

Psychometric Evaluation of an Instrument for Measuring Organizational Climate for Quality: Evidence From a National Sample of Infection Preventionists

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Abstract

In recent years, there has been increased interest in measuring the climate for infection prevention; however, reliable and valid instruments are lacking. This study tested the psychometric properties of the Leading a Culture of Quality for Infection Prevention (LCQ-IP) instrument measuring the infection prevention climate in a sample of 972 infection preventionists from acute care hospitals. An exploratory principal component analysis showed that the instrument had structural validity and captured 4 factors related to the climate for infection prevention: Psychological Safety, Prioritization of Quality, Supportive Work Environment, and Improvement Orientation. LCQ-IP exhibited excellent internal consistency, with a Cronbach α of .926. Criterion validity was supported with overall LCQ-IP scores, increasing with the number of evidence-based prevention policies in place ($P = .047$). This psychometrically sound instrument may be helpful to researchers and providers in assessing climate for quality related to infection prevention.

Keywords

psychometric analysis, organizational climate, quality, health care–associated infections

In recent years, there has been increased recognition of the need to improve the quality of care received by patients in acute care settings.¹ The Institute of Medicine (IOM) published its 2 reports on quality, *To Err Is Human* and *Crossing the Quality Chasm*, highlighting the frequent occurrence and dire consequences of medical errors and outlining a comprehensive strategy to improve the delivery of care.^{1,2} Health care–associated infections were recognized by the IOM as one of the important quality problems because these infections result in significant morbidity and mortality, increased length of stay, and added costs of care.^{3,4} In the past decade, there has been an increase in evidence showing that certain infections can be prevented through the use of care bundles.^{5,6} Although several studies have shown that implementation of and adherence to evidence-based bundles is associated with lower rates of infections,^{7,8} variation exists in the presence of and compliance with these policies in US hospitals.^{9,10}

Possible causes of variation are organizational factors (eg, leadership, work satisfaction, cooperation) that are important components in ensuring compliance with guidelines and quality of care.^{11–14} However, no studies have specifically examined the relationship between

organization climate for quality, defined as members' shared perceptions that the organization expects, supports, and rewards efforts to provide quality care,^{15,16} and compliance with infection prevention bundles. The absence of such studies likely is related to the absence of validated instruments for assessing organizational climate for infection prevention.

Although several validated tools exist for measuring various types of organizational constructs¹⁷ and quality-oriented climate,¹⁸ one drawback of existing instruments is the lack of specificity in measuring climate around infection prevention. Survey/quality improvement experts

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recommend that climate instruments be as specific and targeted as possible in order to facilitate the identification of meaningful relationships among variables and concrete action based on survey results. Additionally, existing climate instruments are often too long to be incorporated in broader surveys intended to capture multiple constructs. For example, the Safety Attitudes Questionnaire is made up of 40 items and measures attitudes about 6 patient safety-related domains.¹⁸ Incorporating lengthy instruments within another survey is likely to create undue burden on survey respondents, leading to low response rates. Ideally, psychometrically valid, shorter instruments can be incorporated to allow researchers and practitioners to assess multiple variables at once without causing survey fatigue in respondents. One instrument that specifically focuses on quality-oriented climate, is relatively short, and can be adapted to assess quality with respect to a specific problem is the Leading a Culture of Quality (LCQ). However, this instrument has yet to be psychometrically evaluated. The objective of this study was to evaluate the psychometric properties of the LCQ in a national sample of infection control directors working in acute care hospitals across the country; specifically, this study evaluated the LCQ's psychometric validity when assessing infection prevention climate.

