

## ON-LINE TECHNICAL APPENDIX

### **“Not another safety culture survey”: Using the Canadian Patient Safety Climate Survey (Can-PSCS) to measure provider perceptions of PSC across health settings**

**Authors:** Ginsburg, L.; Tregunno, D.; Norton, P.G.; Mitchell, J.I.; Howley, H.

#### **Canada’s accreditation system and processes for survey data collection**

- Canada’s accreditation system has influenced global accreditation standards<sup>1</sup> and is one of the most comprehensive systems internationally<sup>2</sup> with over 1,100 organizations (located in over 5,500 sites) across the continuum of care participating in Accreditation Canada programs.
- The Accreditation Canada program, its standards, and surveyor training program all have certification from the International Society for Quality in Healthcare (ISQua).
- The accreditation process operates on a four-year cycle. During each cycle organizations distribute the PSC Survey for completion. Organizations use the on-line version of the Can-PSCS accessed through their Accreditation Canada portal.
- Following the recommendations for electronic surveys<sup>3</sup>, organizations typically send out reminder invitations one to two weeks after the initial invitation inviting staff to complete a survey.
- To allow for anonymous survey completion, no unique identifiers or trackable links are retained.
- Respondents are asked to indicate their job category (i.e., direct care, organization leadership, facility support, administrative support, clinical support) and, if the organization wants their results to be linked back to the relevant work/program area, they are asked to indicate their work area as well (e.g., operating room, long term care, ambulatory care, home care, community outreach, etc.).

#### **Survey Revision Process**

The revision process involved four steps:

- (1) A review of the literature related to “staff willingness to talk about errors” identified several recurring themes including: “Safer/better not to speak up”, “Why talk about errors? Nothing gets done”, “Worry about job/promotion loss”, “Concern over damage to professional reputation”, “Fear of social exclusion”, and “Shame/personal failure”;
- (2) For each of these themes, three to four survey items were identified from existing surveys or were newly created;
- (3) Twenty-six items underwent cognitive testing in a series of six group interviews with RNs, RPNs, allied health professionals and healthcare aides in three organizations (one teaching hospital, one community hospital, one nursing home);
- (4) Based on clarity and importance ratings,<sup>4</sup> variability on each item, as well as item feedback from interviewees, 20 items pertaining to *Communicating and talking about errors* were selected for further validation and were included on the 2010 version of the survey.

### **Chi-square values in CFA**

- The chi-square test, normed chi-square value, comparative fit index (CFI), and the root mean square error of approximation (RMSEA) were used to evaluate model fit in CFA-1, CFA-2, CFA-4 and CFA-6.
- While a non-significant chi-square ( $P > 0.05$ ) is desirable and suggests the model adequately represents the data, it can be difficult to achieve with large samples. The relative / normed chi-square value, which is the chi-square to df ratio, has been suggested as an alternate index that is less dependent on sample size. Good fit is indicated for values less than two<sup>5</sup> or three.<sup>6</sup>
- CFI takes sample size into account and RMSEA is a residual-based index that takes model complexity (e.g. number of parameters) into account<sup>7</sup> and is scaled such that a lower value indicates better fit. Models with CFI values greater than 0.95 and RMSEA values less than .06 are indicative of good model fit.<sup>8</sup> These criteria have been used in previous medical education research.<sup>9</sup>

