AN ANALYTIC APPROACH TO IDENTIFYING VARIATIONS IN PERCEPTIONS OF ORGANIZATIONAL CULTURE BETWEEN THE ICUs OF A SINGLE INSTITUTION

by

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Organizational culture has been shown to be associated with intensive care unit job performance and patient outcomes. These findings have led to recommendations to improve the safety climate in ICUs. While ICUs within a single hospital may be expected to have similar climates, previous research has pointed to variations between ICUs. Also, ICU directors' assessments of their personnel's experiences may not be accurate. The purpose of this thesis was to determine whether variations in organizational culture exist between the ICUs of a single institution and between different types of personnel, as well as to assess the accuracy of ICU directors' perceptions of personnel attitudes.

The personnel of four ICUs within a single hospital were surveyed using the Safety Attitudes Questionnaire – ICU, which was designed to assess organizational culture across six factors: teamwork climate, perceptions of management, safety climate, stress recognition, job satisfaction, and work environment. Mean and percent positive scores (percentage of scores $\geq$75 on a 0-100 point scale) were calculated for each ICU and for each job type across ICUs. Generalized estimating equations were used to model each factor score by job type while accounting for a possible clustering effect due to ICU membership. Directors were asked to estimate their personnel's mean factor scores and differences between director estimates and actual scores were assessed using the Wilcoxon signed rank test.

Scores were found to differ significantly across ICUs for all factors except stress recognition. Scores for job satisfaction, perceptions of management, and working conditions were found to differ significantly between physicians and nurses. ICU directors tended to overestimate the attitudes of their personnel, however the overestimation was not found to be significant.

The results suggest that assessments based on hospital level analysis or director opinion may not be sufficient. It is seemingly important to account for differences between ICUs, as well as between personnel types, when creating policies affecting organizational culture. The public health relevance of this thesis is in determining a unit of analysis for organizational culture assessments to improve job performance of ICU personnel, and subsequently, to hopefully improve patient outcomes.

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PREFACE

I would like to thank my thesis advisor, Dr. Lisa Weissfeld, for her guidance while working on this project. I would also like to thank Dr. David Huang and the CRISMA Laboratory, for giving me the opportunity to work on this project and expand my research experience, and Dr. Lan Kong and Dr. Derek Angus for being my committee members. Finally, I would like to acknowledge my husband, Patrick, and my parents and siblings for their continual love and encouragement in all of my endeavors.

1. Introduction

The impact of organizational culture on job performance and outcomes, while long acknowledged in industry (Helmreich, Foushee, and Benson., 1986, Sexton and Klinect, 2001, Itoh and Anderson, 1999), has only recently been recognized in healthcare. Organizational culture can be measured by personnel attitudes to various job-related factors, such as teamwork and perceptions of management personnel. Wheelan et al. have applied group theory to the study of the relationship between teamwork and patient outcomes. According to this perspective, groups move through successive stages of development, with only more highly functioning groups performing effectively. Higher level groups are characterized by having trust between members, superior teamwork, and cooperation regarding goals and division of labor. This and other studies have found that higher levels of teamwork between ICU personnel were significantly associated with lower lengths of stay (Knaus et al., 1986) and lower mortality in adult ICUs (Baggs, Schmidt, Mushlin, et al., 1999, Wheelan, Burchill, Tilin, 2003). Pollack et al. found that higher levels of organizational processes that reflect staff collaboration were associated with lower incidence of complications in neonatal ICUs (Pollack, Koch, 2003). Studies have also reported high levels of job dissatisfaction among hospital nurses and that there is an association between high nurse-patient ratios and nurse effectiveness and a negative

association between high ratios and mortality (Aiken, Clarke, and Sloane, 2002, Aiken, Sloane, and Lake, 1999). These findings have lead to recommendations for improving organizational culture, particularly in the areas of safety (Institute for Healthcare Improvement, 2003), communication (Joint Commission on Accreditation of Healthcare Organizations, 2003), and teamwork (Committee on the Health Professions Education Summit, 2003).

In order to go about improving the organizational culture of ICUs, the current climate must be assessed to determine a starting point (Institute for Healthcare Improvement, 2003). The first step is to establish the appropriate unit of analysis. Some researchers have chosen to examine the hospital as a whole, assuming that ICUs within a single institution would have similar organizational cultures (Sirio, Shepardson, Rotondi, et al., 1999). While the latter approach is straightforward and less time-consuming, previous research in antibiotic sensitivity has shown significant variations between ICUs within a single hospital (Namias, Samiian, Nino, et al., 2000). It therefore is best to assume that organizational culture may also vary between ICUs, particularly because the relationships between employees and between employees and management will depend upon the unique combination of individuals working within each ICU. Another approach used to evaluate organizational culture is to survey only supervisors, treating them as representatives for all employees they oversee (VHA/American Hospital Association, 2001). It has been shown that the perceptions of supervisors are not accurate measures of the true organizational culture, as they are often not aware of the actual experiences of their staff (Fiske, 1993).

The purpose of this thesis is to determine whether organizational culture varies among the ICUs of a single hospital, to investigate the concordance between ICU

directors' perceptions and attitudes of their personnel, and to explore differences in attitudes between physicians and nurses, while accounting for ICU membership. The Safety Attitudes Questionnaire – ICU Version (SAQ-ICU) was administered to the personnel of four ICUs of a single institution to assess attitudes toward six organizational factors. Directors were asked to estimate the mean scores of their ICU for each of the factors. The investigation of variations between ICUs was accomplished by using ANOVA to compare personnel attitudes across the six factors. Differences between directors' predictions and actual mean scores were assessed using the Wilcoxon signed rank test. Variation in attitudes between physicians and nurses were explored by using a generalized estimating equations approach to account for clustering effects of ICU membership. Wald statistics were calculated to test hypotheses regarding the comparisons between physicians and nurses.

