of the 12-factor model with the complete sample (n=558) resulted in poor model fit. Next, to account for the item wording, we extended the model with additional method factors for negatively worded and positively worded items, which improved the model fit. The results of the three CFAs are presented in table 4.

DISCUSSION

In this study, we evaluated the psychometric properties of the HSPSC-GE. The original 12-factor model demonstrated poor fit with our data and internal consistency of many dimensions was not satisfactory. We were also able to show that parts of the instrument are relatively stable and demonstrate acceptable psychometric properties.

In our study, 8 out of 12 dimensions of PSC showed poor internal consistency. Four of these, namely *Overall Perceptions of Patient Safety*, *Staffing*, *Non-punitive Response to Error* and *Feedback and Communication about Error*, were completely eliminated during EFA. Other validation

Table 3 Rotated factor structure of the five-factor model resulting from the EFA

Factor (α)/item	Factor loadings
Factor 1: Hospital-wide cooperation and support (α=0.79)	
F2. Hospital units do not coordinate well with each other. (N)	0.55
F3. Things 'fall between the cracks' when transferring patients from one unit to another. (N)	0.64
F5. Important patient care information is often lost during shift changes. (N)	0.67
F6. It is often unpleasant to work with staff from other hospital units. (N)	0.57
F7. Problems often occur in the exchange of information across hospital units. (N)	0.57
F9. Hospital management seems interested in patient safety only after an adverse event happens. (N)	0.52
F11. Shift changes are problematic for patients in this hospital. (N)	0.58
Factor 2: Staff's active role in promoting patient safety (α=0.77)	
A6. We are actively doing things to improve patient safety.	0.62
A13. After we make changes to improve patient safety, we evaluate their effectiveness.	0.66
C2. Staff will freely speak up if they see something that may negatively affect patient care.	0.73
F4. There is good cooperation among hospital units that need to work together.	0.69
Factor 3: Frequency of events reported (α=0.87)	
D1. When a mistake is made, but is caught and corrected before affecting the patient, how often is this reported?	0.86
D2. When a mistake is made, but has no potential to harm the patient, how often is this reported?	0.89
D3. When a mistake is made that could harm the patient, but does not, how often is this reported?	0.70
Factor 4: Teamwork within units (α=0.71)	
A1. People support one another in this unit.	0.86
A3. When a lot of work needs to be done quickly, we work together as a team to get the work done.	0.51
A4. In this unit, people treat each other with respect.	0.74
Factor 5: Supervisor/manager expectations and actions promoting patient safety (α=0.65)	
B1. My supervisor/manager says a good word when he/she sees a job done according to established patient safety procedures.	0.52
B2. My supervisor/manager seriously considers staff suggestions for improving patient safety.	0.94

The table demonstrates standardised regression coefficients for items remaining in the model.
Underlined denotes new dimensions that were not part of original 12-factor model.
(N) denotes negatively worded items.
EFA, exploratory factor analysis.

studies have found similar problems with the dimensions *Overall Perceptions of Safety*[6 9 19–21] and *Hospital Management Support for Patient Safety* and *Staffing*.[19] Also, the dimensions *Communication Openness—Continuous Learning* and *Feedback and Communication about Error* often merge together into one common factor.[6 9 21–26] These dimensions may be particularly unstable in translated versions, indicating the need for improvement in the item set and/or wording to support international use of the instrument.

Our results demonstrate that study participants responded differently to positively and negatively worded items. In general, negatively worded items had lower mean values and percentages of positive responses, compared with positively worded items. In the alternative five-factor model, disproportionately more negatively worded items were eliminated. Moreover, in our EFA-based model all five dimensions consisted either entirely of positively or negatively worded items. Finally, our extended model that accounted for the reversed item bias resulted in better fit indices, demonstrating that at least part of the variance in our data can be explained by direction of item wording. These results may suggest that study participants perceive and interpret positively and negatively worded items differently. HSPSC-GE has the same item composition and wording as the original US version,[8] and so it may be reasonable to suggest that the reversed item bias is an inherent part to the original instrument design, rather than a feature of the local version. As such, it may affect other language versions of the instruments as well. Similarly, significant effect of item wording on per cent of positive scores was reported by the experimental study using HSPSC,[27] where control group was asked to fill in the 19 items from HSPSC with original wording, while the wording of the same items was reversed for the study group. The authors concluded that the wording may affect the outcomes, and, to facilitate

Table 4 Indices of confirmatory factor analyses using the original 12-factor model, the EFA-based five-factor model and additional method factors

Model fit indices in CFA	Criteria for good model fit*	Original 12-factor model †	Original model ‡ extended with method factors	EFA-based five-factor model §
Sample size	NA	558	558	279¶
Number of factors	NA	12	12	¶
χ^2/df	<3.00	3.3	2.8	2.2
Root mean square error of approximation (RMSEA)	<0.08	0.065	0.057	0.065
Standardised root mean square residuals (SRMR)	<0.07	0.081	0.070	0.068
Goodness of fit index (GFI)	>0.90	0.81	0.85	0.89
Adjusted GFI	>0.90	0.77	0.82	0.86
Normed fit index	≥0.95	0.67	0.73	0.84
Comparative fit index ≥0.90	≥0.90	0.74	0.80	0.90
Tucker-Lewis Index/non-normed fit index non-normed fit index	≥0.90	0.70	0.77	0.88

*Model fits in accordance with Hair *et al*.[13]
†All 12 dimensions of the original model (H1–H3, U1–U7, O1–O2).
‡Original 12-factor model, extended with method factors for positively and negatively worded items.
§EFA-based five-factor model (19 items from dimensions O2, H1, H2, H3, U1, U2, U5 and U7).
¶Testing subsample.
CFA, confirmatory factor analysis; EFA, exploratory factor analysis; NA, not applicable.

reliable measurement of various components of PSC, they argue for balancing out the number of positively and negatively worded items within all dimensions. Studies using the HSPSC frequently report less positive results for dimensions with predominantly negatively worded items (*Non-punitive Response to Error*, *Staffing* and *Hospital Handoffs and Transitions*).[7 28 29] Although these dimensions may represent truly problematic aspects of hospital safety culture, rather lower scores may be at least partially explained by the reversed item bias (reduced scores on negatively worded items) coupled with unequal presence of negatively worded items in PSC dimensions. Therefore, this method bias should be taken into account when using the HSPSC, while interpreting and comparing the results, as well as in factor analyses.

Relatively limited internal consistency and construct validity in our results may be partially due to characteristics of the study population, and not just by properties of the instrument. Specifically, because the concept of PSC is relatively new for Georgian healthcare, participants might find it difficult to associate certain ideas or behaviours with common constructs. This can be addressed with targeted educational activities and trainings, familiarising healthcare personnel with relevant concepts. Additionally, we observed considerable ceiling effect in most PSC dimensions, indicating a grouping of the results on the highest response category. One could speculate on different factors ‘pushing’ the results towards the positive end. This might be factors associated with study method, like social desirability bias,[30] but also factors associated with participants, like, for example, fear of retribution or possibly lower expectations regarding patient safety-related issues. The factors associated with the sample might be mitigated through education and training. The same analysis using a sample of participants with a more structured and somewhat shared understanding of concepts of PSC could result in better properties of the instrument. This should be considered in further investigations on safety culture in Georgian hospitals.