Background on the LCQ Survey

The LCQ was originally codeveloped by the Institute for Clinical Systems Improvement and Satisfaction Performance Research in Minnesota, the former being an organization that consisted of 35 medical groups that wished to assess their quality-oriented climate using a relatively short and easy to administer survey and the latter being a survey research firm (P. Jury, personal communication, September 7, 2011). The original LCQ consists of 27 items organized into 9 subscales: alignment (4 items), quality focus (4 items), change orientation (3 items), change actions (2 items), openness (3 items), psychological safety (4 items), accountability (2 items), work group cooperation and respect (3 items), and workload (2 items). The items organized by original subscale are listed in online Appendix 1 (available at <http://ajmq.sagepub.com/supplemental>). Responses to all but one item are indicated on a Likert scale of 1 to 5, where 1 corresponds to *strongly agree*, and 5 corresponds to *strongly disagree*; the responses to one item (item 22) range from 1 (*never*) to 5 (*very often*).

With the exception of the Psychological Safety subscale, which was adopted from an existing survey,¹⁹ the subscales were constructed by the survey developers. Both content and face validity of the LCQ were established previously via an expert panel and qualitative interviews conducted by survey developers. Since then,

the instrument has been used with multiple personnel types with up to 20 000 surveys administered over the past 7 years (P. Jury, personal communication, September 7, 2011). The LCQ has been used primarily by organizations for self-assessment of their quality-oriented climate. Recently, it also has been used by researchers to study the effects of interventions aimed at improving quality-oriented climate²⁰ and the effects of such a climate on organizational outcomes.²¹ Despite this use, no published psychometric studies of the instrument were available. The research team conducted a psychometric analysis of a modified LCQ instrument, in which the wording was changed slightly to make it more specific to infection prevention (eg, "quality" changed to "infection prevention").

Methods

Sample and Data Collection Procedures

The modified LCQ in infection prevention (LCQ-IP) instrument was embedded in a national, Web-based survey of infection control directors from hospitals participating in the National Healthcare Safety Network. Infection control directors or, in the absence of a director, the person in charge of infection control at each hospital were asked to serve as an informant for their hospital. These directors are a good population to survey regarding the infection prevention climate because their primary role involves coordinating the hospital's efforts to improve the quality of patient care by implementing evidence-based practices to prevent and control infections. Data were collected in the winter of 2011 using a modified Dillman technique for recruitment, in which an initial invitation letter was followed by weekly reminders and a final chance letter.²² The survey and the recruitment method are described in more detail elsewhere.⁹ This study was approved by the institutional review boards of Columbia University Medical Center and RAND Corporation.

A total of 1013 surveys were collected (response rate of 29% from the overall survey),⁹ with 972 participants providing complete responses to the LCQ-IP instrument. Table 1 provides demographic data of the informants' hospitals. The largest proportion of hospitals were located in a rural setting (41%), followed by suburban, and urban. The average bed size of participating facilities was 239 (standard deviation [SD] = ± 206 ; range = 13-1614). The majority of hospitals were nonprofit, and one third were affiliated with a medical school. A comparison of the study sample with the nonresponding hospitals showed that the facilities that participated in the study were larger; however, there were no differences between respondents and nonrespondents in terms of medical school affiliation, ownership, and most notably, infection rates.⁹

Table 1. Characteristics of Study Hospitals (n = 972).

	n	Percentage ^a
Affiliated with medical school ^b		
Yes	259	37
No	440	63
Ownership status ^b		
Nonprofit	535	77
Private	122	17
Other	42	6
Facility part of a larger system that shares infection prevention resources		
Yes	285	29
No	674	69
Missing	13	1
Participation in infection control initiative		
Yes	626	64
No	323	33
Missing	23	2
Location		
Urban setting	253	26
Suburb	314	32
Rural setting	399	41
Missing	6	1
Region		
Northeast	180	19
Midwest	263	27
South	342	35
West	164	17
Missing	23	2
Infection prevention program has an infection control director position		
Yes	690	71
No	281	29
Missing	1	0
	Mean (SD)	
Beds	239 (±206)	

Abbreviation: SD, standard deviation.

^aPercentages may not add up to 100% because of rounding.

^bBased on an n value of 699.