2. Safety Attitudes Questionnaire – ICU Version

2.1. History of the SAQ-ICU

The aviation industry has historically been the most thorough in investigating the effect of human factors on job outcomes. After working to determine how accidents and errors could be prevented, it was found that communication problems were the cause of most accidents. It is estimated that as much as 70% of aviation accidents are at least partially due to human error (Billings and Reynard, 1984). The National Aeronautics and Space Administration (NASA) created the idea of Crew Resource Management (CRM) in 1979. This management concept, which promotes the role of human factors and teamwork in high stress environments (Cooper, White, and Lauber, 1980), has become a requirement during training in the aviation industry (Helmreich and Foushee, 1993). The improvements in aviation safety in recent years are attributed, by many experts, to the adoption of the CRM. The Cockpit Management Attitudes Questionnaire (CMAQ) resulted from the need to be able to quantify levels of communication and teamwork, without the time-consuming task of directly observing cockpit crew members. The CMAQ has been improved though several validation samples and has been shown to predict performance. (Helmreich, Foushee, Benson, et al, 1986). The role of the CRM and CMAQ in medicine has been the subject of both interest and debate.

In a study by Sexton and collegues, the CMAQ was modified for use in ICUs and was called the Intensive Care Unit Management Attitudes Questionnaire. After validating the survey across a variety of clinical settings, including operating rooms and ambulatory clinics, it was then refined into the Safety Attitudes Questionnaire (SAQ) (Thomas, Sexton, Helmreich, 2003). The SAQ was created to evaluate six safety factors: teamwork climate, job satisfaction, perceptions of management, safety climate, working conditions, and stress recognition (Table 1). These factors were chosen based on previous research that showed associations between the factors and improved outcomes. The SAQ was first used to evaluate 106 ICUs in the United Kingdom's Intensive Care National Audit and Research Centre (ICNARC) and was compared with data that was obtained using methods previously shown to accurately measure organization factors. Sexton's work was the first to psychometrically validate an aviation-based instrument on a large number of ICUs. Additional sample items may be found in the appendix.

Table 1. –SAQ-ICU factor definitions and example items

Scale:	Definition	Example items
Teamwork climate	perceived quality of collaboration between personnel	Our doctors and nurses work together as a well coordinated team
Job satisfaction	positivity about the work experience	I like my job
Perceptions of management	approval of managerial action	Management is doing a good job
Safety climate	perceptions of a strong and proactive organizational commitment to safety	I would feel safe being treated here as a patient
Working conditions	perceived quality of the work environment and logistical support (staffing, equipment etc.)	I have the support I need from other personnel to care for patients
Stress recognition	acknowledgement of how performance is influenced by stressors	I am less effective at work when fatigued

2.2. Design of the SAQ-ICU

The Safety Attitudes Questionnaire was designed to be used as a cross-sectional survey of providers of patient care. Six administrations of the survey were performed in the United States, United Kingdom, and Australia to test the multilevel factor structure. The quality of the survey's psychometric properties was verified by using Cronbach alphas, floor/ceiling effects, item-factor loadings, and inter-factor correlations as measures of reliability for each of the six safety factors. The SAQ-ICU is made up of 64 items, of which certain combinations comprise an employee's perception of one of the six safety factors. For example, six answers are used to quantify perception of teamwork climate. The SAQ has been shown to accurately measure provider attitudes about all six patient-safety factors and can be used to compare provider attitudes across institutions. The survey can also be used to evaluate the effectiveness of interventions to improve attitudes.

3. Methods

3.1. Subjects and Survey Administration

A mailed, self-administered survey was conducted of all personnel in four ICUs within a single, urban, tertiary care hospital between January 1 and April 1, 2003. ICU personnel were defined as personnel regarded by ICU directors as having significant work commitment to the ICU. Lists of personnel to be included in the study were checked by hand for accuracy and validated by the ICU directors. The personnel were categorized into ten different job categories: charge nurses, bedside nurses, nurse manager / head nurse, critical care attending physicians, critical care fellows and residents, non-critical care attending physicians, non-critical care fellows and residents, respiratory therapists, ward clerks, and other. Each employee received a sealed, addressed envelope which contained a cover letter, survey, pencil, and return envelope, by intra-office mail or at staff meetings. Response rates were checked every other week and ICU directors were requested to help increase response when necessary. In order to maintain ICU confidentiality, each ICU was assigned a code which was printed onto each questionnaire for the personnel of the corresponding ICU. The questionnaires did not contain any personal identifiers in order to protect personnel confidentiality. The study design was approved by the University of Pittsburgh's Institutional Review Board. In addition to the survey, the SAQ-ICU requests that respondents write three

recommendations for improving patient safety. Following a preliminary analysis of the data, a coding system was created to standardize responses.

3.2. Quantification of Factor Scores

The surveys were scored using the method developed by the original SAQ-ICU authors (Thomas, Sexton, and Helmreich, 2003). A standard five point Likert Scale was used to measure responses to each item, with the scale ranging from "disagree strongly" to "agree strongly". The responses to negatively worded items were reverse scored. The standard five point scale was then transformed into a scale from 0 to 100, with 100 being optimal, where "disagree strongly" was given a score of 0, "disagree slightly" a score of 25, neutral response a score of 50, "agree slightly" a score of 75, and "agree strongly" a score of 100. The mean score of the items corresponding to a single factor is the factor score. Scores of 75 or greater were considered positive scores. Therefore, in order for a score to be deemed positive, the employee must answer "agree slightly" or higher, on average, to all items related to a particular factor.

Factor scores at the ICU and job category level were calculated two ways. In the first method, the mean scores of all group members are the factor scores. In the second method, the percentages of members who had positive scores (as previously defined) were the factor scores. The factor scores for each ICU were calculated from the scores of the corresponding personnel. The mean scores were used as a point estimate of the

organizational climate within an ICU. The percent positive scores provide a more precise evaluation of the variation in perceptions about a particular factor.

