Reliability, Risk and Safety – Ale, Papazoglou & Zio (eds)
© 2010 Taylor & Francis Group, London, ISBN 978-0-415-60427-7

Dimensions of healthcare safety climate and their correlation with safety outcomes in Japanese hospitals

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ABSTRACT: The present paper reports a study showing a positive contribution of safety climate to safety performance as well as to staff attitudes to error reporting in healthcare. The study comprises 21,666 staff responses (84% mean response rate) from 84 Japanese hospitals to a "safety climate" questionnaire that also included items about respondents' reporting of their own errors and their interaction with patients who have suffered adverse events. We also obtained incident reports submitted between 2004 and 2006 by nurses from one of the hospitals surveyed. From Spearman's rho applying to 18 work unit data of the hospital, we identified significant negative correlations between the rate of Level 2+ incidents (suffered at least temporal adverse effects) and several safety climate dimensions, e.g., higher staff motivation, stronger awareness of communication, smaller power distance and larger weight of blame-free atmosphere within an organisation. Similarly, correlation analysis of a sample from 82 hospitals of self-reported staff attitudes showed that small power distance, blame free atmosphere, and some other dimension are tied to openness about an adverse event and staff willingness to perform "positive" reactions to the patient.

1 INTRODUCTION

It is widely accepted that safety performance of a healthcare organisation is influenced not only by safety management structure but also safety culture/climate. There have been a number of studies on safety culture or climate conducted since 1990's in healthcare as can be seen review articles of this issue (Colla et al. 2005, Fleming 2005, Flin et al. 2006, Flin 2007, Nieva & Sorra 2003). With such increasing concerns with safety climate assessment, there have been developed several instruments which measure safety climate in a specific healthcare organisation or make inter institutional comparisons.

The rationale behind studying the safety climate of a given organisation or work unit is to identify "weak points" in the attitudes, norms and practices of the target groups, and to implement intervention programmes aiming at improving patient safety. In conducting such studies with the purpose of uncovering individual organisation's safety climate, we implicitly assume a positive correlation between safety climate and safety outcomes. Therefore, safety climate scales should be required three important properties: content validity, criterion validity and internal reliability of factor structure (Flin et al. 2006, Madsen et al. 2006).

The content validity is related to how relevant items of a tool or questionnaire are to the targeted construct for the assessment purpose, and this can be judged based on various sources such as relevant theory, empirical literature and expert judgement (Flin et al. 2006). Connecting to this issue, a number of studies have been seeking to develop dimensions of safety climate. For instance, according to reviews of nine instruments measuring safety climate in healthcare (Colla et al. 2005), most of them included the following five dimensions: leadership, policies and procedures, staffing, communication, and reporting. Another literature review (Flin et al. 2006), which included 12 instruments, identified management commitment to safety as the most frequently measured safety climate dimension in healthcare, and suggested that three 'core' themes of healthcare safety climate were management/supervisor commitment to safety, safety systems and work pressure—which are related to job demands and workload. In industrial sectors, Flin et al. (2000), which surveyed 18 safety climate tools developed up to late 90's, extracted common dimensions: management or supervision; risk; work pressure; and competence.

The internal reliability of a developed factor is frequently assessed by use of Cronbach's alpha. As a common acceptance level, 0.7 or higher of the alpha coefficient has been used (Spiliotopoulou 2009).

Criterion validity of safety climate scales should be assessed by correlations of their scores with outcome data, which were preferably collected by some other methods from the "safety climate" questionnaire (Flin et al. 2006). Possible safety outcome data in healthcare settings could be worker behaviours, worker injuries, patient injuries or other organisational outcomes (e.g., litigation costs) (Flin 2007). Data most frequently used for this purpose are self-reported measures of accidents/incidents. In contrast, there have been a very few studies which used actual outcome data such as worker injury and patient harm (Flin et al. 2006). This is majorly due to difficulties to measure the safety performance in attempts to investigate effects of safety climate in healthcare delivery systems. The most intuitive and strong measure of safety outcome involves the accident or adverse event rate of an organisation or work unit. At the same time, there are several reasons why we should be wary of using accident data. Such data may be essentially dependent on external factors and may not reflect internal processes.

Similarly, reporting of near misses and incidents may be a useful measure of safety performance though its overriding goal is not to derive reliable statistics about rates of different types of incidents, but to enable organisations to learn from such experiences (Barach & Small 2000). However, it has been suggested that the wide variation observed across, for instance, hospitals and individual departments may have much more to do with local incentives and local "reporting culture" than with actual patient risks (Cullen et al. 1995). Therefore, when doing comparative studies between organisations—and even between work units within a single organisation—we have difficulties in interpreting the incident rate. This may either be interpreted as a measure of risk—the greater the rate of reported incidents of a given type, the greater is the likelihood that a patient injury may take place; or it may be taken as an index of the inverse of risk, that is, as an index of safety—that is, the more that healthcare providers are demonstrating willingness to report, the greater is their sensitivity to errors and learning potential, and so, the greater is the safety in their department (Edmondson 1996, 2004).

In the present paper, we develop a construct of safety climate in healthcare settings with its examination from three aspects of construct validity: content validity, criterion validity and internal reliability. In particular, we investigate relationships of safety climate dimensions with safety outcomes, which are measured using two different types of data: incident reporting statistics of work units from a single hospital, and self-reported staff attitudes in many hospitals. We seek to uncover positive contributions of safety climate components to safety performance measures from the results of correlation analysis as well as interviews with a hospital risk manager. We briefly discuss some current issues of safety climate in Japanese hospitals as well as factors that jeopardise patient safety.