Data Analysis

Only hospitals with complete survey data (n = 972) were included in the analyses, which were conducted using SPSS version 22.0 (IBM Inc, Armonk, NY). In the first stage of the analysis, the individual items were prepared and evaluated. Specifically, 2 negatively worded items (items 23 and 24; see online Appendix 1) were reverse coded, such that a lower score corresponded to a negative response (eg, *strongly disagree*). Additionally, descriptive statistics for each item were examined, including mean and SD as well as the correlation matrix. Inter-item correlations were examined to identify highly correlated items (ie, items with a correlation of 0.70 or higher).

Highly correlated items were deleted to eliminate redundancy and improve factor structure.²³

The psychometric analysis focused on assessing 3 core properties of the LCQ-IP instrument: structural validity (the degree to which the instrument adequately reflects the dimensionality of the construct), internal consistency (the reliability of the embedded subscales), and criterion validity (the ability of the instrument to estimate or predict the values of other related measures or effects). Each of these is regarded as critical to assessing the psychometric strength of an instrument; a good instrument will perform well with respect to each property.

Structural Validity. The research team conducted factor analysis to assess the structural validity of the LCQ-IP. Based on recommendations for sample size, with 27 items, this study minimally required 270 individuals.²⁴ Thus, there was an adequate sample size. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were used to assess the appropriateness of the overall factor analysis. The anti-image correlation matrix was examined to further assess if the correlation matrix was factorable, with values of ≥ 0.90 indicating "marvelous" measures of sampling adequacy.²⁵ An exploratory principal components analysis (PCA) with varimax rotation was conducted to consolidate items and identify unique factors. The PCA method was selected presuming no a priori hypothesis about factor structure. The specific criteria that determined the number of factors and the number of items within a factor included the point of discontinuity of the scree plot and eigenvalues greater than 1. Once the number of factors being extracted was determined, varimax rotation was conducted to simplify the factor structure. The initial eigenvalues were examined to identify the amount of variance explained by each factor and cumulatively. Items were assigned to a factor if the loading was greater than 0.40. Items with factor loadings of 0.40 or higher on multiple factors indicating a complex structure were deleted if the difference between the loadings was less than 0.15. Additionally, items with factor loadings of less than 0.40 on all factors were eliminated.

Internal Consistency. The internal consistencies of the final reduced LCQ-IP and each subscale were evaluated using Cronbach α coefficients. Consistent with existing guidelines, scales with internal consistencies of ≥ 0.70 were considered acceptable.²⁶

Criterion Validity. To assess criterion validity, the association between the overall LCQ-IP instrument and the number (range = 0 to 5) of evidence-based policies for prevention of central line-associated bloodstream

infections (CLABSIs) in place⁹ was assessed using analysis of variance. It was hypothesized that hospitals with a more positive climate toward infection prevention would have more infection prevention evidence-based policies in place.

Results

Assessment of the correlation matrix (not shown) indicated 2 pairs of highly correlated items. Item 14, “I observe a high level of cooperation among all members of my work unit or department,” was highly correlated ($r = 0.777$) with item 15, “There is a climate of trust in my department or work unit.” Item 18, “My organization’s senior leadership has focused the organization in the right direction,” was highly correlated with item 19, “I am satisfied with the information I receive from management on what’s going on in the organization” ($r = 0.736$). In addition, item 18 also was correlated with item 16 ($r = 0.696$), “I have a clear understanding of the organization’s mission, vision, and values.” Based on these results, items 15 and 18 were removed from further analysis in order to improve the factor structure. A factor analysis was conducted on the 25 remaining items.