3.3. Quantification of ICU Director Perceptions

The ICU directors, one medical director and one nursing director for each ICU, were given a form that requested an estimate of their ICU's mean score for each of the six organizational factors. The directors' estimates were divided by the actual mean scores so that a ratio greater than 1 demonstrates an overestimation and a ratio of less than 1 demonstrates underestimation. In order to ensure accuracy, the form was applied to three physician directors, who gave feedback which was used to make improvements. The modified form was then given to the four nursing directors and one physician director. Only these final five results are reported and used to make conclusions.

3.4. Analyses

3.4.1. Analysis of Variance and Chi-Square Test for Heterogeneity

The means of the six organizational factor scores were compared across the four ICUs using analysis of variance (ANOVA). The magnitudes of significance levels of the F-statistics were used to determine which of the six organizational factors varied the most overall between ICUs. Percent positive scores were compared across ICUs by the Chi-

square test for heterogeneity. Computations comparing the mean factor scores were done using the ANOVA procedure and computations comparing the percent positive scores using the FREQ procedure, both in the Statistical Analysis Software (SAS) version 8.02.

3.4.2. Wilcoxon Signed Rank Test

Directors' perceptions of ICU culture were compared to the actual ICU scores by calculating a ratio of the factor score estimates over the observed scores. The Wilcoxon signed rank test, a nonparametric analog to the paired t-test, was then used to test the agreement between the two measures across all six organizational factors and stratified by each factor separately. Due to the small sample size of five overall director-to-observed score ratios, it was necessary to compute an exact p-value. The test was done using the Univariate Procedure in the Statistical Analysis Software (SAS) version 8.02, which when the sample size is less than 20, computes the p-value from the exact distribution of the test statistic (SAS Institute, 1999). The Wilcoxon signed rank test assumes that the distribution of the differences is symmetric. SAS uses the following formula when computing the signed rank test:

$$S = \sum r_i^+ - n_t\,(n_t + 1)\,/4$$

where,

r_i^+=the rank of the absolute value of positive difference i , which is the difference between the paired observations (director estimate-actual score), differences equal to zero are not ranked

n_t=the number of positive ranks

3.4.3. Generalized Estimating Equations

Mean factor scores and percent positive scores were to be compared between all nurses (charge nurses and bedside nurses combined) and all physicians (Critical Care attendings, non-Critical Care attendings, Critical Care fellows/residents, and non-Critical Care fellows/residents) across all ICUs. However, because personnel working in the same ICU may tend to have similar attitudes toward organizational factors, it was important to account for possible correlations between responses. In order to adjust for clustering effects of ICU membership, a generalized estimating equations (GEE) approach was used to calculate mean and percent positive scores for each job position. GEE, derived by Liang and Zeger in 1986, is an extension to generalized linear models (GLM) which provides a regression approach when responses are not independent and treats the correlation as a nuisance parameter. It is important to adjust for clustering effects because when correlations are ignored, the variances of between-cluster comparisons may be significantly underestimated, which may affect the results of hypothesis tests. In the GEE approach the model used is:

$$g(\mu_{ij}) = \mathbf{x}_{ij}'\boldsymbol{\beta}$$

where g is the link function, which is a matrix of partial derivatives of the mean, taken with respect to the regression parameters for the i^{th} subject. The equation for estimating the regression coefficients is:

$$\mathbf{S}(\boldsymbol{\beta}) = \sum_{i=1}^{K} \frac{\partial \boldsymbol{\mu}_i'}{\partial \boldsymbol{\beta}} \mathbf{V}_i^{-1} (\mathbf{Y}_i - \boldsymbol{\mu}_i(\boldsymbol{\beta})) = \mathbf{0}$$

The working covariance matrix, V_i, is specified in terms of a diagonal matrix of variance terms with the correlation matrix.

$$\mathbf{V}_i = \phi \mathbf{A}_i^{\frac{1}{2}} \mathbf{R}(\alpha) \mathbf{A}_i^{\frac{1}{2}}$$

where: Φ = the over-dispersion parameter which accounts for variation of responses not accounted for by the diagonal matrix of variance terms

(Liang and Zeger, 1986).

GEE uses a working estimate of the structure of the correlation, $R_i(\alpha)$. In this case, an exchangeable working correlation was specified, because the observations are clustered, rather than collected over time, in which case another type of correlation matrix would be appropriate (Hardin and Hilbe, 2001). In an exchangeable correlation matrix, the alpha is estimated by:

$$\hat{\alpha} = \frac{1}{(N^* - p)\phi} \sum_{i=1}^{K} \sum_{j \neq k} e_{ij} e_{ik}$$

where:

$$N^* = \sum_{i=1}^{K} n_i (n_i - 1)$$

(Liang and Zeger, 1986).

In order to estimate the working correlation matrix, an iterative algorithm alternates between a weighted least squares (WLS) step, to calculate the estimates of the linear coefficients (β), and a step based on Pearson residuals, calculated by

$$e_{ij} = \frac{y_{ij} - \mu_{ij}}{\sqrt{v(\mu_{ij})}},$$

to update the estimates of the correlation (SAS Institute, 1999). The WLS step is first done using the standard GLM approach to estimate β, which assumes independence. The working correlation matrix is then calculated based on the Pearson residuals and the covariance is estimated using the above equation for V_i. The coefficient estimate is then updated and this algorithm iterates until β converges. Because this method of estimation is not likelihood-based, inferences based on likelihood are not possible in the GEE approach (Liang and Zeger, 1986).

An important advantage of GEE is that as long as the model that has been specified for the mean is correct, the estimates of the regression coefficients and the covariance of the coefficients are correct regardless of whether the correlation structure has been accurately specified. Correctly specifying the correlation structure does, however, improve efficiency (Liang and Zeger, 1986).