One of the purposes of PSC assessment is to compare the results between different settings (unit/team, hospitals, healthcare systems) or time periods (monitoring the change over time). In order to support such comparisons, a common measurement instrument should be used, which has adequate psychometric properties for all settings. Although our results demonstrate considerably limited psychometric properties of the HSPSC-GE and that some dimensions with extremely limited internal consistency should be interpreted with caution, we still argue against significant changes in the factor structure and item composition. Several arguments can support this claim: (1) First, the psychometric properties, including the dimensionality of the HSPSC-GE may change in time with the evolution of the field of PSC in Georgian healthcare, as the study participants will have increasingly shared understanding and perception of PSC in their organisations. Exposure of study participants to the internationally shared concepts may also facilitate this process. (2) Using the common item set will ensure continuous collection of local data on a common spectrum of relevant items for future analysis, and the ability to compare results with studies from other developed countries and low/middle-income countries. (3) Because problems with some dimensions and items are not unique to our study, but reported rather frequently in validation studies in different languages, the instrument needs to be improved on a larger, international level. (4) And finally, even though the dimensionality of the instrument, as well as its understanding by the participants may vary, the individual items of the instrument are still relevant for the field of PSC and thus should be monitored further.

Limitations

This is the first study validating an established PSC instrument in Georgian healthcare. While we used a large data set from three hospitals, our findings are limited by the study sample which included only general hospitals with more than 100 hospital beds and should not be generalised to smaller or specialised hospitals in Georgia. The generalisability of our results may be also limited by the modest response rate, which however is comparable to similar studies. In 2018, the Agency for Healthcare Research and Quality comparative database report[29] reported average response rate of 56%, ranging from 12% to 100%. According to a recent review, response rate in comparable validation studies from other countries may go as low as 23%.[7] Moreover, the poor performance of the instrument in our sample might be bound to the language version we developed for this study, and this should be taken into consideration in further investigations of safety culture in Georgia. Lastly, we were not able to include the association of PSC with objective patient outcomes of the hospitals (external validity). However, there is growing evidence supporting the positive correlation between PSC and various outcome variables.[2 3]

CONCLUSIONS

HSPSC-GE demonstrated poor psychometric properties, and many items and dimensions may need to be further developed. However, parts of the instrument demonstrated sufficient internal consistency and acceptable reliability to be used in studies of PSC in Georgian hospitals. We were able to demonstrate that negatively worded items may be prone to reversed item bias, which may have an effect on the mean values, as well as on dimensionality of the instrument. It is likely that this effect is inherent in the HSPSC design, and so should be accounted for when interpreting and comparing results, and when analysing the psychometric properties of any language version. Since the problems we found with various dimensions are not unique for our sample, improvement of the instrument should be done on the global, not a local scale. Meanwhile, HSPSC-GE extracts necessary information for developing PSC in healthcare organisations, and we recommend using it in its full form to facilitate further analysis of results and development of the field.

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10.4. Study D

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Psychometric properties of the Georgian version of the Safety Attitudes Questionnaire: a cross-sectional study

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ABSTRACT

Objective To study the psychometric properties of the Georgian version of the Safety Attitudes Questionnaire short version.
Design Cross-sectional study.
Setting Three Georgian hospitals.
Participants Personnel of participating hospitals (n=305 responses, estimated response rate 30%).
Interventions None.
Primary and secondary outcome measures Psychometric properties (model fit, internal consistency, construct validity, convergent and discriminant validity) of the instrument, factor structure derived from the data.
Results The Georgian version of Safety Attitudes Questionnaire demonstrated acceptable construct validity and internal consistency (Cronbach's alpha 0.61–0.91). Three factors, Teamwork Climate, Safety Climate and Working Conditions, had limited convergent and discriminant validity. Confirmatory factor analysis with the original six-factor model resulted in limited model fit (χ^2/df=2.14, root mean square error of approximation (RMSEA)=0.06, goodness of fit index (GFI)=0.83, CFI=0.88, TLI=0.86). Exploratory factor analysis resulted in a modified four-factor model with satisfactory model fit (χ^2/df=2.09, RMSEA=0.06, GFI=0.88, CFI=0.93, TLI=0.91).
Conclusions The Georgian version of the Safety Attitudes Questionnaire (short version) demonstrated acceptable psychometric properties, with acceptable to good internal consistency and construct validity. While the whole model had limited fit to the data, a modified factor model resulted in good model fit. Our findings suggest the dimension Working Conditions has questionable psychometric properties and should be interpreted with caution. Other two correlated dimensions Teamwork Climate and Safety Climate share considerable variance and may be merged. Overall, the instrument can provide valuable information relevant for advancement of patient safety culture in Georgian hospitals.

Strengths and limitations of this study

- First study to validate a Georgian version of the Safety Attitudes Questionnaire (short version).
- A comprehensive analysis of the survey instrument's performance, including exploratory and confirmatory factor analysis.
- Multiprofessional sample from multiple hospitals.
- Study findings are limited by the study sample, which included three general hospitals.

INTRODUCTION

Over the past decades, overwhelming evidence has been accumulated suggesting that patient safety is an ongoing challenge for modern healthcare systems. Cultivating the culture of safety in healthcare organisations has been recommended to enable better communication and open exchange, to learn from errors, eventually leading to better patient outcomes.[1] The recent report by the Organisation for Economic Cooperation and Development (OECD), the Economics of Patient Safety[2] analysed the state of the research and its implications on a larger, national level. Among the key messages and conclusions, the report underlines the importance of placing patient safety among national priorities, and establishing positive patient safety culture at the organisation level. Ensuring high quality and safe healthcare services for all citizens, in line with these recommendations, is also among the current priorities of the Georgian government.[2 3] The healthcare services in the country are largely provided by private organisations which are increasingly required by state regulatory organisations and funding bodies to establish processes and systems to ensure improvements in patient safety.[4] Thus, in order to analyse and develop the culture of safety, Georgian healthcare organisations require valid instruments to measure safety culture in local environments.

The Safety Attitudes Questionnaire short version (SAQ-S),[5] originally adapted from the aviation industry to be used in US hospitals, is among the most frequently used instruments for measuring safety culture internationally.[6] It has been translated into several different languages and validated in many countries.[6–14] Overall, validation studies using SAQ-S have reported acceptable psychometric properties, indicating that the instrument may be relevant for measuring and promoting patient safety culture in different healthcare settings.

In this study, we aimed to evaluate psychometric properties of a Georgian version of the Safety Attitudes Questionnaire short version (SAQ-S-GE), including internal consistency, convergent and discriminant validity, fit to original factor model and possible alternative factor structure.

METHODS

Setting and data collection

The data for this cross-sectional study were collected as part of the study project *Patient Safety Culture in Georgian Healthcare (PaSCu.Ge)*, which aimed to establish a baseline evaluation of patient safety culture in local hospitals using translated and adapted versions of internationally well-studied instruments, the Hospital Survey on Patient Safety Culture[15] and Safety Attitudes Questionnaire.[5] The psychometric properties of the former are presented elsewhere.[16] Using the SAQ-S-GE, data were collected in three Georgian hospitals in two cities between June and August 2017. Hospital employees could complete the survey electronically or on paper. Hospital representatives were trained to act as local study coordinators and facilitate employee participation.

Patient and public involvement

Representatives of patient and public groups were not involved in the study design and implementation. Main findings of the study will be made publicly available online (in both Georgian and English).

Sample

Two of the three participating hospitals have 100–150 hospital beds and the third has <50 hospital beds. All three are for-profit multiprofile hospitals, with an estimated total of 1000 employees who met the inclusion criteria. All personnel of the three participating general hospitals, employed for more than 1 month, were invited to participate. Before completing the survey, all participants were informed that participation was voluntary and anonymous, and provided informed consent.

