Patient Safety Culture Survey in Pediatric Complex Care Settings: A Factor Analysis

Amanda J. Hessels, RN, MPH, PhD, CIC, CPHQ Meghan Murray, MPH,* Bevin Cohen, MPH,* and Elaine L. Larson, RN, PhD, FAAN, CIC**

Objectives: Children with complex medical needs are increasing in number and demanding the services of pediatric long-term care facilities (pLTC), which require a focus on patient safety culture (PSC). However, no tool to measure PSC has been tested in this unique hybrid acute care–residential setting. The objective of this study was to evaluate the psychometric properties of the *Nursing Home Survey on Patient Safety Culture* tool slightly modified for use in the pLTC setting.

Methods: Factor analyses were performed on data collected from 239 staff at 3 pLTC in 2012. Items were screened by principal axis factoring, and the original structure was tested using confirmatory factor analysis. Exploratory factor analysis was conducted to identify the best model fit for the pLTC data, and factor reliability was assessed by Cronbach alpha.

Results: The extracted, rotated factor solution suggested items in 4 (staffing, nonpunitive response to mistakes, communication openness, and organizational learning) of the original 12 dimensions may not be a good fit for this population. Nevertheless, in the pLTC setting, both the original and the modified factor solutions demonstrated similar reliabilities to the published consistencies of the survey when tested in adult nursing homes and the items factored nearly identically as theorized.

Conclusions: This study demonstrates that the *Nursing Home Survey on Patient Safety Culture* with minimal modification may be an appropriate instrument to measure PSC in pLTC settings. Additional psychometric testing is recommended to further validate the use of this instrument in this setting, including examining the relationship to safety outcomes. Increased use will yield data for benchmarking purposes across these specialized settings to inform frontline workers and organizational leaders of areas of strength and opportunity for improvement.

Key Words: patient safety culture, pediatrics, long-term care, factor analysis

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Patient safety is a vital component of health care quality. Patient safety culture (PSC) of a health care organization is defined as "the product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization's health and safety management."[1] In hospitals and adult outpatient settings, a culture of safety, characterized by shared perspectives of the importance of safety, fidelity, and transparency of communications, and shared confidence in the efficacy of preventive measures, has been associated with improved patient outcomes.[1–4] Standardized, valid, and reliable tools exist to measure PSC in hospitalized adults and children, and adults in nonhospital settings, such as the *Safety Attitudes Questionnaire*, *Safety Organizing Scale, Survey on Resident Safety in Nursing Homes*, *Hospital Survey on Patient Safety Culture*, and *Nursing Home Survey on Patient Safety Culture* (NHSPSC), but no tool has been tested for its relevance to pediatric long-term care (pLTC) settings, which are unique and have distinctly different cultures from other types of health care delivery systems.[5–8]

In the past decade, there has been a steady increase in the number and complexity of children with complex medical conditions, some of whom reside in an estimated 100 pLTC facilities in the United States.[9,10] Estimates of the number of children with special health care needs in the United States are as high as 11 million.[11] Estimates of those residing in pLTC with complex medical conditions are variable depending on definitions of condition, care setting, or data repository used but include some of the estimated 29,000 children in congregate care facilities (e.g., skilled nursing, long-term care, or residential care), such as an estimated 4886 children with special health care needs residing in skilled nursing facilities.[12,13] These facilities describe a setting where the children live, and as such, children are referred to as "residents". This is in contrast to settings such as transitional rehabilitation, residential school, and other settings that are time-limited and do not provide higher-level care services.[12] Children with complex medical conditions have intense care needs, typically require 24-hour skilled nursing procedures, and are dependent on technology for activities of daily living and thus reside in pLTC.[12,13]

These children are considerably functionally and or developmentally impaired and may have medical diagnoses such as congenital anomalies, cystic fibrosis, multisystem disease, oncologic disease, or other conditions. Care needs depend on multiple factors, including age, developmental stage, need for mechanical ventilation, orthotic assistance, and other invasive therapies requiring technological and functional support and services to manage lifelong chronic clinical conditions and sequelae.[12,13] Consequently, these children require intense care, use a sizeable amount of resources, and often transition between pLTC and hospital settings to receive care for exacerbations of conditions.[9,11–13]

Health care workers in pLTC settings function in a hybrid acute care–residential setting and have unique workflow patterns, priorities, and relationships among themselves and with residents and their family members.[9,10] Many different types of staff work in these settings such as nurses, physicians, and nursing aides; respiratory, recreational, physical, and occupational therapists; teachers and teachers' aides; and environmental service workers and social workers. In these homelike settings, there is a considerable interaction among children and direct and close contact between children, staff, families, volunteers, and visitors.[9,10] Similar to adult LTC facilities, hospital level care is provided to residents who require 24-hour skilled nursing care for long periods of time.[12]

As such, understanding the nature and extent that factors influence health care workers' behaviors in pLTC settings is important for patient outcomes and may influence health care use, such as rehospitalization rates. Patient safety culture is one such factor that has been identified as essential in all settings that render care to

From the *Columbia University School of Nursing, New York, New York.
Correspondence: Amanda Hessels, RN, MPH, PhD, Columbia University, 617 W 168th St, Room 330, New York, NY, 10032 (e-mail: ah3269@cumc.columbia.edu).