In order to calculate the mean scores for each job category, the responses were assumed to be normally distributed and an identity link function was specified. When modeling the percent positive scores, the responses were binomially distributed and a logit link was specified. Differences between nurses and physicians mean scores were tested using Wald statistics to compare regression coefficients. The Wald test has the advantage over the Likelihood Ratio test of being more flexible in testing various

hypotheses. It requires only an unrestricted model, rather than both the restricted and unrestricted models, which allows one to present separate results for the groups being tested (Liao, 2004). In this case, the null hypothesis being tested was H_o: $\beta_{physician} = \beta_{nurse,}$ which is equivalent to a null hypothesis of

H_o: $\beta_{physician} - \beta_{nurse} = 0$. Therefore, the Wald statistic to be tested was of the following form:

$$W = (\beta_{physician} - \beta_{nurse}) \,/\, \text{standard error}\,(\beta_{physician} - \beta_{nurse})$$

where:

$$\text{standard error}\,(\beta_{physician} - \beta_{nurse}) = \sqrt{[\text{variance}\,(\beta_{physician}) + \text{variance}\,(\beta_{nurse}) - 2\,\text{covariance}\,(\beta_{physician}, \beta_{nurse})]}$$

4. Results

4.1 Survey Response

There were 453 total eligible subjects in the four ICUs. Surveys were returned by mail for an overall response rate of 70.2% (Table 2).

Table 2. – Unit personnel demographics and response rates

Job Category	N	Surveys received	% Response rate	Age mean (SD)	Gender (%female)	Years of experience	Years of experience in this ICU
Nurses	241	175	72.6	35.3 (8.4)	76.0	8.7 (8.6)	5.4 (5.4)
Charge Nurses	99	60	60.6	37.7 (8.6)	80.0	11.4 (7.3)	7.8 (5.4)
Bedside Nurse	138	111	80.4	34.0 (8.1)	73.9	7.3 (8.9)	4.1 (4.9)
Nurse Manager/Head Nurse	4	4	100.0	-	-	-	-
Physicians	140	69	49.3	38.5 (8.6)	8.7	7.7 (6.5)	6.5 (5.5)
Critical Care Attendings	23	16	69.6	40.7 (11.6)	6.3	10.1 (5.9)	6.6 (4.6)
Critical Care Fellows/Residents	18	13	72.2	34 (6.1)	15.4	2.8 (4.9)	1.8 (3.2)
Non-Critical Care Attendings	58	25	43.1	42.9(6.3)	0.0	11.2 (6.6)	7.5 (6.9)
Non-Critical Care Fellows/Residents	41	15	36.6	32.5(2.4)	20.0	3.6 (2.2)	2.3 (2.3)
Respiratory Therapists	39	26	66.7	39.8(10.5)	34.6	11.8 (7.5)	6.0 (5.6)
Ward Clerks	21	15	71.4	43.1(12.1)	80.0	9.7 (9.3)	6.2 (8.6)
Other*	12	11	91.7	-	-	-	-
No Job Category Listed	NA	22	NA	-	-	-	-
TOTALS	453	318	70.2				

- includes Nurse Aide/Assistants, Nurse Practitioner/Physician Assistants, Pharmacists, Social Workers, and Dietitians.

Overall, nurses had a greater response rate than physicians, with 72.6% of nurses and 49.3% of physicians responding. Critical care physicians had a greater response than non-critical care physicians (70.7% versus 40.4%). ICUs with more personnel tended to have higher response rates (Table 3). Nurses made up 53.2% of ICU personnel and returned 55% of the surveys.

Table 3. – Number of personnel, returned surveys and % response rate, by ICU

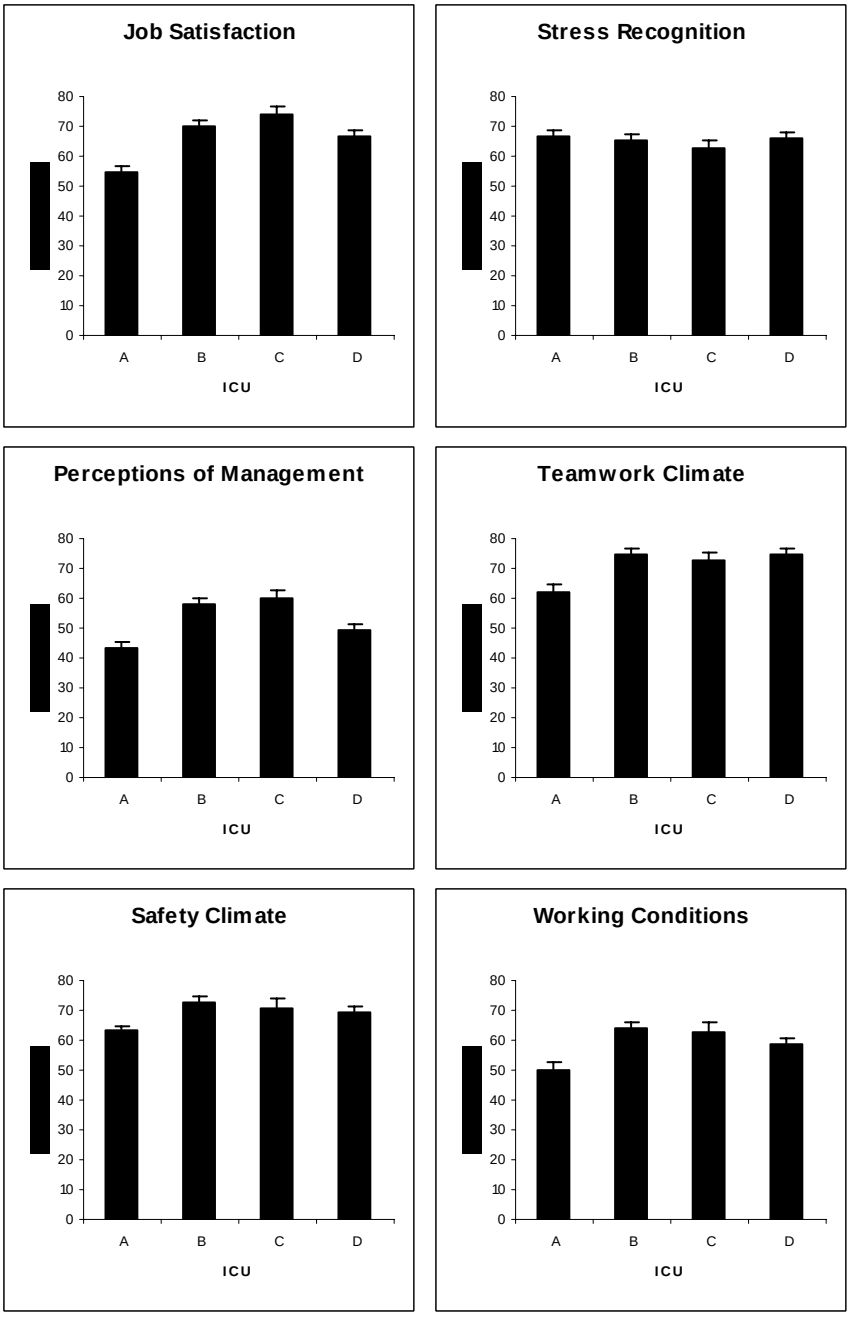
ICU	# of personnel	# of returned surveys	% response
A	99	66	66.7%
B	64	41	64.1%
C	142	108	76.1%
D	133	98	73.6%
ICU not identified*	15	5	NA
Total	453	318	70.2%