Measure

Safety Attitudes Questionnaire short version (SAQ-S)[5 17] consists of 36 items, 31 of which are grouped into six dimensions. All 36 items of the instrument measure participants' agreement (from 1=strongly disagree to 5=strongly agree) to various patient safety-related statements on a five-point Likert scale. In this study, we also included the outcome item *Patient Safety Grade* from another widely used instrument on patient safety culture, the Hospital Survey on Patient Safety Culture.[15] The item asks for an employee evaluation of patient safety on a five-point quality scale (from 1=failing to 5=excellent). In addition, the questionnaire included the demographic information on study participants (ie, department, profession, gender, tenure).

The original version of the SAQ-S was translated from English to Georgian by a native speaker with experience of working in Georgian healthcare. The translated version was adapted to the Georgian healthcare context without changing the overall structure of the instrument. Next, the Georgian version was back-translated to English by a professional translator. The discrepancies with the original version were discussed by the research team (NG, AH and TM) and necessary revisions were made. We asked five Georgian professionals (healthcare researchers and managers, physicians and nurses) who were not otherwise associated with the study to do a cognitive pretest of the revised version and to provide feedback on the content and language. Based on the results of the pretest, we were able to establish the final Georgian version of the questionnaire used in this study (SAQ-S-GE). In order to support comparability of the results, we made sure to maintain the overall composition and item wording of the original SAQ-S. The SAQ-S-GE is available on request from the corresponding author.

Analysis

Data processing and preliminary analysis

Before the analysis, negatively coded items were reverse coded, so that higher scores correspond to more positive safety culture. Descriptive analyses, as well as analyses of acceptability, were conducted using the complete sample. It has been shown that by means of imputing the missing answers, a considerable part of the sample may be made available for the analysis sensitive to missing values.[18] However, in order to maintain high data quality, we excluded cases with more than 10% missing answers before imputation. The remaining missing values were imputed using the expectation maximisation algorithm.

Descriptive statistics

Mean scores for SAQ-S-GE dimensions were calculated by averaging the corresponding items. We calculated means and SD and the percentage of positive responses (scores 4 and 5) for each item and dimension.[5]

Acceptability

To evaluate the acceptability of the questionnaire, we calculated the percentage of missing answers on individual items and complete dimensions. We considered floor and ceiling effects (ie, the percentage of lowest and highest available answers, respectively), as an indication of the instrument's performance at the extremes of the measured construct. For dimensions, we considered a floor or ceiling effect of <15% acceptable.[17]

Internal consistency, construct validity, convergent and discriminant validity

As an indication of internal consistency of the instrument, we calculated Cronbach's alpha for each dimension. Cronbach's alpha ≥0.7 was considered good.[19 20] We evaluated Spearman's correlations between the SAQ-S-GE dimensions, as well as correlation with the additional single-item outcome variable Patient Safety Grade, as preliminary analysis of construct validity. Because all dimensions are considered to be measuring constructs related to patient safety, we expected to find low to moderate positive correlations. However, excessive correlation between dimensions (>0.85) could indicate possible collinearity.[15 19]

Additionally, we evaluated the convergent and discriminant validity of the SAQ-S-GE.[21] As an indication of convergent validity of a dimension, we calculated the average variance extracted (AVE) and expected it to be >0.5. For divergent validity, we used the Fornell-Larcker criterion[21] and expected a higher square root of AVE (√AVE), compared with the highest correlation with other factors.

Exploratory factor analysis

Before conducting the factor analysis, we evaluated if the data were suitable for the analysis. We used Kaiser-Meyer-Olkin (KMO) and measure of sampling adequacy (MSA) (>0.7 desired, >0.9 perfect) to evaluate if the sample of items and each individual item were adequate for factor analysis.[19] A significant p value (<0.05) of Bartlett's test of sampling adequacy would indicate that it is possible to extract more than one factor.[19]

To explore a possible alternative factor structure based on our data, we conducted exploratory factor analysis (EFA) using the 31 items of the original six dimensions of SAQ-S. We used maximum likelihood algorithm for factor extraction with Varimax orthogonal prerotation and Promax oblique rotation to aid with interpretation of the factor model.[20] The number of factors extracted was guided by scree plot inspection and the Kaiser criterion (eigenvalues>1). We considered factor loadings ≥0.4 significant and cross-loading <0.4 acceptable.[19 20] We evaluated the similarities and differences between the EFA-based modified factor structure and the original model.

Confirmatory factor analysis

Confirmatory factor analysis (CFA) was used to evaluate how well the data fit the original factor model. The hypothesised model of SAQ-S-GE is presented in online supplementary appendix 1. We used the following indices and benchmarks: normed χ^2 (χ^2/df ≤2.5), root mean square error of approximation (RMSEA≤0.07), goodness of fit index (GFI>0.90), comparative fit index (CFI≥0.90) and Tucker-Lewis Index/non-normed fit index (TLI>0.90).[5 19 20] We analysed the fit of complete model, as well as that of each of the six original dimensions. Finally, we evaluated the fit of the EFA-based modified model. All analyses were done using SAS V.9.4.

Table 1 Descriptive characteristics of study sample

Characteristics	N	%
Total sample	305	100.0
Gender		
Female	219	71.8
Male	66	21.6
Missing	20	6.6
Profession		
Nurse	79	25.9
Physician	128	42.0
Other	79	25.9
Missing	19	6.2
Patient contact		
Yes	254	83.3
No	28	9.2
Missing	23	7.5
Managerial functions		
Yes	77	25.2
No	186	61.0
Missing	42	13.8
Hours per week		
Less than 20 hours	11	3.6
20–39 hours	76	24.9
40–59 hours	135	44.3
60 hours or more	61	20.0
Missing	22	7.2
Years in the department		
Less than 1 year	28	9.2
1–5 years	49	16.1
6–10 years	70	23.0
11–15 years	38	12.5
16–20 years	20	6.6
21 years or more	73	23.9
Missing	27	8.9
Years in the field		
Less than 1 year	4	1.3
1– 5 years	37	12.1
6–10 years	51	16.7
11–15 years	31	10.2
16–20 years	36	11.8
21 years or more	117	38.4
Missing	29	9.5

RESULTS

Study sample and descriptive statistics

A total of 305 questionnaires were collected from three participating hospitals, resulting in an estimated response rate of 30.5%. Twenty-one participants (6.9%), all from one hospital, used the online questionnaire. Most participants indicated having direct contact with patients (83.3%) and no managerial functions (61.0%). Descriptive characteristics of the sample are presented in table 1.

Percentage of missing answers per item was 6.8% on average, with a minimum of 2.3% ("Working here is like being part of a large family") and a maximum of 13.1% ("I receive appropriate feedback about my performance"). The dimension *Stress Recognition* had a floor effect >15%, while all other dimensions demonstrated a ceiling effect of >15%. Mean values and percentages of positive responses, as well as corresponding standard errors for all SAQ-S-GE dimensions, each individual item and the single item Patient Safety Grade are presented in table 2. The table presents all original 36 items and the corresponding six factors according to the guidelines of the Centre for Healthcare Quality and Safety of the University of Texas (available at https://med.uth.edu/chqs/survey).