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pediatrics to eliminate avoidable harm, such as adverse drug events, health care–associated infections, and errors of care.[14] Patient safety problems and solutions are described as unique for children, as developmental, physical, and legal status issues are unique and multifactorial, although notably, studies on pediatric safety are limited in nonhospital settings.[14]

Synthesizing literature regarding the importance of PSC in adult populations in nursing home and critical care settings, and given the emerging issues of an increased number of children with complex medical conditions in congregate care settings (such as pLTC) and policy statements from the American Academy of Pediatrics regarding patient safety, we believe PSC may be an important construct in pLTC and merit measurement. Typical safety events in pLTC, adverse events, and critical incidents are not currently subject to standardized reporting mechanisms and measures, such as quality indicators or patient safety indicators in hospitals, thus limiting prevalence estimations and benchmarking. We believe a measure of PSC may serve as an intervention to raise staff awareness of safety issues, as a means to evaluate safety improvement initiatives, and as a diagnostic tool of safety culture as facilities track and trend case and event reporting rates within their facilities. That is, it is likely the PSC is important in these settings as well, and identifying the role of the PSC in pLTC could guide organizational improvement.

Yet, it is unknown if existing tools adequately capture the PSC construct in these settings. As these pediatric setting and provider characteristics that influence team functioning are similar to adult LTC, the NHSPSC was selected as opposed to the hospital survey. This tool was selected after face and content validity screening to evaluate the dimension and item relevancy by 2 pediatric physicians, who are both clinicians and researchers, familiar with the setting. The tool was also familiar to the leadership of the facilities. The purpose of this study was to evaluate the construct validity through factor analysis of the Agency for Healthcare Research and Quality (AHRQ) NHSPSC tool slightly modified for use in the pLTC setting.

METHODS

Sample and Setting

This study was part of a larger parent project funded by the Agency for Healthcare Research and Quality (AHRQ, Keep it Clean for Kids (KICK), R01HS021470). This 4-year (2012–2016) research project was designed to improve infection prevention practices and PSC in 3 metropolitan New York area pLTC facilities with 54, 97, and 137 beds. Residents have a variety of complex and chronic medical conditions: 77% to 85% have a feeding tube (e.g., gastrostomy, nasogastric tube, and jejunal tube), 29% to 51% have a tracheostomy, and 60% to 74% are nonambulatory. Each site provides a wide range of medical, educational (e.g., on-site Department of Education school), and therapeutic services including respiratory, physical, occupational, recreational, music, and art therapies. The number of staff at each site ranges from 244 to 539. Inclusion criteria of the convenience sample included all staff available (e.g., nurses, administrative, school, therapists, housekeeping personnel) and willing to participate in this pen and paper survey; no site personnel were excluded. The study was approved by the Columbia University Medical Center Institutional Review Board (IRB) and the relevant ethics review group at each facility.

Original Instrument

The NHSPSC is a 44-item survey designed for staff and administrators of nursing homes facilities; it was not designed for use in assisted living, community care, or independent living facilities.[2,15] Responses are measured on a 5-point Likert scale ranging from strongly disagree to strongly agree, or never to always for frequency reporting. Briefly, tool development included a review of the literature on resident safety in nursing homes, health care quality, medical errors, error reporting, safety climate and culture, and organizational climate and culture. In addition, a review of existing nursing home surveys was conducted, and none were identified focused specifically on staff opinions about resident safety issues. Researchers consulted with more than 2 dozen experts in the field of nursing home safety to identify key topics and issues. They identified a potential list of dimensions to include in the survey and sought consensus from long-term care experts. A draft of survey items was developed to measure the key dimensions and iteratively pretested with nursing home staff to ensure that the items were easy to understand and to answer and were relevant to resident safety in nursing homes. The pilot test version of the NHSPSC was completed in 2007 by 3700 staff working in 40 nursing homes across the United States. Participating nursing homes varied by bed size, geographic region, urban or rural setting, and ownership.[2]

After individual item analysis, the tool was again revised to ensure that the survey has sound psychometric properties; upon further examination, 42 items were grouped into 12 conceptually distinct dimensions. The 12 dimensions include teamwork, staffing, compliance with procedures, training and skills, nonpunitive response to mistakes, handoffs, feedback and communication about incidents, communication openness, supervisor expectations and actions promoting resident safety, overall perceptions of resident safety, management support of resident safety, and organizational learning. The remaining 2 items asked respondents to assign an overall patient safety grade and number of events reported in the past 12 months.[2]