*For 15 personnel it could not be determined prior to survey distribution in which ICU they primarily worked. These personnel were asked to indicate their primary ICU on their returned surveys; 5 did not.

4.2 Organizational Culture Factor Variability by ICU

Factor scores were relatively low across all factors, with mean scores ranging from 43.4 to 74.9 out of 100 and percent positive scores ranging from 8.6 to 69.4 overall. No ICU had consistently high or low scores across all factors. All mean scores, except

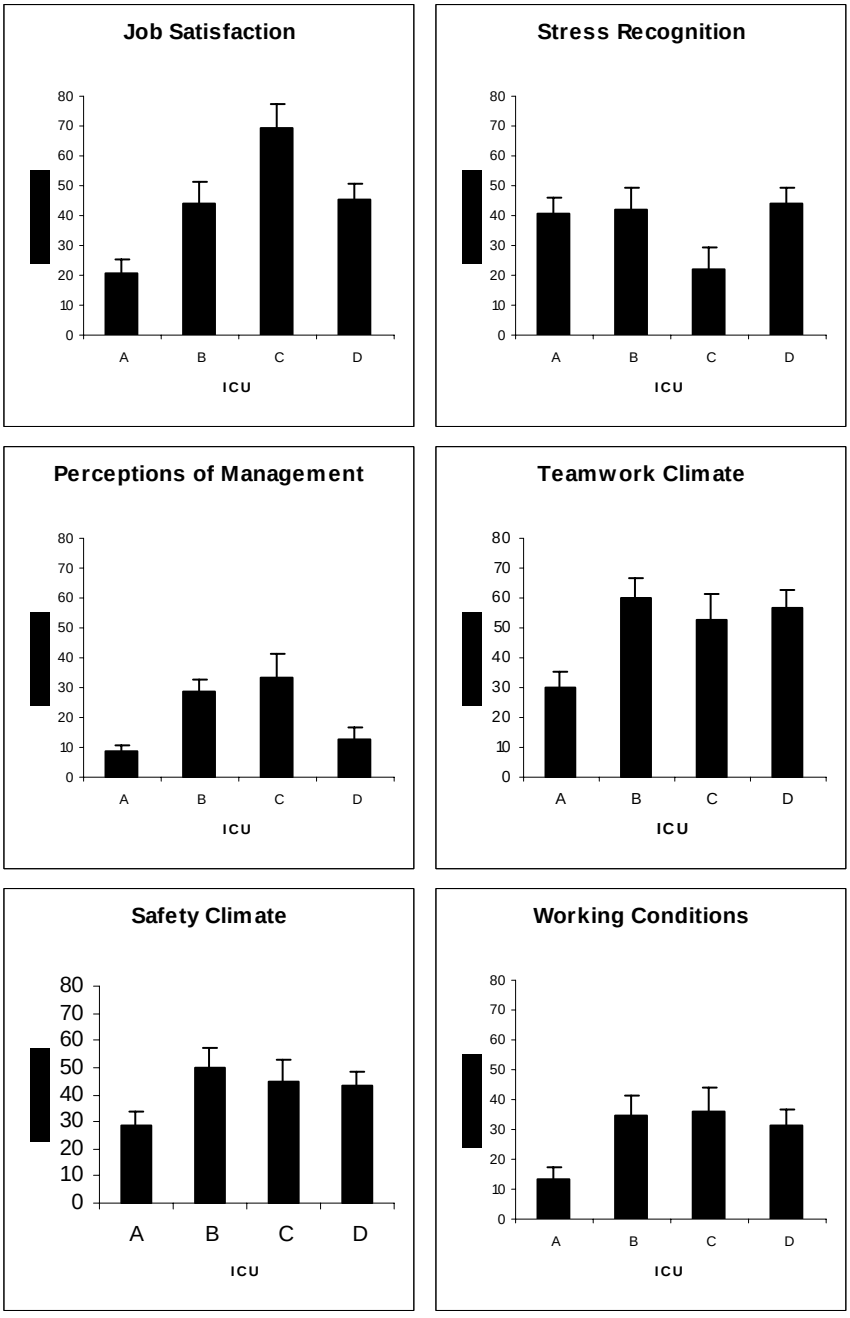
stress recognition scores (p=0.369), were shown to be significantly different across ICUs by ANOVA (Figure 1).



