Psychometric properties of the Hospital Survey on Patient Safety Culture: findings from the UK

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ABSTRACT

Background Patient safety culture is measured using a range of survey tools. Many provide limited data on psychometric properties and few report findings outside of the US healthcare context. This study reports an assessment of the psychometric properties and suitability of the American Hospital Survey on Patient Safety Culture for use within the UK.

Methods A questionnaire survey of three hospitals within a large UK Acute NHS Trust. 1437 questionnaires were completed (37% response rate). Exploratory factor analysis, confirmatory factor analysis and reliability analyses were carried out to assess the psychometric performance of this survey instrument and to explore potential improvements.

Results Reliability analysis of the items within each proposed scale showed that more than half failed to achieve satisfactory internal consistency (Cronbach's $\alpha<0.7$). Furthermore, a confirmatory factor analysis carried out on the UK data set achieved a poor fit when compared with the original American model. An optimal measurement model was then constructed via exploratory and confirmatory factor analyses with split-half sample validation and consisted of nine dimensions compared with the original 12 in the American model.

Conclusion This is one of the few studies to provide an evaluation of an American patient safety culture survey using data from the UK. The results indicate that there is need for caution in using the Hospital Survey on Patient Safety Culture survey in the UK and underline the importance of appropriate validation of safety culture surveys before extending their usage to populations outside of the specific geographical and healthcare contexts in which they were developed.

The measurement of patient safety culture is a growing industry among researchers and healthcare professionals.[1–6] In the UK, at least a third of NHS Trusts are taking part in some form of culture assessment.[7] Measurement methods range from more generic "toolkits" to methods designed for specific healthcare contexts (eg, primary care).[8 9] Questionnaire surveys are frequently used to measure—for example, team working, attitudes towards errors and general perceptions of safety. However, it has been suggested that many questionnaires lack explicit theoretical underpinning and fail to report the full psychometric properties of measures,[10 11] raising the possibility that they neither consistently measure specific aspects of patient safety nor generalise across different national and healthcare-specific environments.[2] This has particular relevance for the assessment of patient safety culture in the UK because a number of the surveys currently being used within NHS Trusts were developed in the USA.[7 4 12] In this paper, we report the use within the UK of the American Agency for Healthcare Research and Quality–sponsored Hospital Survey on Patient Safety Culture (HSOPC) questionnaire. We focus on the psychometric properties of the HSOPC and its suitability for use within a UK context.

HOSPITAL SURVEY ON PATIENT SAFETY CULTURE

The HSOPC questionnaire is based on a set of pilot studies carried out in 21 different hospitals involving 1461 hospital staff across the USA.[12] As a result of a series of item and content analyses, reliability analysis, and exploratory and confirmatory factor analyses, it consists of 42 items that group into 12 dimensions; two outcome dimensions and 10 safety dimensions. For each item there were five possible response categories, the labelling of which varies across dimensions. Of the 42 items, 17 are asked from a "negative" viewpoint and are subsequently reverse-scored. The confirmatory factor analysis carried out during the development of the questionnaire indicated that the 12-factor model proposed had an adequate level of fit to the data using established criteria,[13] specifically with comparative fit index (CFI)=0.94, non-normed fit index (NNFI)=0.93, root mean square error of approximation (RMSEA)=0.04 and root mean square residual (RMR)=0.04.[12] Very few published accounts of the use of the survey are available; however, the Agency for Healthcare Research and Quality have made available a database that facilitates the benchmarking of findings from other users of the survey. The database for 2008—for example, consists of data drawn from 160 176 respondents across 519 hospitals in the USA.[14] Comparable data from the UK and Europe are not available, although there is evidence that the survey is being used within UK Trusts.[7]

METHOD

Sample

The HSOPC questionnaire was distributed to three hospitals within a large NHS Acute Trust in the East Midlands between May and June 2006. Questionnaires were distributed by key staff working in wards and other specialist areas across the three hospitals. Clinical and non-clinical staff could freely and anonymously fill in the questionnaire and return their responses by post in an envelope provided. The project was reviewed and approved as an audit by both the chair of the local ethics research committee and the research and development department.