Internal consistency and construct validity, convergent and discriminant validity

After removing 42 cases with more than 10% missing answers on any of 31 SAQ-S-GE items and imputing the remaining missing values, 263 questionnaires were available for further analyses. The dimensions of the SAQ-S-GE demonstrated good internal consistency with Cronbach's alpha ≥0.7, with the exception of the dimension Working Conditions (α=0.61). All interfactor correlations were statistically significant, except for the correlation between Stress Recognition and Working Conditions. Most dimensions correlated positively with each other, except for Stress Recognition, which had a negative correlation with all other dimensions. Convergent validity of the three out of six dimensions, Teamwork Climate, Safety Climate and Working Conditions, failed to reach the required benchmark of 0.5. Also, √AVE of these three dimensions was much lower than the highest correlation with other factors, demonstrating limited discriminant validity. Another three dimensions, Job Satisfaction, Stress Recognition and Perceptions of Hospital Management, showed good reliability with good internal consistency and convergent validity, and acceptable divergent validity, with Job Satisfaction having slightly less √AVE compared with the highest correlation. Table 3 presents the results of validity analyses of the original six dimensions.

Evaluating fit of the data to original model, and exploring an alternative model

KMO test returned 0.89, while the average MSA for the individual items was 0.86 and varied between 0.59 and 0.95. Bartlett's test was highly significant ($p<0.0001$), further indicating that the sample was adequate for factor analysis.

EFA resulted in a modified four-factor model with 21 items. Ten items were removed from this model because of either low factor loadings (<0.4) or high cross-loadings (>0.4). Two dimensions, Teamwork Climate and Safety Climate, were merged to form a combined dimension of Teamwork and Safety Climate. Three original dimensions, Job Satisfaction, Stress Recognition and Perceptions of Hospital Management, remained in the model, retaining all or most of the original items. The items from the dimension Working Conditions were mostly removed from the model. The EFA-based four-factor model is presented in table 4.

In CFA, we evaluated the fit of our data to the original six-factor model.[5] While the whole model hardly satisfied set criteria for a good fit, individual dimensions had better fit indices. Finally, we checked the fit of the EFA-based four-factor model to the data using CFA, which resulted in acceptable fit indices. Results of all CFA, together with considered thresholds for acceptable fit, are presented in table 5.

DISCUSSION

In this study, we evaluated the psychometric properties of SAQ-S-GE by analysing its acceptability, internal consistency, convergent and discriminant validity, as well as the fit to the original model and an alternative factor structure. We were able to identify dimensions with satisfactory properties and dimensions that may need further improvements and/or study.

Overall, the SAQ-S-GE was well accepted, with acceptable percentages of missing answers. Some studies using SAQ reported much lower (<2%) missing rates,[5 7 14] while our findings are more in line with European studies, reporting up to about 10% missing.[9 10 22–24] Further, we observed a significant ceiling effect in most dimensions and items, indicating that the instrument may not be effectively distinguishing the measurements at the higher end. A recent study using Rasch analysis similarly found considerable ceiling effect in all dimensions of the SAQ-S.[25] Moreover, in the recent study conducted in Georgian hospitals with another safety climate instrument, Georgian version of Hospital Survey on Patient Safety Culture, we have also found considerable ceiling effect in most dimensions.[16] This effect may be explained at least partially by social desirability bias pushing responses towards the positive end. Interestingly, the only dimension in our study demonstrating a floor effect was Stress Recognition. This dimension stood out in further analyses as well.

Our analysis of internal consistency obtained acceptable to good results, with only the dimension Working Conditions showing a low Cronbach's alpha. This is in line with other studies using the SAQ that reported lower internal consistency for this dimension.[12 13 23 24] Most items from this dimension had relatively high rates of missing values and were eventually removed from the alternative factor model, further indicating possible problems with validity or stability of the dimension. At this stage, the scores from this dimension should be interpreted with caution.

All dimensions except Stress Recognition were positively associated with each other, and with the outcome item Patient Safety Grade, reinforcing the validity of the instrument to measure a common underlying construct—Patient Safety Culture. The dimension Stress Recognition, however, was negatively associated with most other dimensions, which is well in line with findings from other studies using the SAQ.[5 9 10 23 24 26] Taylor and Pandian[26] called this dimension 'a dissonant scale' and recommended separating it from the instrument. Indeed, as many authors have pointed out, this scale asks participants

Table 2 SAQ-S-GE dimensions and items; percentage of missing values, floor and ceiling effects, mean scores and percentage of positive responses with corresponding standard errors

Dimensions/Items	Missing %	Floor %	Ceiling %	Mean scores (SE)	Percent of positive responses (SE)
Teamwork Climate	**0.7**	**0.7**	**29.8**	**4.41 (0.04)**	**85.1 (1.2)**
1. Nurse input is well received in this clinical area.	6.6	6.6	44.3	4.01 (0.07)	74.4 (2.6)
2. In this clinical area, it is difficult to speak up if I perceive a problem with patient care. (N)	9.2	5.9	57.4	4.11 (0.08)	72.9 (2.7)
3. Disagreements in this clinical area are resolved appropriately (ie, not who is right, but what is best for the patient).	6.2	2.3	68.5	4.55 (0.05)	90.2 (1.8)
4. I have the support I need from other personnel to care for patients.	8.5	1.3	70.5	4.66 (0.05)	94.3 (1.4)
5. It is easy for personnel here to ask questions when there is something that they do not understand.	6.6	3.3	69.5	4.50 (0.06)	88.1 (1.9)
6. The physicians and nurses here work together as a well-coordinated team.	3.6	2.3	76.1	4.61 (0.05)	90.8 (1.7)
Safety Climate	**3.6**	**0.0**	**16.7**	**4.27 (0.04)**	**81.6 (1.2)**
7. I would feel safe being treated here as a patient.	7.5	2.0	63.3	4.50 (0.05)	89.7 (1.8)
8. Medical errors are handled appropriately in this clinical area.	7.2	0.7	63.9	4.53 (0.05)	89.8 (1.8)
9. I know the proper channels to direct questions regarding patient safety in this clinical area.	6.6	1.3	73.4	4.65 (0.05)	91.6 (1.6)
10. I receive appropriate feedback about my performance.	13.1	12.8	32.8	3.61 (0.09)	62.6 (3.0)
11. In this clinical area, it is difficult to discuss errors. (N)	8.2	9.8	52.8	3.94 (0.09)	70.7 (2.7)
12. I am encouraged by my colleagues to report any patient safety concerns I may have.	6.9	3.0	62.0	4.43 (0.06)	86.3 (2.0)
13. The culture in this clinical area makes it easy to learn from the errors of others.	6.6	3.0	49.5	4.22 (0.06)	81.4 (2.3)
Job Satisfaction	**0.3**	**1.0**	**57.4**	**4.61 (0.04)**	**91.5 (1.3)**
15. I like my job.	3.6	1.6	76.4	4.66 (0.05)	92.9 (1.5)
16. Working here is like being part of a large family.	2.3	1.3	76.4	4.68 (0.04)	94.6 (1.3)
17. This is a good place to work.	4.3	1.6	65.2	4.53 (0.05)	90.4 (1.7)
18. I am proud to work in this clinical area.	3.6	1.0	74.8	4.64 (0.04)	90.5 (1.7)
19. Morale in this clinical area is high.	3.9	2.3	73.1	4.59 (0.05)	90.1 (1.7)
Stress Recognition	**5.6**	**15.4**	**5.2**	**2.82 (0.08)**	**46.6 (2.3)**
20. When my workload becomes excessive, my performance is impaired.	6.9	37.4	14.8	2.71 (0.10)	45.8 (3.0)
21. I am less effective at work when fatigued.	6.2	28.5	16.4	2.94 (0.09)	51.0 (3.0)
22. I am more likely to make errors in tense or hostile situations.	7.2	27.9	28.2	3.16 (0.10)	55.1 (3.0)
23. Fatigue impairs my performance during emergency situations (eg, emergency resuscitation, seizure).	9.8	42.0	13.1	2.46 (0.09)	34.2 (2.9)
Perceptions of Hospital Management	**3.3**	**0.3**	**43.3**	**4.31 (0.06)**	**82.5 (1.8)**
24. Hospital management supports my daily efforts.	6.2	3.6	59.0	4.31 (0.07)	83.2 (2.2)
25. Hospital management doesn't knowingly compromise patient safety.	7.9	0.7	74.4	4.64 (0.05)	90.0 (1.8)
26. Hospital management is doing a good job.	7.9	4.9	49.5	4.09 (0.07)	75.8 (2.6)
27. Problem personnel are dealt with constructively by our hospital management.	8.5	3.3	57.7	4.34 (0.06)	82.8 (2.3)