Error bars=standard error

Figure 1. – Mean safety attitude scores by ICU

Similarly, all percent positive scores, with the exception of stress recognition (p=0.09) were shown to be significantly different across ICUs by Chi-square (Figure 2).



Error bars = standard error

Figure 2. – Percent positive safety attitude scores by ICU

4.3 Director Perceptions versus Actual Factor Scores

Taken as a whole, ICU directors tended to overestimate their personnel's factor scores (Figure 3), however the overestimation was not statistically significant (p=0.31) by the signed rank test. Teamwork scores were the most overestimated, with all directors' estimates exceeding the actual scores with a mean overestimate of 15%. When the results were stratified by the six factor scores, there was marginally significant discordance between director estimates and actual scores for teamwork climate (p=0.0625).

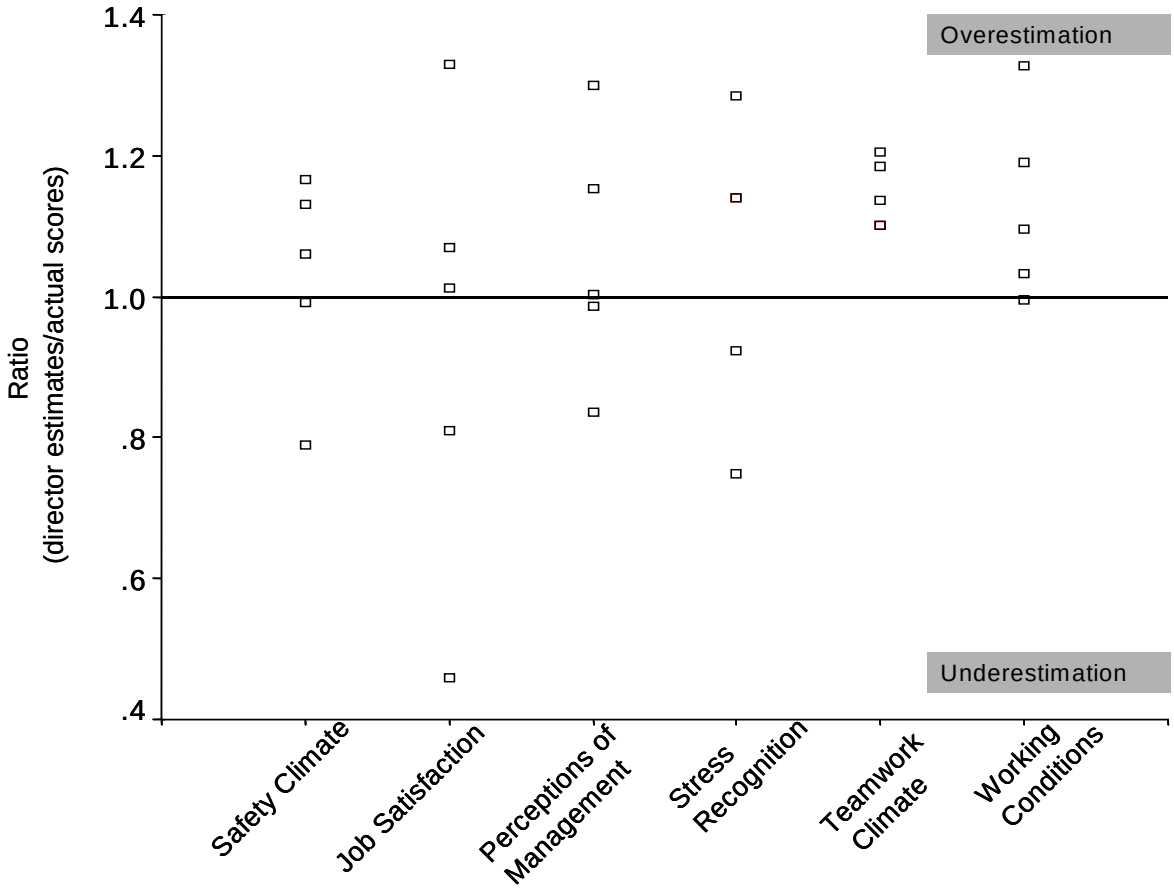


Figure 3. – Ratios of ICU director estimates of their ICUs' safety attitudes to the actual scores

4.1. Patient Safety Recommendations

Of the 162 respondents (50.9%) who wrote-in recommendations for patient safety, 116 (71.3%) were nurses. There were 379 total recommendations, the four most common of which were to "Improve Staffing" (35%), "Improve Education" (12%), "Improve Teamwork" (12%), and "Improve Equipment" (12%). Only eight respondents (2.1%) suggested "Higher Salary / Compensation".

4.2. Organizational Culture Factor Variability by Type of Personnel

Overall nurses had lower factor scores than physicians, however, only job satisfaction, perceptions of management, and working conditions were shown to be significantly different ($p<0.05$) by Wald tests comparing regression coefficients for mean scores (Table 4).

Table 4. – Mean Scores: Estimates of GEE Regression Coefficients (Standard Errors in Parentheses) and Wald Test P-Values for Comparing Nurses and Physicians by Factor

Factor	β_{Nurse}	$\beta_{Physician}$	P-Value
Teamwork Climate	-3.83 (4.55)	2.82 (2.27)	0.060
Job Satisfaction	-6.98 (3.43)	-1.25 (3.53)	0.015
Perceptions of Management	-3.63 (1.4)	5.75 (3.91)	0.001
Safety Climate	-2.49 (3.29)	1.19 (1.61)	0.144
Working Conditions	-4.21 (2.41)	10.73 (2.16)	<0.001
Stress Recognition	6.46 (2.08)	8.90 (2.15)	0.352

The mean scores for teamwork climate were marginally different between nurses and physicians (p=0.06). For percent positive scores, the regression coefficients and results of Wald tests are shown in Table 5.