Changes made to the questionnaire

As a result of presurvey group discussions with staff members, a number of changes were made. These included adjustments to the wording of individual items with respect to terminology used within UK. The words "area" and "unit" were changed to "ward" and "department" (affecting questions A28, A1, A7, A20, A12, F4, F13, F2, F7, F3, F9) and the term "adverse outcome" was used to substitute for "error" and "mistake" (questions D1, D2, D3, C7, C9). The words "over and over" in question B4 were replaced by "repeatedly". In addition, after discussions with hospital management, one item (question A19) in the "Non-punitive responses to error" dimension was removed from the questionnaire. Finally, because of a proofreading error, the meaning of one item (question F1) in the "Hospital management support for patient safety" dimension was altered. This item was subsequently discarded because of this change of meaning, resulting in 40 items used in our data analyses compared with 42 from the original HSOPC survey (table 1). The survey also collected a small amount of background information, specifically on respondents' hospital, job type and tenure.

Survey response and sample properties

Four thousand questionnaires were distributed, of which 1461 were returned (a 37% response rate representing 12% of the total employees in the Trust). Within these cases, 1017 respondents had given valid responses to the 40 HSOPC items subsequently analysed. Sixty per cent of the sample were nursing staff (trained and untrained), followed by allied healthcare professionals (21%), management and administrative staff (11%) and medical staff (8%); just less than half the sample (45%) had been working in their current hospital for at least 5 years.

Table 1 Modified version of the HSOPC questionnaire

Question number	Dimension/item
Overall perceptions of safety (outcome dimension)	
A25	Patient safety is never sacrificed to get the work done
A30	Our procedures and systems are good at preventing errors from happening
A18	It is just by chance that serious mistakes don't happen around here
A28*	We have patient safety problems in this ward/department
Frequency of error reporting (outcome dimension)	
D1	When an event occurs, but is caught and identified before affecting the patient, how often is it reported?
D2	When an event occurs, but it has no adverse outcome to the patient, how often is it reported?
D3	When an event occurs that could have an adverse outcome to the patient but does not, how often is it reported?
Supervisor/manager expectations and actions promoting patient safety	
B1	My supervisor/manager provides positive feedback 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	Whenever pressure build up, my supervisor/manager wants us to work faster, even if it means taking shortcuts
B4	My supervisor/manager overlooks patient safety problems that happen repeatedly
Organisational learning—continuous improvement	
A14	We are actively doing things to improve patient safety
A16	Mistakes have led to positive changes around here
A22	After we make changes to patient safety, we evaluate their effectiveness
Teamwork within units	
A1*	People support one another in this ward/department
A3	When a lot of work needs to be done quickly, we work together as a team to get the work done
A7*	In this ward/department, people treat each other with respect
A20*	When one area in this ward/department gets busy, others help out
Communication openness	
C3	Staff will freely speak up if they see something that may negatively affect patient care
C8	Staff feel free to question the decisions and actions of those with more authority
C11	Staff are afraid to ask questions where something doesn't seem right
Feedback and communication about error	
C1	We are given feedback about changes put into place based on event reports
C7	We are informed about events that happen in this ward/department
C9	In this ward/department, we discuss ways to prevent events from happening again
Non-punitive response to error	
A19†	When an event is reported, it feels like the person is being written up, not the problem
A15	Staff feel that their mistakes are held against them
A26	Staff worry that mistakes they make are kept in their personal files
Staffing	
A2	We have enough staff to handle the workload
A12*	Staff in this ward/department work longer hours that is best for patient care
A13	We use more agency/temporary staff than is best for patient care
A24	We often work in "crisis mode" trying to do too much, too quickly
Hospital management support for patient safety	
F1†	Hospital management provides a work climate that promotes patient safety
F10	The actions of hospital management show that patient safety is a top priority
F11	Hospital management seems interested in patient safety only after an adverse event happens
Teamwork across hospital units	
F4*	There is good cooperation across hospital wards/departments that need to work together
F13*	Hospital wards/departments work well together to provide the best care for patients
F2*	Hospital wards/departments do not coordinate well with each other
F7*	It is often unpleasant to work with staff from other hospital wards/departments
Hospital handoffs/transitions	
F3*	Things "fall between the cracks" when transferring patients from one ward/department to another
F5	Important patient care information is often lost during shift changes
F9*	Problems often occur in the exchange of information across hospital wards/departments
F14	Shift changes are problematic for patients in this hospital

*Item changed from original HSOPC questionnaire.
†Item not used in the questionnaire or discarded from the analysis.
HSOPC, Hospital Survey on Patient Safety Culture.

Analysis of data

We first examined the responses made to each item within the 12 HSOPC dimensions, and assessed the original 12 dimension model in relation to our sample, both in terms of the internal consistency reliability of each dimensional grouping of items and as a whole using confirmatory factor analysis to assess the overall level of fit.