Administration of the Instrument

Before administration of the tool, 2 pediatric physicians who practice in both hospital and pLTC settings served as content experts and confirmed the relevancy of the NHSPSC dimensions and items for the pLTC setting. In this study, whereas the items are relevant to a pediatric setting, wording of this instrument was modified for the pediatric setting (e.g., the term *this nursing home* was replaced by *this facility*). The modified survey used in this study is named the NHSPSC-pLTC (Table 1) and was administered following the AHRQ *Survey User's Guide on Patient Safety Culture*.[15] In fall 2012, the paper-based surveys were distributed on each unit at each facility for 1 day shift and one night shift to all staff, both direct and indirect care staff, including on-site school personnel. Staff self-identified in the following categories: (1) administrator/manager (e.g. executive director/administrator, medical director, director of nursing/nursing supervisor, department head, unit manager/charge nurse, assistant director/assistant manager, minimum data set coordinator/resident nurse assessment coordinator (RNAC)); (2) physician (MD, DO); (3) licensed nurse (nurse practitioner (NP), clinical nurse specialist (CNS), registered nurse (RN), licensed practical nurse (LPN), wound care nurse); (4) nursing assistant/aide (certified nursing assistant (CNA), nursing aide/nursing Assistant); (5) other care staff (activities staff member, dietitian/nutritionist, medication technician, pastoral care/chaplain, pharmacist, podiatrist, social worker, physical/occupational/speech/respiratory therapist); (6) administrative support staff (administrative assistant, admissions, billing/insurance, secretary, human resources, medical records) or (7) support staff (drivers, food service/dietary, housekeeping, laundry service, maintenance, security).

TABLE 1. Dimensions, Items, and Reliability of the NHSPSC-pLTC Used in the Present Study

1. Teamwork: published reliability of this dimension—Cronbach alpha (4 items) = 0.86; this sample = 0.84
   - A1. Staff in this facility treat each other with respect.
   - A2. Staff support one another in this facility.
   - A5. Staff feel like they are part of a team.
   - A9. When someone gets really busy in this facility, other staff help out.
2. Staffing: published reliability of this dimension—Cronbach alpha (4 items) = 0.71; this sample = 0.55
   - A3. We have enough staff to handle the workload.
   - A8. Staff have to hurry because they have too much work to do (negatively worded).
   - A16. Children's needs are met during shift changes
   - A17. Because so many staff quit their jobs, there are few experienced staff to provide safe care (negatively worded).
3. Compliance with procedures: published reliability of this dimension—Cronbach alpha (3 items) = 0.73, this sample = 0.68
   - A4. Staff follow standard procedures to care for children.
   - A6. Staff use shortcuts to get their work done faster (negatively worded).
   - A14. To make work easier, staff often ignore procedures (negatively worded).
4. Training & Skills: published reliability of this dimension—Cronbach alpha (3 items) = 0.76; this sample = 0.72
   - A7. Staff get the training they need in this facility.
   - A11. Staff have enough training on how to handle difficult children.
   - A13. Staff understand the training they get in this facility.
5. Nonpunitive response to mistakes: published reliability of this dimension—Cronbach alpha (4 items) = 0.74; this sample = 0.74
   - A10. Staff are blamed when a child is harmed (negatively worded).
   - A12. Staff are afraid to report their mistakes (negatively worded).
   - A15. Staff are treated fairly when they make mistakes.
   - A18. Staff feel safe reporting their mistakes.
6. Handoffs: published reliability of this dimension—Cronbach alpha (4 items) = 0.86; this sample = 0.83
   - B1. Staff are told what they need to know before taking care of a child for the first time.
   - B2. Staff are told right away when there is a change in a child's care plan.
   - B3. We have all the information we need when children are transferred from the hospital.
   - B10. Staff are given all the information they need to care for children.
7. Feedback and communication about incidents: published reliability of this dimension—Cronbach alpha (4 items) = 0.85; this sample = 0.84
   - B4. When staff report something that could harm a child, someone takes care of it.
   - B5. In this facility, we talk about ways to keep incidents from happening again.
   - B6. Staff tell someone if they see something that might harm a child.
   - B8. In this facility, we discuss ways to keep children safe from harm.
8. Communication Openness: published reliability of this dimension—Cronbach alpha (3 items) = 0.84, this sample = 0.85
   - B7. Staff ideas and suggestions are valued in this facility.
   - B9. Staff opinions are ignored in this facility (negatively worded).
   - B11. It is easy for staff to speak up about problems in this facility.
9. Supervisor expectations and actions promoting resident safety: published reliability of this dimension—Cronbach alpha (3 items) = 0.81; this sample = 0.82
   - C1. My supervisor listens to staff ideas and suggestions about *the safety of children.*
   - C2. My supervisor says a good word to staff who follow the right procedures.
   - C3. My supervisor pays attention to *child* safety problems in this *facility.*
10. Overall perceptions of resident safety: published reliability of this dimension—Cronbach alpha (3 items) = 0.86; this sample = 0.84
    - D1. Children are well cared for in this facility.
    - D6. This facility does a good job keeping children safe.
    - D8. This facility is a safe place for children.
11. Management support for resident safety: published reliability of this dimension—Cronbach alpha (3 items) = 0.83, this sample = 0.84
    - D2. Management asks staff how the facility can improve safety for children.
    - D7. Management listens to staff ideas and suggestions to improve safety for children.
    - D9. Management often walks around the facility to check on care for children.
12. Organizational Learning: published reliability of this dimension—Cronbach alpha (4 items) = 0.81; this sample = 0.72
    - D3. This facility lets the same mistakes happen again and again (negatively worded).
    - D4. It is easy to make changes to improve safety for children in this facility.
    - D5. This facility is always doing things to improve safety for children.
    - D10.When this facility makes changes to improve safety for chil dren, it checks to see if the changes have worked.
13. Overall Ratings
    - E1. I would tell friends that this is a safe facility for their children.
    - E2. Please give this facility an overall rating on safety for children.