### **CFA Results**

- CFA-1 tested the seven-factor model of PSC and included all 33 items ( $\chi^2 = 4095.45$ ,  $df = 474$ ,  $p = .000$ , CFI = 0.926, RMSEA = 0.050, GFI = 0.920, AGFI = 0.906, relative  $\chi^2 = 8.64$ ).
- The model did not demonstrate good fit. The modification indices and examination of the standardized residuals highlighted ten items not well accounted for by the model (a particularly high standardized residual for the covariance between two variables suggests the relationship between those variables is not well accounted for by the model).
- Prior to removing any items, careful consideration was given to the content of the item. From a theoretical standpoint these ten items were felt to have a fairly high degree of redundancy with other items on the survey or were noted to have had ongoing interpretation problems (see Table 1).
- The retrofitted seven-factor, 23-item model produced good model fit in CFA-2 ( $\chi^2 = 1134.97$ ,  $df = 209$ ,  $p = .000$ , CFI = 0.971, RMSEA = 0.038, GFI = 0.968, AGFI = 0.957, relative  $\chi^2 = 5.43$ ).
- However, the results of CFA-3 did not support invariance across the five care settings (baseline model CFI = 0.944, RMSEA = 0.023), relative  $\chi^2 = 5.43$ ).
- Removal of 4 additional items (OL\_22 and the remaining three items in the negatively phrased supervisory leadership dimension) reduced the number of items with standardized residuals  $>2.58$  (the recommended cutoff) from 24 down to 5.
- This further retrofitted six-factor 19-item model produced good model fit in CFA-4 ( $\chi^2 = 641.63$ ,  $df = 137$ ,  $p = .000$ , CFI = 0.981, RMSEA = 0.035, GFI = 0.978, AGFI = 0.970, relative  $\chi^2 = 4.68$ ).
- CFA-4 was considered optimal in representing the observed data. In order to avoid fitting the model to trivial artefacts of the data further improvements in model fit were not carried out.<sup>7</sup> and the model was cross-validated in a separate sample in CFA-6 ( $\chi^2 = 906.07$ ,  $df = 137$ ,  $p = .000$ , CFI = 0.983, RMSEA = 0.033, relative  $\chi^2 = 6.61$ ). The final path diagram is shown in Figure 1.
- The results of CFA-5 support invariance across the five care settings (baseline model CFI = 0.960, RMSEA = 0.021, GFI = 0.936, AGFI = 0.923, relative  $\chi^2 = 2.19$ ).

- The results of the *invariance testing* suggest that the measurement model (e.g. the factor loading parameters) is invariant across the five care settings in our study (model 1  $\Delta\chi^2_{(26)} = 44.94$   $p = .012$ ,  $\Delta CFI = .001$ ). Given the highly significant chi-square difference in model 2, structural invariance (e.g. factor covariances) of the model remains equivocal despite the acceptable  $\Delta CFI$  (model 2  $\Delta\chi^2_{(68)} = 177.32$ ,  $p = .000$ ,  $\Delta CFI = .007$ ). These results, which provide full support for measurement invariance and partial support for structural invariance, indicate that the number of factors and their items (e.g., the meaning of the six PSC factors) is consistent across these different groups of health professionals. The partial support for structural invariance in CFA-5 may reflect real world differences in how the six factors in the model *relate to one another* in the eyes of staff working in these different care settings.<sup>10,11</sup>

**Discriminant Validity Analysis**

- The Fornell and Larcker<sup>12</sup> discriminant validity test is suggested as the best approach.<sup>13</sup> To use this approach we calculated the shared variance (square of the correlation between the two latent constructs (dimensions)) and the average variance extracted (AVE) estimate. The AVE is the average amount of variation that a latent construct is able to explain in the observed variables to which it is theoretically related. It is calculated as the average of the squared factor loadings for all observed variables related to the latent construct.
- Using this technique discriminant validity is supported when the AVEs for each variable exceed the shared variance between two variables. It is calculated for each pair of latent variables in the model.<sup>14</sup>
- The calculations are based on the factor loadings and correlations between latent variables shown in figure 1 (CFA-6 – the validation model). The results are shown below. Column A shows the AVE calculations. Table B shows the shared variance.
- Using this approach, discriminant validity is supported for all dimensions with the exception of the Incident follow-up dimension which shares variance with safety leadership commitment at the organization and unit levels (three grey highlight shared variances in Column B exceed AVE for the IFU dimension).

COLUMN A				COLUMN B					
	<b><u>loading</u></b>	<b><u>load sq</u></b>	<b><u>AVE</u></b>	<b><u>SHARED VARIANCE (sqr corr between 2 vars)</u></b>					
EOCI	0.77	0.59	0.53		EOCI	EOCII	OL	UL	SL
	0.72	0.52		EOCI					
	0.69	0.48		EOCII	0.50				
EOCII	0.76	0.58	0.52	OL	0.06	0.01			
	0.78	0.61		UL	0.10	0.02	0.35		
	0.61	0.37		SL	0.11	0.03	0.45	0.48	
OL	0.83	0.69	0.55	IFU	0.09	0.01	0.61	0.56	0.66
	0.74	0.55		-----					
	0.76	0.58		EOCI = Enabling Open Communication I: judgment-free environment					
	0.63	0.40		EOCII = Enabling Open Communication II: job repercussions of error					
UL	0.76	0.58	0.67	OL = Organizational (senior) leadership support for safety					
	0.86	0.74		UL = Unit learning culture					
	0.88	0.77		SL = Supervisory leadership for safety					
	0.77	0.59		IFU = Incident follow up					
SL	0.88	0.77	0.68						
	0.76	0.58							
IFU	0.71	0.50	0.47						
	0.68	0.46							
	0.67	0.45							

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