We then constructed the optimal measurement model for our sample to see if and how this differed from the original model. Our sample was split randomly into two halves; on one "construction" half, exploratory factor analysis (EFA) was used to construct a measurement model for the items; the other "validation" half of the data was then used to test this model via confirmatory factor analysis (CFA). Having finalised our optimal model, we then performed reliability analysis on the sets of items in each resulting dimension using the whole sample. Table 2 provides a glossary that explains some the common terms used when carrying out EFA and CFA statistical analyses.

RESULTS

Item responses

With the exception of two factors (ie, hospital handover hand-offs and transitions), the main findings were positive with regard to the type of safety culture within the Trust as a whole. Online Appendix A shows the percentage responses in each category reported for each item used in the survey.

Testing the original model

The results of a reliability analysis on the original dimensions are presented in table 3. Of the 12 groupings of items, 7 (Overall perceptions of safety, Supervisor/manager expectations, Organisational learning—continuous improvement, Communication openness, Non-punitive responses to error, Staffing, Hospital management support) fell short of an adequate level of internal consistency (Cronbach's $\alpha<0.7$), with Staffing exhibiting an extremely poor level of reliability ($\alpha=0.58$). Only two of the dimensions achieved α values >0.80 (Frequency of error reporting, Feedback and communication about error).

A CFA of the original model was then run ($\chi^2=1907$, 674 df); the full range of fit indices suggested a level of fit with marginal adequacy; specifically CFI=0.91, NNFI=0.89, RMSEA=0.04, standardised root mean square residual=0.05. Of the 40 items, 4 (A12, A13, B4 and B7) had <20% of their variability explained by the model, and a further 7 items had <30% of variability explained. In addition, of the 40 standardised path coefficients, 8 dropped below the widely applied 0.5 cutoff.

Constructing an optimal model

Having found that the original model did not fit the UK data satisfactorily, we then carried out a robust construction of the optimal measurement model for the 40 HSOPC items in the UK survey. On one randomly selected "construction" half of the data, we performed an EFA, using principal axis factoring as the extraction method and assessing the number of factors to be extracted by a combination of Kaiser's criterion and Cattell's screen plot method.[15] An oblique rotation was carried out to aid interpretation of the resulting factors. Having examined a series of possible models, and gradually removing 13 items that were either severely cross-loaded or had very low loadings and communalities, the evidence pointed most strongly towards a nine-factor model for the remaining 27 items. This accounted for 66.8% of their total variance and is given with the factor loadings in online appendix B.

We then tested the fit of this model to the other "validation" half of the data set using CFA ($\chi^2=588$, 288 df). The fit indices suggested an adequate fit to the data, with CFI=0.95, Tucker–Lewis Index=0.93, RMSEA=0.04, standardised root mean square residual=0.04. Furthermore, the model accounted for at least 20% of the variance of each item and greater than 30% of the variance for all but two items. All but one of the factor loadings from the EFA and all 27 standardised path coefficients from the CFA were >0.5.

The interpretations of the dimensions resulting from the optimal measurement model constructed and tested on the UK data were similar to those from the original model. Indeed, there still existed dimensions for "Communication openness", "Feedback, frequency of event reporting", "Non-punitive responses to