Surveys were distributed at the beginning of the shift and collected at the end of the shift, or staff had the option of returning them to the mailbox of the staff member responsible for infection control. All staff were instructed that the survey was voluntary and anonymous. Staff who returned a survey were eligible for inclusion in a raffle for several $5 coffee shop gift cards per site. The list for the raffle was completely separate from the surveys.

Statistical Analysis

Eight of the 42 items that comprised the 12 dimensions were negatively worded and reverse coded for analysis. All items were examined in the factor analyses performed. Statistical analysis was performed using Stata/MP version 12.1 software (StataCorp LP, College Station, TX). Since the number of subjects who completed the survey was greater than 200, an approximated 5 times the total number of items used for factor analysis (*N:p* ratio, 5:1), missing data were not imputed in analysis.[16] Complete data on all items were available for 125 respondents demonstrating a sufficient *N:p* ratio of 3:1 for the set of items. The overarching approach was to test the a priori model of the original structure using confirmatory factor analysis (CFA), and then if the model does not adequately fit the data, the current structure is examined through

exploratory factor analysis (EFA).[16] The study follows comprehensive reporting guidelines and recommendations.[17]

Sampling adequacy was further assessed using Kaiser-Meyer-Olkin (KMO) and anti-image correlation matrix procedures. Items that comprised each construct were then examined for the a priori identified 12 dimensions using Cronbach alpha for internal consistency. A correlation matrix of all items in the scale was generated and an initial unrotated factor solution was extracted. Finally, principal factor analysis was used employing both oblique (Promax) and orthogonol (Varimax) rotation to maximize the independence of the factors and enhance theoretical clarity of the underlying survey structure.

Communality to identify the variance shared by one or more variables in the factors and uniqueness was ascertained to measure the variance in single variables uncorrelated with the component factors.[16,18,19] Only factors with an Eigenvalue greater than or equal to 1.0 were retained in all model construction, and a strict factor loading cutoff of 0.40 was used. The dimensions and items, published Cronbach alpha reliability coefficients and those calculated from this study sample of the NHSPSC-pLTC are shown in Table 1.

RESULTS

A total of 239 completed surveys were pooled from 3 settings for use in this analysis. It was not possible to record the number of surveys distributed to this convenience sample within the facilities, as surveys were distributed in person and site liaisons also made copies and redistributed in hard copy and via e-mail. Therefore, we could not estimate the response rate during our sampling period. However, we do estimate there are approximately 1100 total staff employed at the facilities.

Most respondents from whom data were available worked directly with children "most of the time" (83%), primarily in roles of licensed nurses (42%), nursing assistants/aides (22%), or other care staff (activities staff, dietitian/nutritionist, medication technician, pastoral care/chaplain, pharmacist, physical/occupational/speech/respiratory therapist, podiatrist, social worker). Data were also available from those who responded in administrator/management, physician, administrative care staff, and support staff categories. There were no categories that were not represented. Respondents reported being employed in their respective facilities for 2 to 11 months (26%), or 6 to 10 years (19%), 11 years or more (21%), where they worked 25 to 40 hours per week (67%) or more (24%). Most (57%) of the respondents work the day, followed by night (29%) and evening (14%) shifts.

Although the total number of missing items was low, and the number missing per item was also low, missing responses were evident. Missing values at the item level due to blank or invalid responses and "doesn't apply or don't know" ranged from one missing (0.004%) to 25 missing (10.4%). Missing data from these respondents were examined for patterns and by respondent type and item to allow for additional appraisal of lines of evidence for the relevant subgroups in the intended population for this instrument.[20] Those who selected "don't know/doesn't apply" to at least one item included approximately 21% of nurses, 36% of nursing aides, and 45% of the "other staff," or by tenure at facility approximately 46% of those employed 2 to 11 months, 19% of those employed 6 to 10 years, and 15% of those employed 11 years or longer. At least one missing item was found in surveys completed by approximately 40% of nursing assistants/aides, 23% of nurses, and 18% of "other staff;" or by tenure at facility, at least one missing item in 28% of those employed 2 to 11 months, 25% of those employed 6 to 10 years, and 42% of those employed 11 years or longer. All items had missing data; therefore, the sample size to test each dimension, and subsequently the overall construct, was affected by missing responses.