The analysis indicated that the LCQ-IP showed structural validity because the instrument captured factors related to a climate for infection prevention. The KMO test yielded a value of 0.959, and the P value for the Bartlett’s test was $<.001$, indicating that the data could be factor analyzed. Additionally, an examination of the anti-image correlation matrix for the individual items showed that the KMO measure of sampling adequacy was greater than 0.9, further supporting the use of PCA. The PCA resulted in a 4-factor solution (Table 2) that explained a total of 58.8% of the variance. One item (number 21) was deleted because of low factor loadings, and 5 items (numbers 1, 14, 16, 19, and 24) were eliminated because of high loading on multiple factors, leaving 19 items across 4 factors. Factor 1 consisted of 7 items, explaining 18.2% of the variance. Items loading on this factor reflected the respondents’ perception that employees are respected and can speak freely without the fear of repercussions; therefore, this factor was named “Psychological Safety.” Factor 2 consisted of 5 items reflecting the extent to which an emphasis on quality care permeates the organization’s mission and action and was named “Prioritization of Quality.” The next factor included 4 items that focused on whether leaders and organizational work policies enabled infection prevention and was named “Supportive Work Environment.” Finally, factor 4 included 3 items that reflected the organization’s improvement-oriented environment; this factor was named “Improvement Orientation.”

The mean scores for the individual items within factors (Table 2) as well as the mean scores for each factor (Table 3) were high, indicating positive organizational climates for infection prevention overall. However, the SD (20% of the mean on average) indicated variability in support for infection prevention with respect to climates. Additionally, there was variability in the degree to which each factor was present. The Improvement Orientation factor received the highest mean score (mean = 4.43; SD = 0.52), and Supportive Work Environment received the lowest mean score (mean = 3.42; SD = 0.71).

The internal consistency reliabilities for the overall revised instrument and the 4 subscales (representing each of the factors) are presented in Table 3. The Cronbach α for each subscale ranged from .724 for Improvement Orientation (3 items) to .883 for Psychological Safety (7 items). The overall 19-item instrument exhibited an α of .926, indicating excellent internal consistency.

Table 4 provides evidence that the instrument has criterion validity also. The mean LCQ-IP scores increased with the studied criterion: the number of CLABSI policies in place ($P = .047$).

Discussion

This is the first analysis conducted to evaluate the psychometric properties of an instrument for assessing infection prevention climate, the LCQ-IP, in a national sample of hospital infection control directors. The results suggest that the LCQ-IP is psychometrically sound in several respects because it demonstrated structural and criterion validity as well as reliability. Thus, this instrument may be useful to others who wish to measure infection prevention climate. The instrument also may be useful to those wishing to adapt it to measure other quality-related climates, such as patient safety, or to those interested in quality-oriented climate generally.

The principal component analysis resulted in a reduced instrument consisting of 19 items and the identification of 4 factors indicating that the LCQ consists of fewer distinct concepts than originally conceptualized. The 4 factors include some of the constructs found in the original version of the survey and those found in other instruments measuring quality-oriented climate.¹⁸ The 4 items that make up the “Supportive Work Environment” factor describe the perceived work environment of the respondent and come from multiple subscales in the original instrument, including workload (2 items), accountability (1 item), and change orientation (1 item). The “Prioritization of Quality” items came from the quality focus and change orientation subscales of the original instrument. Nembhard et al²⁰ also found that combining these subscales results in a single reliable scale.