Continued

Table 2 Continued

Dimensions/Items	Missing %	Floor %	Ceiling %	Mean scores (SE)	Percent of positive responses (SE)
28. I get adequate, timely information about events that might affect my work, from hospital management.	7.5	7.5	53.8	4.13 (0.08)	78.4 (2.5)
Working Conditions	**4.6**	**0.0**	**30.2**	**4.25 (0.05)**	**80.8 (1.6)**
29. The levels of staffing in this clinical area are sufficient to handle the number of patients.	4.9	3.9	64.9	4.37 (0.07)	85.5 (2.1)
30. This hospital does a good job of training new personnel.	7.5	5.2	46.6	4.07 (0.07)	77.7 (2.5)
31. All the necessary information for diagnostic and therapeutic decisions is routinely available to me.	10.2	1.0	57.0	4.33 (0.06)	81.8 (2.3)
32. Trainees in my discipline are adequately supervised.	10.2	5.2	53.1	4.19 (0.07)	76.6 (2.6)
Items not belonging to any dimension					
14. My suggestions about safety would be acted on if I expressed them to management.	7.2	4.3	47.2	4.13 (0.07)	76.3 (2.5)
33. I experience good collaboration with nurses in this clinical area.	3.6	1.6	88.9	4.85 (0.04)	95.9 (1.2)
34. I experience good collaboration with staff physicians in this clinical area.	3.6	1.6	87.9	4.83 (0.04)	96.3 (1.1)
35. I experience good collaboration with pharmacists in this clinical area.	8.2	0.7	75.1	4.69 (0.04)	88.6 (1.9)
36. Communication breakdowns that lead to delays in delivery of care are common. (N)	8.2	12.5	39.0	3.48 (0.09)	55.7 (3.0)
Added single item *Patient Safety Grade*	**7.5**	**0.3**	**6.2**	**3.69 (0.04)**	**62.8 (2.9)**

n=305. Five items, namely, numbers 14 and 33–36, are not part of any scale and were not used in the factor analysis. These items are part of the instrument because they provide additional information relevant to the Patient Safety Culture.
N, Negatively worded items; SAQ-S-GE, Georgian version of Safety Attitudes Questionnaire short version.

for a self-evaluation while all remaining items refer to behaviours of others (ie, team, management or organisation). In spite of the described unexpected performance, items included in this scale, representing recognition of the effect of stress on performance, are without a doubt important for establishing a better culture of safety. Thus, stress recognition should be further measured and developed in healthcare organisations.

Our analysis of convergent and discriminant validity revealed problems with three dimensions—Teamwork Culture, Safety Culture and Working Conditions. The former two seem to have limited validity because of high intercorrelation, which was reaffirmed in EFA by merging these two dimensions together. Similarly, in most studies using SAQ-S, the correlation between these two dimensions was moderate to high, including the original study

Table 3 Internal consistency, indicators of convergent and divergent validity, and factor correlations of the original six-factor model

	α	AVE	√AVE	Factor correlation matrix TC	SC	JS	SR	HM
TC—Teamwork Climate	0.71	0.34	0.59					
SC—Safety Climate	0.72	0.31	0.56	0.83**				
JS—Job Satisfaction	0.90	0.65	0.81	0.70**	0.82**			
SR—Stress Recognition	0.83	0.56	0.75	−0.22*	−0.19*	−0.16*		
HM—Perceptions of Hospital Management	0.89	0.64	0.80	0.47**	0.61**	0.64**	−0.23**	
WC—Working Conditions	0.61	0.30	0.55	0.68**	0.76**	0.75**	−0.13	0.75**

Note: Analyses conducted after imputing missing values; n=263.
*p<0.05, **p<0.001.
α, Cronbach's alpha; AVE, average variance extracted; √AVE, square root of average variance extracted.

Table 4 Rotated factor pattern based on the exploratory factor analysis (EFA)

EFA-based four-factor model	Original six dimensions and corresponding items	Factor loading
Factor 1: Teamwork and Safety Climate	**Teamwork Climate**	
	1. Nurse input is well received in this clinical area.	RM
	2. In this clinical area, it is difficult to speak up if I perceive a problem with patient care.(N)	RM
	3. Disagreements in this clinical area are resolved appropriately (ie, not who is right, but what is best for the patient).	0.609
	4. I have the support I need from other personnel to care for patients.	0.685
	5. It is easy for personnel here to ask questions when there is something that they do not understand.	0.564
	6. The physicians and nurses here work together as a well-coordinated team.	0.720
	Safety Climate	
	7. I would feel safe being treated here as a patient.	0.564
	8. Medical errors are handled appropriately in this clinical area.	0.637
	9. I know the proper channels to direct questions regarding patient safety in this clinical area.	0.515
	10. I receive appropriate feedback about my performance.	RM
	11. In this clinical area, it is difficult to discuss errors. (N)	RM
	12. I am encouraged by my colleagues to report any patient safety concerns I may have.	0.420
	13. The culture in this clinical area makes it easy to learn from the errors of others.	RM
Factor 2: Job Satisfaction	**Job Satisfaction**	
	15. I like my job.	0.606
	16. Working here is like being part of a large family.	RM
	17. This is a good place to work.	0.669
	18. I am proud to work in this clinical area.	0.775
	19. Morale in this clinical area is high.	RM
Factor 3: Stress Recognition	**Stress Recognition**	
	20. When my workload becomes excessive, my performance is impaired.	0.757
	21. I am less effective at work when fatigued.	0.757
	22. I am more likely to make errors in tense or hostile situations.	0.697
	23. Fatigue impairs my performance during emergency situations (eg, emergency resuscitation, seizure).	0.756
Factor 4: Perceptions of Hospital Management	**Perceptions of Hospital Management**	
	24. Hospital management supports my daily efforts.	0.766
	25. Hospital management doesn't knowingly compromise patient safety.	0.482
	26. Hospital management is doing a good job.	0.844
	27. Problem personnel are dealt with constructively by our hospital management.	0.691
	28. I get adequate, timely information about events that might affect my work, from hospital management.	0.851
	Working Conditions	
	29. The levels of staffing in this clinical area are sufficient to handle the number of patients.	RM
	30. This hospital does a good job of training new personnel.	RM
	31. All the necessary information for diagnostic and therapeutic decisions is routinely available to me.	RM
	32. Trainees in my discipline are adequately supervised.	0.417

N, Negatively worded item; RM, removed from the model.

by Sexton *et al*[5] reporting within-area correlation of 0.94. This could indicate overall association between these two dimensions, not specific to our study. The third dimension, Working Conditions, not only demonstrated poor validity but was also mostly removed from the alternative model. Similarly, EFA conducted by Smits *et al*,[11] using an ambulatory version of the instrument, resulted in a five-factor solution, with Working Conditions not being presented in the model.[5] Overall, except for the items associated with the dimension Work Conditions, the SAQ-S-GE adequately measures the underlying constructs.