Matrix Analysis

Correlation matrices were generated to identify relationships among the items in this study. The Bartlett test of sphericity (χ^2 = 3468.1; df = 861; P < 0.001) indicated sufficiency of interitem correlations, the KMO measure of sampling adequacy was 0.85 and deemed "meritorious" on the recognized KMO rating, and the anti-image correlation matrix values were closer to zero.[18,19,21,22] Based on these 3 tests, and in consideration of a priori knowledge of the underlying structure of the construct, we considered that the data and matrix were appropriate for factor extraction and all items were included in the analysis.

Confirmatory Analysis

The CFA was performed using maximum likelihood structural equation modeling techniques without constraints on the 42 items in the a priori identified 12 dimensions. Goodness-of-fit indices were then calculated including the χ^2 index of discrepancy between the model fit and data, commonly known as an "exact fit index," and indicated a poor fit by χ^2 likelihood ratios (χ^2 = 1575.57; df = 594; P <0.001). The root mean square error of approximation takes both sample size and error approximation into account and demonstrated a poor fit with the data, (root mean square error of approximation = 0.119) (cutoff <0.06), as did the comparative fit index of 0.54, the non-normed Tucker-Lewis index of 0.51 (cutoff is ≥0.90 for comparative fit index and Tucker-Lewis index), and the standardized root mean squared residual (0.29; perfect fit is 0, good fit is less than 0.10).[22,23] The coefficient of determination (CD) index, considered an R^2 for the model, indicated a good fit (CD = 1), where a value close to 1 indicates a good fit.[24]

This model identified a poor correlation between the observed variables and factors as follows. A4 ("staff follow standard procedures to care for children") loaded just above threshold with *compliance with procedures* (0.42; R^2 = 0.18), A16 ("children's needs are met during shift changes") loaded poorly on *staffing* (0.3; R^2 = 0.09), as did D3 ("this facility lets the same mistakes happen again and again") on *organizational learning* (0.34; R^2 = 0.12). The low R^2 values indicate the items do not fit well with the model. However, the factor loading matrix item A12 ("staff are afraid to report their mistake") performed well with a factor loading of 0.77 (R^2 = 0.59), as did A8 ("staff have to hurry because they have too much work to do") with a factor loading of 0.67 (R^2 = 0.45). Finally, modification indices were conducted and suggest that several variables manifest the same latent variables including A11 and B1, A10 and A15, A12 and A18, and A9 and D10.

In consideration of both the difference between the number of respondents who completed all items in all dimensions (125) and all items per dimension (range, 190-227) and our aim to test the structure of each factor, we then treated each dimension independently as a 1-factor model. This allowed us to better discriminate the relationship among the observed variables that comprised a distinct a priori underlying construct. Goodness-of-fit tests were conducted, and as shown in Table 2, 8 of the 12 one-factor models were a good fit as indicated by 4 or more goodness-of-fit statistics, demonstrating construct validity of these factors. The models that showed a poor fit included *staffing*, *nonpunitive response to mistakes*, *communication openness*, and *organizational learning*.

TABLE 2. Summary of NHSPSC 12-factor Goodness-of-Fit Statistics

Factor (No. of Items, No. of Respondents)	Model Versus Saturated χ^2 (*df*)	*P*	RMSEA	CFI	TFI	CD
Teamwork (4, 223)	4.36(2)	0.11*	0.073	0.99*	0.98*	0.90*
Staffing (4, 201)	8.42(2)	0.02	0.13	0.94*	0.82	0.68
Comply with procedures (3, 211)	0.00(0)	0.00	0.00*	1.00*	1.00*	0.77*
Training and skills (3, 210)	0.00(0)	0.00	0.00*	1.00*	1.00*	0.73*
Nonpunitive response to mistakes (4, 190)	42.13(2)	0.00	0.33	0.78	0.35	0.76*
Handoffs (4, 216)	1.71(2)	0.43*	0.00*	1.00*	1.00*	0.84*
Feedback and incident communication (4, 215)	2.39(2)	0.30*	0.03*	0.99*	1.00*	0.85*
Communication openness (3, 212)	0.00(0)	0.00	1.00	1.00*	0.86*	0.82*
Supervisor expectations and actions (3, 221)	0.00(0)	0.00	0.00*	1.00*	1.00*	0.86*
Overall perceptions of safety (3, 227)	0.00(0)	0.00	0.00*	1.00*	1.00*	0.90*
Management support (3, 204)	0.00(0)	0.00	0.00*	1.00*	1.00*	0.86*
Organizational learning (4, 209)	13.31(2)	0.00	0.16	0.94*	0.81	0.77*

*Acceptable model indices: χ^2 value, near zero; $P > 0.05$; RMSEA < 0.06, CFI and TFI ≥ 0.90, and CD ≥ 0.70 (where 1 indicates a perfect fit).
CD, coefficient of determination; CFI, comparative fit index; RMSEA, root mean square error of approximation; TFI, Tucker-Lewis fit index.