Table 2 Glossary of terms used with exploratory and confirmatory factor analysis

Term	Explanation
Measurement model	Model that relates a set of latent (unmeasurable) factors to a larger number of observed variables (indicators) being used to measure them.
EFA	A technique used to identify the factors, and hence the possible measurement model(s), underlying a large number of observed variables.
Principle axis factoring	A method of identifying the relationship between these factors and the observed variables from the observed correlations between the variables.
Kaisers (eigenvalue >1) criterion	A method for deciding how many factors underlie the observed variables, based on extracting only factors that explain more variability than any single observed variable would.
Cattell's screen plot	A method for deciding how many factors underlie the observed variables, based on using a plot to identify at which point subsequent extracted factors explain only spurious extra variability, and hence should not be retained.
(Oblique) factor rotation	Factor rotation aids interpretation of factors via rearranging the variance explained between them. A oblique rotation specifically allows factors to be correlated and is hence considered suitable when the expected underlying concepts are likely to be related.
CFA	A technique used to test the fit of a hypothesised measurement model to the data, generally by comparing the observed and expected covariance matrices. Unlike EFA that seeks to find one or more possible "best" models, CFA attempts to say how good these best models actually are.
Model χ^2 statistic	A statistic for the measure of fit between observed data and that expected given the hypothesised measurement model. A χ^2 statistic significantly different from zero indicates that the observed and expected models differ significantly. However, as sample size increases, the model χ^2 is increasingly sensitive; for even in simple models, minor differences between expected and observed data can lead to a significant χ^2 statistic (hence, the need for other fit indices to reflect model fit—eg, comparative fit indices).
CFI, and the TLI or NNFI	Fit indices based on comparing the model χ^2 statistic to that for the null model, with model complexity penalised. Both take values between 0 and 1, with the current consensus being that values >0.9 indicate an adequate fit and values >0.95 indicate a good fit.
RMSEA	A fit index based on adjusting the χ^2 statistic for the sample size. Current consensus is that good models have an RMSEA of ≤0.05, and that models with RMSEA >0.10 have a poor fit to the observed data.
SRMR	A fit index based on the standardised difference between the observed covariance and predicted covariance matrices, with a value <0.08 considered as indicating a model with good fit to the observed data.

CFA, confirmatory factor analysis; CFI, comparative fit index; EFA, exploratory factor analysis; NNFI, non-normed fit index; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual; TLI, Tucker–Lewis Index.

Table 3 HSOPC items in the UK data and their fit to the original 12 dimension model

Dimension/item		Item R^2 from CFA*	Standard path coefficient from CFA*	Reliability of dimension†
Overall perceptions of safety (outcome dimension)				0.67
A25	Patient safety is never sacrificed to get the work done	0.25	0.50	
A30	Our procedures and systems are good at preventing errors from happening	0.33	0.58	
A18	It is just by chance that serious mistakes don't happen around here	0.45	0.67	
A28	We have patient safety problems in this ward/department	0.37	0.60	
Frequency of error reporting (outcome dimension)				0.83
D1	When an event occurs, but is caught and identified before affecting the patient, how often is it reported?	0.45	0.67	
D2	When an event occurs, but it has no adverse outcome to the patient, how often is it reported?	0.87	0.93	
D3	When an event occurs that could have an adverse outcome to the patient but does not, how often is it reported?	0.59	0.77	
Supervisor/manager expectations and actions promoting patient safety				0.68
B1	My supervisor/manager provides positive feedback when he/she sees a job done according to established patient safety procedures	0.54	0.73	
B2	My supervisor/manager seriously considers staff suggestions for improving patient safety	0.68	0.82	
B3	Whenever pressure build up, my supervisor/manager wants us to work faster, even if it means taking shortcuts	0.26	0.51	
B4	My supervisor/manager overlooks patient safety problems that happen repeatedly	0.14	0.38	
Organisational learning—continuous improvement				0.66
A14	We are actively doing things to improve patient safety	0.45	0.67	
A16	Mistakes have led to positive changes around here	0.30	0.55	
A22	After we make changes to patient safety, we evaluate their effectiveness	0.45	0.67	
Teamwork within units				0.73
A1	People support one another in this ward/department	0.62	0.79	
A3	When a lot of work needs to be done quickly, we work together as a team to get the work done	0.45	0.67	
A7	In this ward/department, people treat each other with respect	0.62	0.79	
A20	When one area in this ward/department gets busy, others help out	0.23	0.48	
Communication openness				0.67
C3	Staff will freely speak up if they see something that may negatively affect patient care	0.51	0.72	
C8	Staff feel free to question the decisions and actions of those with more authority	0.54	0.73	
C11	Staff are afraid to ask questions where something doesn't seem right	0.29	0.54	
Feedback and communication about error				0.80
C1	We are given feedback about changes put into place based on event reports	0.52	0.72	
C7	We are informed about events that happen in this ward/department	0.54	0.74	
C9	In this ward/department, we discuss ways to prevent events from happening again	0.64	0.80	
Non-punitive response to error				0.65
A15	Staff feel that their mistakes are held against them	0.81	0.90	
A26	Staff worry that mistakes they make are kept in their personal files	0.28	0.53	
Staffing				0.58
A2	We have enough staff to handle the workload	0.34	0.59	
A12	Staff in this ward/department work longer hours that is best for patient care	0.17	0.41	
A13	We use more agency/temporary staff than is best for patient care	0.09	0.30	
A24	We often work in "crisis mode" trying to do too much, too quickly	0.54	0.74	
Hospital management support for patient safety				0.69
F10	The actions of hospital management show that patient safety is a top priority	0.54	0.73	
F11	Hospital management seems interested in patient safety only after an adverse event happens	0.51	0.72	
Teamwork across hospital units				0.70
F4	There is good cooperation across hospital wards/departments that need to work together	0.43	0.66	
F13	Hospital wards/departments work well together to provide the best care for patients	0.42	0.65	
F2	Hospital wards/departments do not coordinate well with each other	0.50	0.70	
F7	It is often unpleasant to work with staff from other hospital wards/departments	0.15	0.39	
Hospital handoffs and transitions				0.77
F3	Things "fall between the cracks" when transferring patients from one ward/department to another	0.51	0.72	
F5	Important patient care information is often lost during shift changes	0.48	0.69	
F9	Problems often occur in the exchange of information across hospital wards/departments	0.57	0.76	
F14	Shift changes are problematic for patients in this hospital	0.29	0.54	