Table 2. Items, Means, and Factor Loadings (n = 972).^a

Item Number	Mean	SD	Factor Loadings			
			1	2	3	4
Psychological Safety						
8. The climate in the organization promotes the free exchange of ideas	3.93	0.812	0.620			
9. Staff will freely speak up if they see something that may improve patient care or affect patient safety	3.92	0.829	0.624			
10. I feel free to express my opinion without worrying about the outcome	4.02	0.874	0.547			
13. In general, people in our organization treat each other with respect	4.16	0.691	0.599			
25. People in this organization are comfortable checking with each other if they have questions about the right way to do something	4.02	0.656	0.723			
26. The people in this organization value others' unique skills and talents	3.90	0.701	0.744			
27. Members of this organization are able to bring up problems and tough issues	3.83	0.761	0.723			
Prioritization of Quality						
2. The health care–associated infection prevention goals and strategic plan of our organization are clear and well communicated	4.15	0.761		0.645		
3. Results of our infection prevention efforts are measured and communicated regularly to staff	4.17	0.804		0.719		
4. There is a good information flow among departments to provide high-quality patient safety and care	3.91	0.823		0.666		
6. People here feel a sense of urgency about preventing health care–associated infections	3.65	0.906		0.624		
7. Employees are encouraged to become involved in infection prevention	4.17	0.757		0.673		
Supportive Work Environment						
5. Senior leadership here has created an environment that enables changes to be made	3.90	0.890			0.532	
20. Where I work, people are held accountable for the results of their work	3.61	0.999			0.425	
22. The quality of work suffers because of the amount of work staff are expected to do	3.08	0.833			0.769	
23. Most people in this organization are so busy that they have very little time to devote to infection prevention efforts ^b	3.12	0.994			0.729	
Improvement Orientation						
11. I can think of examples when problems with patient infections have led to changes in our procedures or equipment	4.32	0.689				0.638
12. I know of one or more health care–associated infection prevention initiatives going on within our organization this year	4.53	0.605				0.732
17. I have a clear understanding of the organization's mission, vision, and values	4.43	0.637				0.707
Percentage of variance explained			18.2	13.8	13.5	13.3

Abbreviation: SD, standard deviation.

^aExtraction method: principal component analysis. Rotation method: varimax with Kaiser normalization.

^bReverse coded.

This study has a number of strengths and limitations. First, this was the first study to psychometrically test the LCQ-IP in a large national sample of infection control directors. Although only one employee from each institution completed the survey, the sample was

homogeneous because participants had similar roles within their respective institutions. However, this may limit the reliability of the results and prevents the research team from assessing climate as a shared perception. Therefore, the team recommends future

Table 3. Reliabilities for the LCQ-IP and 4 Newly Developed Subscales.

Factor	Number of Items	Mean (SD)	α
1: Psychological Safety	7	3.97 (0.59)	.883
2: Prioritization of Quality	5	4.01 (0.63)	.840
3: Supportive Work Environment	4	3.43 (0.71)	.767
4: Improvement Orientation	3	4.43 (0.52)	.724
Total scale	19	3.94 (0.52)	.926

Abbreviations: LCQ-IP, Leading a Culture of Quality in Infection Prevention; SD, standard deviation.

Table 4. Relationship Between Presence of CLABSI Policies and LCQ-IP.^a

Number of CLABSI Policies	n	Total Climate Score (Mean)	SD
0	19	69.5	8.7
1	4	67.3	15.4
2	8	72.9	9.1
3	26	73.1	10.4
4	105	74.0	10.3
5	702	75.3	9.7

Abbreviations: CLABSI, central line-associated bloodstream infection; LCQ-IP, Leading a Culture of Quality in Infection Prevention; SD, standard deviation.

^aP value from analysis of variance = .047.

psychometric analyses in other samples (ie, physicians, allied health professionals), with multiple respondents and with assessment of test-retest reliability. This is especially important because previous researchers have found that staff report climate differently based on their profession.²⁰ Finally, although the research team examined criterion validity based on the presence of evidence-based guidelines, and previously it has been found that the presence of these guidelines is associated with lower infection rates, the team was not able to test the predictive validity of the LCQ-IP using infection rates.

Conclusion

Examining the organizational climate, particularly regarding infection prevention, has become a priority in health care. This study contributes to the field by evaluating the psychometric properties of an instrument that might be used to facilitate the examination: the LCQ-IP. This study found that the LCQ-IP captures core dimensions of an infection prevention climate and performs well on several psychometric measures used to assess the quality of an instrument. Thus, the LCQ-IP may

be a helpful tool for researchers and health care providers who aim to assess hospitals' climates for quality specifically related to infection prevention and control. Furthermore, this instrument may be modified and could be useful in assessing other quality-related climates.

Declaration of Conflicting Interests

The authors declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Dr Pogorzelska-Maziarz has served as a consultant to Becton, Dickinson and Company. All other authors report no conflicts of interest.

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