Factor Extraction

The EFA results confirmed the existence of multiple factors or dimensions, providing evidence that suggested many of the a priori item groupings did fall into distinct factors, affirming the dimensionality of the construct. Based on the testing of this instrument in adult nursing home settings, we expected a 12-factor solution. An unrotated principal factors analysis was conducted on the 42 items, identifying a total of 8 factors with Eigenvalues greater than or equal to 1.

The factor loadings, or pattern matrix, were calculated, and most variables sufficiently demonstrated a good fit by unique variances communality greater than 0.40, with exception of items A3 (0.31), A8 (0.39), A16 (0.25), A4 (0.36), and D3 (0.33), indicating these variables share more variance with other variables in the factor model. A scree plot was then constructed, which indicated a break in Eigenvalues at factor number 4, indicating a 3-factor solution, and again at factor number 9, indicating an 8-factor solution. Based on the aims of this study, we proceeded with analysis using the 8-factor solution.

Factor Rotation

Two types of rotation were used to better interpret the 8-factor structure: the orthogonal Varimax and the oblique Promax rotations. Factors loaded identically in both methods indicating the orthogonal method was well suited and chosen for the remaining analysis. The rotated component matrix and factors showing items with loading factors above 0.4 are shown in Table 3. Four items did not have a loading factor greater than 0.40 (A4, D3, A8, and A16), and 2 items (A12 and B7) loaded on 2 factors.

Factor Reliability and Independence

Cronbach alpha coefficients were used to measure internal consistency of the group of items measuring the a priori identified 12 dimensions. Good to very good reliability by alpha coefficient was found in all dimensions, ranging from 0.72 to 0.85, with exception of the dimension *compliance with procedures* deemed acceptable ($\alpha = 0.67$) and *staffing* deemed poor ($\alpha = 0.55$).[25] This was also conducted with the identified 8-factor solution, and findings were either consistent (*compliance with procedures* deemed acceptable, $\alpha = 0.68$), or demonstrated improved internal consistency with Cronbach alpha coefficients ranging from 0.79 to 0.88.

The internal consistency was also examined by average interitem correlations to determine the effect of removal or addition of items from the NHSPSC-pLTC to each of the 8 identified factors as shown in Table 4. High interitem correlations were demonstrated, all sufficiently above acceptable cutoff value of 0.30, indicating the items are related to the same construct.[18,25] Affirming the factors are distinct and uncorrelated, the clean pattern matrix was clean; only 2 of the 42 items cross-loaded on more than one factor. Finally, the standardized loadings that represent the correlation between the observed variable and the latent factor were examined, and R^2 was calculated for each of the observed variables to identify the amount of variance accounted for by the latent variables.[17,18,26] Of all the items in the extracted 8-factor model, the least item variance accounted for was D3 ("this facility lets the same mistakes happen again and again") by $R^2 = 0.22$, indicating that this item did not fit well with the factor organizational learning and perhaps taps a dimension of organizational learning not captured by the other variables.

DISCUSSION

This study examined aspects of the psychometric properties of the NHSPSC modified for use in pLTC settings. The factors extracted from the data were generally consistent with those in the literature for the Hospital Survey on Patient Safety Culture.[27–29] To our knowledge, only one other study has examined the psychometric properties of the NHSPSC, using a Swiss version.[30] Similar to the study by Zúñiga et al (2013),[30] our analysis suggests a reduction from 12 factors to 8, and although the items comprising the factors are very similar to the parent NHSPSC structure, items did shift. Only one factor was identical between the original NHSPSC and the NHSPSC-pLTC: *supervisor expectations and actions*. The greatest change by number of items loaded was the addition of 5 items from the dimensions *communication openness* and *management support* to the dimension of *non-punitive response to mistakes*. This means in the pLTC setting, these are not distinctly different factors, based on these statistical analyses, and as proposed in the NHSPSC based on theory-driven expert opinion for the adult settings.[2,8] Conceptually, the items measure the bidirectional relationship of the perception of communication tone and support from management to frontline workers and the perceived value and engagement in communication from frontline workers to management. This suggests a relationship between staff engagement in safety that is closely intertwined with staff

TABLE 3. Extracted Variable Factor Loadings and Matrix (n = 125)