Table 5 Results of confirmatory factor analyses using different factor models

Model for analysis	χ^2/df	GFI	CFI	TLI	RMSEA
Thresholds for acceptable fit	≤2.5	>0.90	>0.90	>0.90	≤0.07
Original six-factor model	**2.10**	**0.83**	**0.88**	**0.86**	**0.06**
Dimension Teamwork Climate	3.45	0.96	0.93	0.89	0.10
Dimension Safety Climate	2.83	0.96	0.93	0.89	0.08
Dimension Job Satisfaction	3.01	0.98	0.99	0.97	0.09
Dimension Stress Recognition	4.44	0.98	0.98	0.95	0.11
Dimension Perceptions of Hospital Management	5.00	0.97	0.97	0.95	0.12
Dimension Working Conditions	2.88	0.99	0.97	0.90	0.08
EFA-based four-factor model	**2.09**	**0.88**	**0.93**	**0.91**	**0.06**

N=263. Underline indicates values that do not reach corresponding thresholds
CFI, comparative fit index; χ^2/df, normed χ^2; GFI, goodness of fit index; RMSEA, root mean square error of approximation; TLI, Tucker-Lewis Index/non-normed fit index.

Limitations

Our sample was limited to three general hospitals from two cities in Georgia while there are many other similar hospitals in the country. Thus, the findings should not be directly generalised to other healthcare settings in Georgia. Another limitation of the study was the relatively small sample size, due to which we were not able to conduct a split-sample validation. Thus, our findings should be tested in future research using a larger independent sample. Further research could also establish the ability of the instrument to measure change over time, which was not allowed by the cross-sectional study design.

CONCLUSIONS

The SAQ-S-GE demonstrated adequate psychometric properties, with acceptable to good internal consistency and construct validity. While the original six-factor model had poor fit to the data, we demonstrated an alternative factor model with acceptable model fit, indicating one problematic dimension and most dimensions being relatively stable and thus suitable for further studies. Until these findings are cross-validated in future studies with larger sample size, we argue for using the instrument in its full form, but recommend caution while interpreting the data on Working Conditions. As in most other studies, the dimension Stress Recognition was dissociated from the remaining instrument, while simultaneously demonstrating good psychometric properties. This dimension may require further investigation. The SAQ-S-GE can provide valid and useful information to further patient safety culture in Georgian hospitals.

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10.5. The study instruments

Table A1: The composition of Hospital Survey on Patient Safety Culture – English version

Dimension / Item
01. Teamwork Within Hospital Units
A1. People support one another in this unit.
A3. When a lot of work needs to be done quickly, we work together as a team to get the work done.
A4. In this unit, people treat each other with respect.
A11. When one area in this unit gets really busy, others help out.
02. Organizational Learning—Continuous improvement
A6. We are actively doing things to improve patient safety.
A9. Mistakes have led to positive changes here.
A13. After we make changes to improve patient safety, we evaluate their effectiveness.
03. Non-punitive Response To Error
A8. (N) Staff feel like their mistakes are held against them.
A12. (N) When an event is reported, it feels like the person is being written up, not the problem.
A16. (N) Staff worry that mistakes they make are kept in their personnel file.
04. Staffing
A2. We have enough staff to handle the workload.
A5. (N) Staff in this unit work longer hours than is best for patient care.
A7. (N) We use more agency/temporary staff than is best for patient care.
A14. (N) We work in “crisis mode,” trying to do too much, too quickly.
05. Overall Perceptions of Safety
A10. (N) It is just by chance that more serious mistakes don’t happen around here.
A15. Patient safety is never sacrificed to get more work done.
A17. (N) We have patient safety problems in this unit.
A18. Our procedures and systems are good at preventing errors from happening.
06. Supervisor/manager expectations & actions promoting safety
B1. My supervisor/manager says a good word when he/she sees a job done according to established patient safety procedures.
B2. My supervisor/manager seriously considers staff suggestions for improving patient safety.
B3. (N) Whenever pressure builds up, my supervisor/manager wants us to work faster, even if it means taking shortcuts.
B4. (N) My supervisor/manager overlooks patient safety problems that happen over and over.
07. Frequency of Event Reporting
D1. When a mistake is made, but is caught and corrected before affecting the patient, how often is this reported?
D2. When a mistake is made, but has no potential to harm the patient, how often is this reported?
D3. When a mistake is made that could harm the patient, but does not, how often is this reported?
08. Feedback and Communication About Error
C1. We are given feedback about changes put into place based on event reports.
C3. We are informed about errors that happen in this unit.
C5. In this unit, we discuss ways to prevent errors from happening again.

09. Communication Openness

C2. Staff will freely speak up if they see something that may negatively affect patient care.

C4. Staff feel free to question the decisions or actions of those with more authority.

C6. (N) Staff are afraid to ask questions, when something does not seem right.

10. Hospital Management Support for Patient Safety

F1. Hospital management provides a work climate that promotes patient safety.

F8. The actions of hospital management show that patient safety is a top priority.

F9. (N) Hospital management seems interested in patient safety only after an adverse event happens.

11. Teamwork Across Hospital Units

F2. (N) Hospital units do not coordinate well with each other.

F4. There is good cooperation among hospital units that need to work together.

F6. (N) It is often unpleasant to work with staff from other hospital units.

F10. Hospital units work well together to provide the best care for patients.

12. Hospital Handoffs & Transitions

F3. (N) Things “fall between the cracks” when transferring patients from one unit to another.

F5. (N) Important patient care information is often lost during shift changes.

F7. (N) Problems often occur in the exchange of information across hospital units.

F11. (N) Shift changes are problematic for patients in this hospital.

E1. Patient safety grade

E2. Number of events

(N) – Negatively worded item

Table A2: The composition of Hospital Survey on Patient Safety Culture – Georgian version