Table 5. – Percent Positive Scores: Estimates of GEE Regression Coefficients (Standard Errors in Parentheses) and Wald Test P-Values for Comparing Nurses and Physicians by Factor

Factor	β_{Nurse}	$\beta_{Physician}$	P-Value
Teamwork Climate	-0.304 (0.270)	0.156 (0.189)	0.171
Job Satisfaction	-0.782 (0.261)	0.222 (0.332)	0.025
Perceptions of Management	-0.355 (0.289)	-1.184 (0.366)	0.144
Safety Climate	-0.199 (0.176)	-0.261 (0.156)	0.810
Working Conditions	-0.988 (0.159)	-0.402 (0.207)	0.019
Stress Recognition	-0.124 (0.161)	-0.344 (0.132)	0.384

Only job satisfaction and working conditions had significantly different ($p<0.05$) percent positive scores. Mean and percentage of scores defined as positive are shown in Table 6.

Table 6. – Mean and percent positive safety attitude scores, by job category

	Teamwork Climate		Job Satisfaction		Perceptions of Management		Safety Climate		Working Conditions		Stress Recognition	
	Mean	% Positive	Mean	% Positive	Mean	% Positive	Mean	% Positive	Mean	% Positive	Mean	% Positive
Nurses[1,2]	68.78*	46.19	63.21*	36.39*	48.92*	17.69	67.67	36.39	53.94*	19.64*	66.66	38.59
Charge Nurses	66.02	43.85	59.48	23.81	42.94	10.17	65.07	32.23	48.93	13.38	67.72	44.29
Bedside Nurses	70.74	47.97	65.78	44.88	52.94	18.48	69.43	42.44	57.44	23.65	66.02	35.06
Physicians[2]	75.44	57.88	68.95	53.93	58.29	30.20	71.36	46.08	68.88	49.56	69.10	46.09
Critical Care Attendings	77.08	62.95	65.47	52.35	49.92	13.33	68.96	34.22	67.08	35.23	74.97	60.26
Critical Care Fellows/Residents	72.76	42.35	68.62	50.69	59.94	30.77	73.62	53.45	70.01	61.09	70.18	38.73
Non-Critical Care Attendings	75.96	62.74	73.82	97.19	67.46	47.62	72.90	56.16	69.24	60.82	64.26	38.44
Non-Critical Care Fellows/Residents	74.58	59.55	64.97	41.77	50.84	9.09	69.24	35.44	69.49	35.33	69.30	54.93
Respiratory Therapists	76.85	49.89	71.00	70.48	50.05	8.00	68.61	29.56	57.45	26.82	60.54	28.19
Wards Clerks	65.09	40.04	63.82	60.59	54.65	19.99	69.42	46.95	53.18	13.08	59.83	40.33
Range Width	11.76	22.91	14.34	73.38	24.52	39.62	8.55	26.60	21.08	48.01	15.14	32.07

[1] Does not include Nurse Managers (n = 4)

[2] Only Nurses and Physicians scores were compared to each other

* $p < .05$ by Wald Test (Mean Teamwork Climate score (p=.06) marginally significantly different)

5. Discussion and Conclusions

The purpose of this study was to determine whether organizational culture varies among the ICUs of a single hospital, to investigate the concordance between ICU directors' perceptions and attitudes of their personnel, and to explore differences in attitudes between physicians and nurses, while accounting for ICU membership. The results of the analysis of variance and chi-square tests for differences between ICUs show that organizational culture does, indeed, differ significantly between the ICUs of a single institution. The differences were found to be most prominent for job satisfaction and working conditions. ICU directors' estimates of the attitudes of their personnel tended to be overestimates of the actual scores, but this difference was not found to be significant by the signed-rank test. When looking at the factors separately, the difference between the estimated and actual scores was greatest for teamwork, with the difference being marginally significant. Nurses were found to have mean scores which were significantly lower than physicians in job satisfaction, perceptions of management, and working conditions, with teamwork being marginally significantly lower. Nurses also had percent positive scores for job satisfaction and working conditions which were significantly lower.

These results suggest that it is important to assess organizational culture at the ICU level, rather than at the hospital level. Also, directors' assessments may not accurately reflect the true climate of an ICU. It is also apparent from the results of this study that different types of ICU personnel have significantly different attitudes, even after accounting for ICU membership.

Therefore, it is important to take these differences into consideration when implementing new policies both at ICU-specific and institutional levels.

It is also important to consider that differences may exist between the six organizational factors within a single ICU, and therefore it is desirable to assess individual factors, rather than calculating an overall score for organizational culture. While assessing organizational culture at the ICU level may be more time-consuming, it will lead to policies and interventions that are more specific to the needs of the individual ICUs and will hopefully be more effective in improving job performance.

Potential limitations of this study include the relatively small sample of four ICUs, all of which belong to a single institution. Also, most respondents (55%) were nurses and the remaining 45% of respondents were a combination of 4 personnel types. However, this disparity reflects the usual composition of an ICU, where the largest percent of personnel are nurses and so it is likely that the attitudes of nurses contribute the most to an ICU's organizational culture.

It has been shown that there is significant variation in organizational culture across the ICUs of a single institution and between the attitudes of different types of ICU personnel. Because of this variation and the discrepancies between ICU directors' estimates and actual personnel scores, assessments that are based on institutional level scores or director estimates are not likely to provide accurate measures of the organizational culture of an ICU. Assessments of personnel at an ICU level which explore multiple organizational domains will result in more reliable measures and will allow for more effective solutions.

APPENDIX A

Safety Attitudes Questionnaire: ICU Version - Additional Sample Items

From: Sexton and Thomas, 2003.