	Factors and Factor Loadings							
Item	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
A1. Staff in this facility treat each other with respect.				0.68				
A2. Staff support one another in this facility.				0.83				
A5. Staff feel like they are part of a team.				0.66				
A9. When someone gets really busy in this facility, other staff help out.				0.57				
A3. We have enough staff to handle the workload.				0.41				
A17. Because so many staff quit their jobs, there are few experienced staff to provide safe care.	0.46							
A6. Staff use shortcuts to get their work done faster.								0.56
A14. To make work easier, staff often ignore procedures.								0.61
A7. Staff get the training they need in this facility.					0.65			
A11. Staff have enough training on how to handle difficult residents.					0.65			
A13. Staff understand the training they get in this facility.					0.57			
A10. Staff are blamed when a child is harmed.	0.67							
A12. Staff are afraid to report their mistakes.	0.56							0.47
A15. Staff are treated fairly when they make mistakes.	0.55							
A18. Staff feel safe reporting their mistakes.	0.63							
B1. Staff are told what they need to know before taking care of a child for the first time.					0.54			
B2. Staff are told right away when there is a change in a child's care plan.		0.56						
B3. We have all the information we need when resident children are transferred from the hospital.					0.44			
B10. Staff are given all the information they need to care for children.		0.59						
B4. When staff report something that could harm a child, someone takes care of it.		0.58						
B5. In this facility, we talk about ways to keep incidents from happening again.		0.78						
B6. Staff tell someone if they see something that might harm a child.		0.69						
B8. In this facility, we discuss ways to keep children safe from harm.		0.68						
B7. Staff ideas and suggestions are valued in this facility.	0.61	0.45						
B9. Staff opinions are ignored in this facility.	0.63							
B11. It is easy for staff to speak up about problems in this facility.	0.67							
C1. My supervisor listens to staff ideas and suggestions about the safety of children							0.77	
C2. My supervisor says a good word to staff who follow the right procedures.							0.61	
C3. My supervisor pays attention to child safety problems in this facility.							0.77	
D1. Residents are well cared for in this facility.			0.64					
D6. This facility does a good job keeping children safe.			0.75					
D8. This facility is a safe place for children.			0.79					
D2. Management asks staff how the facility can improve the safety for children	0.53							
D7. Management listens to staff ideas and suggestions to improve the safety for children.						0.54		
D9. Management often walks around the facility to check on care for children.						0.73		
D4. It is easy to make changes to improve resident safety in this facility.			0.55					
D5. This facility is always doing things to improve the safety for children.			0.73					
D10. When this facility makes changes to improve safety for children, it checks to see if the changes have worked.						0.69		

perceptions of being blamed or treated fairly when they make mistakes, events happen, or they provide information to leadership.

Perhaps the most unexpected finding was the poor factor loading of 2 of the 4 items comprising *staffing,* which were thus eliminated from the extracted model. The remaining 2 items, A3 ("We have enough staff to handle the workload") and A17 ("Because so many staff quit their jobs, there are few experienced staff to provide safe care"), loaded with t*eamwork* and *nonpunitive response to mistake*s, respectively. This suggests that a unique construct of staffing adequacy as measured by these items is not evident in the pLTC setting, although components of perceptions of staffing are related to staff perceptions of teamwork and a nonpunitive environment. This finding is consistent with that identified by Zúñiga et al [30] who examined the factor structure in adult nursing homes. Furthermore, staffing may be a multidimensional concept in pLTC settings, as it relates to safety; notably, the items that were omitted owing to factor loadings of 0.40 or less include A16 ("Children's needs are met during shift changes") and A8 ("Staff have to hurry because they

TABLE 4. Differences in Composition of AHRQ NHSPSC and NHSPSC–p-LTC

AHRQ NHSPSC Factor Structure				NHSPSC-pLTC Factor Structure			
Factor (No. of Items)	**Items**	**Factor Reliability (α)**	**Average Interitem Correlation**	**Factor**	**Items**	**Factor Reliability (α)**	**Average Interitem Correlation**
Teamwork (4)	A1, A2, A5, A9	0.84	0.57	Teamwork and staffing (5)	A1, A2, A5, A9, **A3**	0.82	0.48
Staffing (4)	A3, A8, A16, A17	0.55	0.24				
Compliance with Procedures (3)	A4, A6, A14	0.68	0.41	Compliance with procedures (2)	A6, A14	0.68	0.52
Training and Skills (3)	A7, A11, A13	0.72	0.47	Training, skills and handoffs	A7, A11, A13, **B1, B3**	0.79	0.42
Nonpunitive response to mistakes (4)	A10, A12, A15, A18	0.74	0.42	Nonpunitive response, communication openness and management support and staffing (9)	A10, A12, A15, A18, **B7, B9, B11, D2, A17**	0.88	0.46
Handoffs (4)	B1, B2, B3, B10	0.83	0.54				
Feedback and incident communication (4)	B4, B5, B6, B8	0.84	0.57	Feedback and communication and handoffs (6)	B4, B5, B6, B8, **B2, B10**	0.86	0.50
Communication openness (3)	B7, B9, B11	0.85	0.66				
Supervisor expectations and actions (3)	C1, C2, C3	0.82	0.61	Supervisor expectations and actions (3)	C1, C2, C3	0.82	0.61
Overall perceptions of safety (3)	D1, D6, D8	0.84	0.64	Overall perceptions and organizational learning (5)	D1, D6, D8, **D4, D5**	0.86	0.56
Management support (3)	D2, D7, D9	0.83	0.63	Management support and organizational learning (3)	D7, D9, **D10**	0.80	0.58
Organizational learning (4)	D3, D4, D5, D10	0.73	0.40				