განზრა / შეკითხვა
01. განყოფილებებში თანამშრომლობა
A1. ამ განყოფილებაში ხალხი ერთმანეთს მხარს უჭერს.
A3. როცა ბევრი საქმეა გასაკეთებელი მოკლე დროში, ჩვენ ვმუშაობთ ერთ გუნდად სამუშაოს შესასრულებლად.
A4. ამ განყოფილებაში ხალხი ერთმანეთს პატივისცემით ეპყრობა.
A11. როცა ამ განყოფილების რომელიმე ნაწილი ძალიან დაკავებულია, სხვები ცდილობენ დახმარებას.
02. ორგანიზაციული დასწავლა – უწყვეტი გაუმჯობესება
A6. ჩვენ ვაქტიურობთ რათა გავაუმჯობესოთ პაციენტთა უსაფრთხოება.
A9. წარსულში დაშვებულმა შეცდომებმა ჩვენთან დადებითი ცვლილებები გამოიწვიეს.
A13. მას შემდეგ რაც გავაკეთებთ ცვლილებებს პაციენტთა უსაფრთხოების გასაუმჯობესებლად, ჩვენ ვაფასებთ ამ ცვლილებების ეფექტურობას.
03. შეცდომაზე არადამსჯელობითი პასუხი
A8. (N) თანამშრომლებს აქვთ შეგრძნება, რომ დაშვებულ შეცდომებს მათ წინააღმდეგ გამოიყენებენ.
A12. (N) როცა შემთხვევას (ან შეცდომას) მოახსენებენ, ისეთი შთაბეჭდილება იქმნება, თითქოს პიროვნებას სდებენ ბრალს, ხოლო პრობლემა უყურადღებოდ რჩება.
A16. (N) თანამშრომლები ნერვიულობენ, რომ მათ მიერ დაშვებული შეცდომები ინახება მათ პირად საქმეებში.
04. პერსონალით უზრუნველყოფა
A2. ჩვენ გვყავს საკმარისი პერსონალი რათა გავუმკლავდეთ სამუშაო დატვირთვას.
A5. (N) პერსონალი ამ განყოფილებაში მუშაობს უფრო მეტ საათს, ვიდრე აჯობებდა პაციენტისათვის.
A7. (N) ჩვენ ვიყენებთ დროებით დამხმარე პერსონალს უფრო ხშირად, ვიდრე პაციენტებზე ზრუნვისთვის აჯობებდა.
A14. (N) ჩვენ ვმუშაობთ "კრიზისის რეჟიმში" და ვცდილობთ მოვასწროთ ძალიან ბევრი ძალიან მოკლე დროში.
05. პაციენტთა უსაფრთხოება მთლიანობაში
A10. (N) უბრალოდ გამართლებაა, რომ აქ უფრო სერიოზული შეცდომები არ ხდება ხოლმე.
A15. მეტი საქმის მოსწრება არასდროს არ ხდება პაციენტთა უსაფრთხოების ხარჯზე.
A17. (N) ამ განყოფილებაში გვაქვს პაციენტთა უსაფრთხოების პრობლემები.
A18. განყოფილების სტრუქტურები და პროცესები წარმატებით ახერხებენ შეცდომების თავიდან არიდებას.
06. უშუალო ხელმძღვანელის მოლოდინები და პაციენტთა უსაფრთხოების ხელშეწყობა
B1. ჩემი უშუალო ხელმძღვანელი არ იშურებს შექებას, როცა ხედავს რომ სამუშაო შესრულებულია პაციენტთა უსაფრთხოებისთვის დადგენილი პროცედურების (წესების და რეგულაციების) მიხედვით.
B2. ჩემი უშუალო ხელმძღვანელი სერიოზულად განიხილავს თანამშრომელთა მოსაზრებებს პაციენტთა უსაფრთხოების გასაუმჯობესებლად.
B3. (N) როგორც-კი დატვირთვა იზრდება, ჩემი უშუალო ხელმძღვანელი მოითხოვს დაჩქარებულ ტემპში მუშაობას, მაშინაც კი, როცა ეს გულისხმობს გარკვეული ნაბიჯების შემოკლებას ან გამოტოვებას.
B4. (N) ჩემი უშუალო ხელმძღვანელი ყურადღებას არ აქცევს პაციენტთა უსაფრთხოების იმ პრობლემებს, რომლებიც განმეორებით ხდება.

07. შემთხვევების მოხსენების სიხშირე

D1. როცა მოხდება რაიმე შემთხვევა (მაგ. შეცდომა), რომელიც გამოსწორებულ იქნა მანამ სანამ პაციენტს ზიანი მიადგებოდა, რამდენად ხშირად ხდება ასეთი შემთხვევების მოხსენება?
D2. როცა მოხდება რაიმე შემთხვევა (მაგ. შეცდომა), რომელსაც არ შეუძლია პაციენტისათვის ზიანის მიყენება, - რამდენად ხშირად ხდება ასეთი შემთხვევების მოხსენება?
D3. როცა მოხდება რაიმე შემთხვევა (მაგ. შეცდომა), რომელსაც შეუძლია პაციენტისათვის ზიანის მიყენება, - რამდენად ხშირად ხდება ასეთი შემთხვევების მოხსენება?

08. შეცდომების შესახებ კომუნიკაცია და უკუკავშირი

C1. ჩვენ ვიღებთ ინფორმაციას იმ ცვლილებების შესახებ, რომლებიც განხორციელდა შეცდომების და/ან სხვა შემთხვევების მოხსენების შედეგად.
C3. ჩვენ ვიღებთ ინფორმაციას ამ განყოფილებაში მომხდარი შეცდომების და/ან სხვა შემთხვევების შესახებ.
C5. ამ განყოფილებაში ჩვენ განვიხილავთ გზებს, რათა თავიდან ავიცილოთ მომხდარი შეცდომების გამეორება.

09. ღია კომუნიკაცია

C2. თანამშრომლები თამამად გამოთქვამენ აზრს თუ შეამჩნიეს ისეთი რამ, რამაც შეიძლება უარყოფითად იმოქმედოს პაციენტთა მოვლაზე.
C4. თანამშრომლები თამამად დააყენებენ ეჭვქვეშ და გადაამოწმებენ უფრო მაღალ პოზიციაზე მდგომთა გადაწყვეტილებებს და ქმედებებს.
C6. (N) თანამშრომლებს ეშინიათ შეკითხვების დასმა როცა გრძნობენ, რომ რაღაცა არასწორადაა.

10. საავადმყოფოს მენეჯმენტის მიერ პაციენტთა უსაფრთხოების მხარდაჭერა

F1. საავადმყოფოს მენეჯმენტი უზრუნველყოფს სამუშაო გარემოს, რომელიც ხელს უწყობს პაციენტთა უსაფრთხოებას..
F8. საავადმყოფოს მენეჯმენტის საქმიანობა აჩვენებს, რომ პაციენტთა უსაფრთხოება არის მათთვის უპირველეს ყოვლისა.
F9. (N) საავადმყოფოს მენეჯმენტი მხოლოდ მას შემდეგ ჩანს პაციენტთა უსაფრთხოებით დაინტერესებული, როცა პაციენტისთვის ზიანის მომტანი შემთხვევა მოხდება.

11. საავადმყოფოს განყოფილებებს შორის თანამშრომლობა

F2. (N) საავადმყოფოს განყოფილებები არ მუშაობენ ერთმანეთთან შეთანხმებულად.
F4. კარგი თანამშრომლობა არის საავადმყოფოს იმ განყოფილებებს შორის, რომლებმაც ერთად უნდა იმუშაონ.
F6. (N) საავადმყოფოს სხვა განყოფილებების თანამშრომლებთან მუშაობა ხშირად უსიამოვნოა.
F10. საავადმყოფოს განყოფილებები კარგად მუშაობენ ერთად, რათა უზრუნველყონ საუკეთესო ზრუნვა პაციენტებისათვის.

12. საავადმყოფოში პაციენტთა და ცვლის გადაბარება

F3. (N) პაციენტის ერთი განყოფილებიდან მეორეში გადაყვანისას იკარგება ხოლმე ინფორმაციის ნაწილი.
F5. (N) მნიშვნელოვანი ინფორმაცია პაციენტების შესახებ ხშირად იკარგება ცვლის გადაბარებისას.
F7. (N) საავადმყოფოს სხვადასხვა განყოფილებებს შორის ინფორმაციის მიმოცვლისას ხშირად იჩენს თავს სხვადასხვა პრობლემები.
F11. (N) ამ საავადმყოფოში ცვლის გამოცვლა პრობლემურია პაციენტებისათვის.