Answers are on a 5 point scale:

Disagree Strongly – Disagree Slightly – Neutral – Agree Slightly - Agree Stongly

1. High levels of workload are common in this ICU
2. I like my job
3. Nurse input is well received in this ICU
4. I would feel safe being treated here as a patient
5. Medical error are handled appropriately in this ICU
6. This hospital does a good job of training new personnel
7. All the necessary information for diagnostic and therapeutic decisions is routinely available to me
8. Working in this hospital is like being part of a large family
9. The administration of this hospital is doing a good job
10. Hospital administration supports my daily efforts
11. I receive appropriate feedback about my performance
12. In this ICU, it is difficult to discuss errors
13. Briefings are important for patient safety
14. Thorough briefings are common in this ICU
15. This hospital is a good place to work
16. When I am interrupted, my patients' safety is not affected
17. All the personnel in my ICU take responsibility for patient safety
18. Hospital management does not knowingly compromise the safety of patients
19. The levels of staffing in this ICU are sufficient to handle the number of patients
20. Decision-making in this ICU utilizes input from relevant personnel
21. This hospital encourages teamwork and cooperation among its personnel
22. I am encouraged by my colleagues to report any patient safety concerns I may have
23. The culture in this ICU makes it easy to learn from the errors of others
24. The hospital deals constructively with problem personnel
25. The medical equipment in this ICU is adequate
26. In this ICU, it is difficult to speak up if I perceive a problem with patient care
27. When my workload becomes excessive, my performance is impaired

28. I am provided with adequate, timely information about events in the hospital that might effect my work
29. I have seen others make errors that had the potential to harm patients
30. I know the proper channels to direct questions regarding patient safety in this ICU

BIBLIOGRAPHY

Aiken LH, Clarke SP, Sloane DM, et al, (2002). Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. *JAMA*, 288, 1987-1993.

Aiken LH, Sloane DM, Lake ET, et al, (1999). Organization and outcomes of inpatient AIDS care. *Med Care*, 37, 760-772.

Baggs JG, Schmitt MH, Mushlin AI, et al, (1999). Association between nurse-physician collaboration and patient outcomes in three intensive care units. *Crit Care Med*, 27, 1991-1998.

Billings CE, Reynard WD, (1984). Human factors in aircraft incidents: Results of a seven year study. *Avait Space Environ Med,* 55, 960-65.

Committee on the Health Professions Education Summit, Institute of Medicine (2003). Greiner C.A., Knebel E (Eds). Health Professions Education: A Bridge to Quality.

Cooper GE, White MD, Lauber JK, (1980). Resource management on the flightdeck: Proceedings of a NASA / Industry Workshop. Moffet Field, CA: NASA – Ames Research Center. NASA Conference Publication No. CP-2120.

Fiske ST (1993). Controlling Other People - the Impact of Power on Stereotyping. *Am Psychol*, 48, 621-628.

Hardin JW, Hilbe JM, (2002). *Generalized Estimating Equations*. New York: Chapman and Hall / CRC.

Helmreich RL, Foushee HC, (1993). Why crew resource management? Empirical and theoretical bases of human factors in training and aviation. In Weiner E, Kanki BG, Helmreich RL, (Eds.), *Cockpit Resource Management* (pp. 3-45). San Diego: Academic Press.

Helmreich RL, Foushee HC, Benson R, et al, (1986). Cockpit resource management: Exploring the attitude-performance linkage. *Aviat Space Environ Med* , 57, 1198-1200.

Institute for Healthcare Improvement (2003). *Institute for Healthcare Improvement*, 12-7-2003.

Itoh K, Andersen HB, (1999). Motivation and morale of night train drivers correlated with accident rates. In Karwowski W, Mondelo P, Mattila M, (Eds), *Proceedings of the International Conference on Computer-Aided Ergonomics and Safety*. Barcelona, Spain, May 19-21, 1999. [CD-rom], CAES.

Joint Commission on Accreditation of Healthcare Organizations (JCAHO) National Patient Safety Goals, (2003). *JCAHO*; 12-7-2003.

Knaus WA, Draper EA, Wagner DP, et al, (1986): An evaluation of outcome from intensive care in major medical centers. *Ann Intern Med*, 104, 410-418.

Liang, KY, Zeger, SL, (1986). Longitudinal data analysis using generalized linear models. *Biometrika*, 73 (1) 13-22.

Liao, TF, (2004). Comparing social groups: Wald statistics for testing equality among multiple logit models. *International Journal of Comparative Sociology*, 45 (1-2) 3-16.

Namias N, Samiian L, Nino D, et al (2000). Incidence and susceptibility or pathogenic bacteria vary between intensive care units within a single hospital: Implications for empiric antibiotic strategies. *Journal of Trauma-Injury Infection and Critical Care*, 49, 638-645.

Pollack MM, Koch MA, (2003). Association of outcomes with organizational characteristics of neonatal intensive care units. *Critical Care Medicine*, 31,1620-1629.

SAS Institute Inc. (1999. SAS OnlineDoc®, Version 8, Cary, NC: SAS Institute Inc.

Sexton JB, Klinect JR, (2001). The link between safety attitudes and observed performance in flight operations. In Jensen RS (Ed), *Proceedings of the Eleventh International Symposium on Aviation Psychology*. Columbus, OH, The Ohio State University.

Sexton JB, & Thomas EJ, (2003). The Safety Climate Survey: Psychometric and Benchmarking Properties. *Technical Report 03-03***.** The University of Texas Center of Excellence for Patient Safety Research and Practice (AHRQ grant # 1PO1HS1154401 and U18HS1116401).

Sirio CA, Shepardson LB, Rotondi AJ, et al, (1999). Community-wide assessment of intensive care outcomes using a physiologically-based prognostic measure: Implications for critical care delivery from Cleveland Health Quality Choice. *Chest*, 115, 793-801.

Thomas EJ, Sexton JB, Helmreich RL, (2003). Discrepant attitudes about teamwork among critical care nurses and physicians. *Crit Care Med*, 31, 956-959.

VHA / American Hospital Association, (2001). Strategies for leadership: an organizational approach to patient safety. American Hospital Association.

Wheelan SA, Burchill CN, Tilin F, (2003). The link between teamwork and patients' outcomes in intensive care units. *Am J Crit Care* 2003, 12, 527-534.