Bold AHRQ NHSPSC factors indicate poor goodness-of-fit statistics; bold NHSPSC–p-LTC items indicate where differences occur between factor structures. Items.A4, D3, A8, and A16 are not included in the NHSPSC–p-LTC due to factor loadings <0.40; items A12 and B7 loaded on 2 factors and are placed in the factor with the highest loading.

have too much work to do"). It seems the items pertaining to the staffing adequacy by number of personnel are relevant, but those that ascertain the effect of workflow and conditions under which the number of staff operate are inadequate. However, this requires further exploration in other pLTC settings, as these omitted items are conceptually relevant to the PSC construct.

The original NHSPSC factors identified and tested in adult settings did not fit exactly with the data from pLTC settings in this study, despite good internal reliability of the dimensions. This may suggest that the underlying theoretical structure may not adequately capture the perceptions of the PSC by health care workers in pLTC settings. After factor extraction and rotation, 4 items (A4, D3, A8, and A16) were omitted from further statistical testing, resulting in a better fit of a more parsimonious model of 8 factors. Whereas these items do seem to cover core PSC issues and are theoretically congruent, our interpretation is based on our stated approach using a strict factor loading cutoff threshold of 0.40. Reasons for the low factor loadings may be related to other items more strongly correlated to the latent variables that better exemplify the construct of interest in this sample, rather than the item being irrelevant to the construct of PSC. Therefore, our findings suggest that this tool in modified format, including the items excluded after the EFA and using the subscales in modified form, may be appropriate for this population and setting in future surveys. This supports the pursuit of additional lines of evidence to support the validity and reliability of the instrument to measure PSC in pLTC.[20]

There are limitations to this study, including face validity testing restricted to physicians, a possible nonresponse bias, and a relatively small sample size of respondents to all items in the full scale. Missing values at the item level due to blank or invalid responses and "doesn't apply or don't know" ranged from one missing (0.004%) to 25 missing (10.4%). Because of this loss of responses for items that comprise all factors, items that comprised each factor were examined consistent with factor analysis procedures to include only those that responded to all items in a factor and omitted those that did not. Thus, although each dimension may be individually confirmed, the full model in the EFA used a limited sample size, thus limiting our ability to explore the PSC construct in this sample, as the grouping of items are based on the EFA results. That is, each dimension was tested, but the full construct testing of PSC was limited by the sample size that completed all items. As shown in Table 2, each original NHSPSC factor included at least 3 to 4 items with 190 to 227 complete values for analysis, indicating model testing requirements were met.[21] Therefore, any limitation in sample size is anticipated to be minimal, as complete responses were available from most respondents per factor (80%–95%).

Finally, analytic precision may be compromised by pooling data from 3 sites if there is considerable variation in perception of PSC. In this survey, nearly 60% of the data came from one site with an equal amount from the other 2 sites, and there was a sizeable proportion of respondents who had worked for either a very limited or very lengthy time in their respective facilities. In this factor analysis, however, the heterogeneity may be viewed as strength.

CONCLUSIONS

This study demonstrates that the AHRQ NHSPSC may be appropriate for pLTC settings. This is the first psychometric testing of this instrument in this population, and it warrants more robust testing to conclude if it is a sound instrument to measure PSC in this population. In this study, we conducted a CFA to assess whether the adapted instrument had a similar structure to the original instrument, and then an EFA as the structure could not be confirmed for several subscales. Further testing should include additional construct validity testing with sufficient response rates in a larger data set to test the proposed model structure found in the EFA. After any revisions, the next step would be to conduct a larger sample CFA and determine whether the results are reliable across settings and populations. Additionally, further testing is needed to establish more broadly its content validity by examining if the scale includes items relevant for all professional groups in pLTC. Discriminant validity testing should also be conducted to assess if the scale actually measures something different from other instruments that measure simply teamwork or leadership. Finally, the scale must be examined in relationship to safety outcomes in pLTC to establish the relevance and usefulness of the tool in practice. Ultimately, increased use of this tool may yield data for benchmarking purposes across these specialized settings to inform frontline workers and organizational leaders of areas of strength and opportunity for improvement.

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