*n=1017.
†Cronbach's α statistic for internal consistency reliability, $1238<n<1412$.

error" and "Hospital handoffs and transitions", which all formed as before. The dimensions for "Teamwork across units" and "Teamwork within units" both dropped a single item, and the "Supervisor/manager expectations and actions promoting patient safety" dimensions dropped two items. The most noticeable differences were the absence of "Organisational learning—continuous improvement" and "Hospital management support", and the grouping of a subset of the items that previously formed the "Overall perceptions of safety" and "Staffing" dimensions into a single dimension.

Finally, using the whole sample, reliability analyses were performed for each of the groups of items defined by this factor structure. These generally indicated suitable internal consistency, with Cronbach's $\alpha>0.7$ for seven of the nine dimensions. Of the two dimensions that fell below this level, one was a two-item scale, and both were among the five dimensions to survive unchanged from the original model (ie, the weak reliability was not due to the form of our revised model). None of the scales gained improved consistency by dropping further items.

DISCUSSION AND CONCLUSIONS

Our findings differ from the results obtained within the USA. Although we might have expected the changes made to the UK questionnaire to have resulted in some differences, they are unlikely by themselves to explain the findings. The results from the spilt EFA and CFA indicate that the questionnaire may be measuring different constructs, or aspects of patient safety within the UK, as compared to the USA. For example, the optimal model derived from the UK data resulted in a dimension that linked "Overall perceptions of safety" and "Staffing". This may have come about because of an increased tendency to associate staffing levels with safety within the UK as compared to the USA. Similarly, it is possible that the items in the dimensions "Organisational learning—continuous improvement" and "Hospital management support for patient safety" may have been interpreted differently within a UK sample. Our findings indicate that national and healthcare-specific differences may limit the extent to which the HSOPC survey is applicable outside of the USA. We would also point to the lack of cross-validation (EFA followed by CFA) in the USA data set as indicating another potential flaw in the design and validation of the HOSPC questionnaire. The relatively higher values for the CFA fit indices achieved in the original study from which the HSOPC scales were constructed may be partially explained by their use of the same sample for the EFA and CFA. Split-half validation was not undertaken; and testing the model using the same data from which it was constructed would most likely result in an overestimate of the degree of fit.

The measurement of safety culture and climate in healthcare is still in a relatively immature stage of development as compared to other domains (eg, offshore installations, manufacturing).[16 17] Other researchers[3] have warned about the dangers of too readily generalising about safety culture and climate across industries with widely differing characteristics, forms of hierarchy and work practices. This is especially the case within healthcare, where hospitals—for example, may vary greatly according to norms and operating procedures, even within the same Trust. Our findings add further weight to the argument that there is a need to further develop and construct theoretical models that are sensitive to the context-specific nature of healthcare environments including hospitals.[18] Without such work, researchers run the risk of adopting a "broad brush" approach to safety culture and overgeneralising their findings. Our advice to healthcare managers considering a survey of patient safety culture within their organisations is twofold: first, to examine carefully the extent to which survey tools and instruments provide extensive details of their psychometric properties; and second, to consider the degree to which potential surveys have undergone validation in other contexts either within their own country or with other healthcare systems that are similar or comparable. A number of surveys fulfil the requirements of these criteria and psychometric and validation exercises have been carried out with other patient safety tools and surveys.[4 6 9] With regard to our future work, we plan to compare our findings using the HSOPC with similar studies that we understand to be on-going within the UK, other European countries and elsewhere.

Competing interests None.

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