E1. პაციენტთა უსაფრთხოების დონე

E2. უკანასნელი 12 თვის განმავლობაში მომზადებული ანგარიშების რაოდენობა

(N) – უარყოფითად ფორმულირებული შეკითხვები

Table A3: The composition of Safety Attitudes Questionnaire, short form, English version

Dimension / item
Teamwork Climate
1. Nurse input is well received in this clinical area.
2. (N) In this clinical area, it is difficult to speak up if I perceive a problem with patient care.
3. Disagreements in this clinical area are resolved appropriately (i.e., not who is right, but what is best for the patient).
4. I have the support I need from other personnel to care for patients.
5. It is easy for personnel here to ask questions when there is something that they do not understand.
6. The physicians and nurses here work together as a well-coordinated team.
Safety Climate
7. I would feel safe being treated here as a patient.
8. Medical errors are handled appropriately in this clinical area.
9. I know the proper channels to direct questions regarding patient safety in this clinical area.
10. I receive appropriate feedback about my performance.
11. (N) In this clinical area, it is difficult to discuss errors.
12. I am encouraged by my colleagues to report any patient safety concerns I may have.
13. The culture in this clinical area makes it easy to learn from the errors of others.
Job Satisfaction
15. I like my job.
16. Working here is like being part of a large family.
17. This is a good place to work.
18. I am proud to work in this clinical area.
19. Morale in this clinical area is high.
Stress Recognition
20. When my workload becomes excessive, my performance is impaired.
21. I am less effective at work when fatigued.
22. I am more likely to make errors in tense or hostile situations.
23. Fatigue impairs my performance during emergency situations (e.g. emergency resuscitation, seizure).
Perceptions of Hospital Management
24. Hospital management supports my daily efforts.
25. Hospital management doesn’t knowingly compromise patient safety.
26. Hospital management is doing a good job.
27. Problem personnel are dealt with constructively by our hospital management.
28. I get adequate, timely information about events that might affect my work, from hospital management.
Working Conditions
29. The levels of staffing in this clinical area are sufficient to handle the number of patients.
30. This hospital does a good job of training new personnel.
31. All the necessary information for diagnostic and therapeutic decisions is routinely available to me.
32. Trainees in my discipline are adequately supervised.
Items not belonging to any dimension
14. My suggestions about safety would be acted upon if I expressed them to management.
33. I experience good collaboration with nurses in this clinical area.
34. I experience good collaboration with staff physicians in this clinical area.
35. I experience good collaboration with pharmacists in this clinical area.
36. (N) Communication breakdowns that lead to delays in delivery of care are common.

(N) – Negatively worded item

Table A4: The composition of Safety Attitudes Questionnaire, short form, Georgian version

განხრა / შეკითხვა
გუნდური მუშაობის კლიმატი
1. ჩვენ განყოფილებაში მიესალმებიან როცა ექთნებს შეაქვთ წვლილი განხილვებში.
2. (N) ჩვენთან ძნელია ხმის ამოღება როცა პაციენტის მოვლასთან დაკავშირებულ პრობლემებს ვხედავ.
3. უთანხმოებები ჩვენთან სათანადოდ წყდება (ანუ, მთავარია რა ჯობს პაციენტისთვის, და არა ვინ არის მართალი).
4. დანარჩენი პერსონალისგან ვიღებ საჭირო მხარდაჭერას რათა პაციენტებზე ვიზრუნო.
5. აქ თანამშრომლებს უადვილდებათ შეკითხვების დასმა, როდესაც რამე არ ესმით.
6. აქ ექიმები და ექთნები ერთად მუშაობენ, როგორც კარგად შეთანხმებული გუნდი.
უსაფრთხოების კლიმატი
7. ჩემთვის აქ რომ ემკურნალათ მე თავს უსაფრთხოდ ვიგრძნობდი.
8. ჩვენთან სამედიცინო შეცდომების შემთხვევებს სათანადოდ ეპყრობიან.
9. ვიცი ვის უნდა მივმართო თუ პაციენტთა უსაფრთხოებასთან დაკავშირებული შეკითხვები გამიჩნდება.
10. მე ვიღებ შესაფერის უკუკავშირს ჩემს საქმიანობასთან დაკავშირებით.
11. (N) ჩვენთან რთულია დაშვებული შეცდომების განხილვა.
12. ჩემი კოლეგები ხელს მიწყობენ/ მიბიძგებენ რათა ღიად განვაცხადო როცა რაიმე საკითხი მაწუხებს პაციენტთა უსაფრთხოებასთან დაკავშირებით.
13. ჩვენთან არსებული ორგანიზაციული კულტურა აადვილებს სხვის შეცდომებზე სწავლას.
სამსახურით კმაყოფილება
15. მე მომწონს ჩემი სამსახური.
16. ჩვენ ვმუშაობთ როგორც ერთი დიდი ოჯახი.
17. ეს არის კარგი ადგილი სამუშაოდ.
18. მე ვამაყობ რომ აქ ვმუშაობ.
19. აქ ვმუშაობთ მაღალი შემართებით.
სტრესის ამოცნობა
20. როცა ზედმეტად ბევრი სამუშაო მაქვს, ეს ცუდად აისახება ჩემს შესრულებაზე.
21. სამსახურში ნაკლებად ეფექტური ვარ როცა ვიღლები.
22. უფრო მეტად შეიძლება დავუშვა შეცდომა დაძაბულ ან მტრულ სიტუაციებში.
23. როდესაც დაღლილი ვარ ეს აისახება ჩემს საქმიანობაზე გადაუდებელ სიტუაციებში (მაგ. გულ-ფილტვის რეანიმაცია, კრუნჩხვები).
განყოფილების მენეჯმენტის მუშაობა
24. მენეჯმენტი მხარს უჭერს ჩემს ყოველდღიურ საქმიანობას.
25. მენეჯმენტი შეგნებულად არ დააყენებს პაციენტთა უსაფრთხოებას რისკის ქვეშ.
26. მენეჯმენტი კარგად ასრულებს თავის საქმეს.
27. პრობლემურ პერსონალს ეპყრობიან კონსტრუქციულად/ სათანადოდ.
28. მენეჯმენტისგან დროულად ვიღებ საკმარის ინფორმაციას იმ მოვლენების შესახებ, რომლებმაც შესაძლოა ჩემს სამუშაოზე გავლენა იქონიონ.
სამუშაო პირობები
29. აქ არსებული პერსონალი საკმარისია რათა გაუმკლავდეთ პაციენტთა არსებულ რაოდენო.
30. მ საავადმყოფოში კარგად ატრენინგებენ/წვრთნიან ახალ თანამშრომლებს.
31. სადიაგნოსტიკო და თერაპიული გადაწყვეტილებების მისაღებად საჭირო მთელი ინფორმაცია მუდამ ხელმისაწვდომია ჩემთვის.
32. ჩემს სფეროში პრაქტიკანტები იღებენ სათანადო ზედამხედველობას.

დამატებითი კითხვები

14. დირექციისთვის რომ მომეხსენებინა ჩემი მოსაზრებები უსაფრთხოებასთან დაკავშირებით, მათ მხედველობაში მიიღებდნენ.
33. მე მაქვს კარგი თანამშრომლობა აქ მომუშავე ექთნებთან.
34. მე მაქვს კარგი თანამშრომლობა აქ მომუშავე ექიმებთან.
35. მე მაქვს კარგი თანამშრომლობა აქ მომუშავე ფარმაცევტებთან.
36. (N) ხშირია კომუნიკაციის პრობლემები, რომლებიც იწვევენ შეფერხებებს პაციენტის მოვლაში.

(N) – უარყოფითად ფორმულირებული კითხვები