2 SURVEY AND INCIDENT REPORTS

2.1 *Questionnaire and respondents*

The questionnaire comprised three parts—the present paper used the first two parts—and had an additional demographic section where respondents fill in their clinical specialty or ward, job rank, length of work experience and age group. The main parts of the questionnaire had been also employed for former studies (Itoh et al. 2002, 2005). The first part of the questionnaire, which dealt with a safety climate issue, was adapted from ORMAQ (Operating Room Management Attitudes Questionnaire; Helmreich & Merritt 1998). This part contained 57 items about staff perceptions of hospital management as well as general questions that may shape themselves safety climate of a healthcare organisation. Respondents were asked to rate their agreement or disagreement with each statement on a five-point Likert scale between 1 and 5 (from 'strongly disagree' to 'strongly agree').

In the second part, each respondent was asked about his/her behaviour and reactions in terms of reporting own errors and interactions with the patient who had been a victim of a medical error. His or her reactions were elicited as responses to three fictitious incident cases: one in which the patient suffered a relatively severe outcome and rather mild outcome as another case as well as a near-miss case. The respondent was asked to read each case and subsequently to rate his/her certainty likelihood of engaging in each of the following actions after the event: (1) keep the event to himself/herself, (2) report the event to his/her leader or doctor in charge, (3) report the event to the local reporting system, (4) inform the patient about the event and future risk, and (5) apologise about the event to the patient. The likelihood rating was made on a five point scale ranging from 'definitely no' to 'definitely yes'. The cases and questions of this part were adopted from those used in a similar Danish survey (Andersen et al. 2002).

A survey was carried out between August and November 2006 (Itoh & Andersen 2008). The questionnaire was distributed to doctors, nurses, pharmacists and medical engineers or technicians working for 84 hospitals, all of which were medium or large scales having at least 200 beds, and 521 beds on average. A total of 21,666 responses were collected, and the mean response rate was 84% across the four hospital professional groups. A summary of the sample is shown in Table 1.

Table 1. Profile of collected sample.

Profession	No. of hosp.	No. of resp.	Resp. rate	Mean age (yr)	Mean expe. (yr)
Doctor	41	1,005	51%	41.5	12.1
Nurse	83	17,585	88%	38.6	14.3
Pharmacist	51	542	48%	37.9	13.5
Technician	50	1,934	89%	36.2	12.8
Other/NA	–	327	–	–	–
Total	84	21,666	84%		

2.2 *Incident reporting statistics*

To examine correlations of safety climate with safety outcome measures, incident reports submitted in 2004–2006 (for three years) by nurses were collected from one of the hospitals surveyed. The hospital was privately owned, located in Tokyo metropolitan area, and it covered almost all the clinic areas and employed 160 full-time doctors and 357 nurses having 482 beds at the moment of the questionnaire-based survey (2006). There were 19 work units as nurses' working places: 14 wards for inpatients, outpatients, OR (Operating Room), Kidney Centre, Medical Examination Centre and administration office—the last unit was excluded since they worked in an office, usually not with patients.

It is common for Japanese hospitals to adopt a six-level severity classification of events, ranging from 0 (near miss) to 5 (death). Usually, cases at Levels 0 and 1 give no effect to a patient, and those resulting in a temporary, minor effect such as slight fever, headache or bad mood are at Level 2. Events should be assigned to Level 3 (or higher) only if an additional treatment is required for a longer period of hospitalisation than the planned due to causes of the health care system or staff and not by the underlying disease of the patient. However, only a few reports at Level 3 or higher have been submitted by nurses during this period. In addition, according to interviews with risk managers and nurse leaders not only from this hospital but also many other hospitals in Japan, they mentioned that all events at Level 2 or higher (Level 2+) are submitted by nursing staff although they did not have the same acknowledgement for doctors. Therefore, we categorised all incident cases into two "combined" types in terms of outcome severity: Level 0 and 1 (no effect cases) and Level 2+ (which may be considered more reliable as indicating risk of healthcare errors). The statistics summary of reported incidents is shown in Table 2 based on the event types, (a) incidents excluding patient fall and (b) patient fall cases, in each year.

Table 2. Number of incident reports submitted each year.

		2004	2005	2006	Total
Incidents, excluding patient fall	Level 0 & 1	773	879	782	2,434
	Level 2+	39	57	21	117
	All Levels	812	936	803	2,551
Patient fall	Level 0 & 1	184	213	223	620
	Level 2+	63	78	41	182
	All Levels	247	291	264	802
Total	Level 0 & 1	957	1,092	1,005	3,054
	Level 2+	102	135	62	299
	All Levels	1,059	1,227	1,067	3,353

3 HEALTHCARE SAFETY CLIMATE

3.1 *Safety climate dimensions*

Principal component analysis with the Promax rotation was applied to all responses of the survey sample to develop a construct of healthcare safety climate. Each principal component was labelled by interpretation from highly loaded items. A result of the analysis is shown in Table 3, including dimension label, variance accounted, highly loaded items and their loadings, and Cronbach's alpha for each principal component. Twelve dimensions—eigenvalues were higher than 1.0 for all of these—were elicited with 44% of cumulative variance accounted for. Each dimension was labelled based on items highly loaded, and therefore some items were overlapped in multiple dimensions. The dimensions were (1) communication and coordination, (2) motivation, (3) power distance, (4) efforts against stress, (5) trust in management/organisation, (6) safety awareness, (7) competence awareness, (8) collectivism-individualism, (9) member-conflicting attitudes, (10) team/stress management, (11) seniority dependency and (12) blame-free atmosphere.

Regarding content validity, this construct included many dimensions—or those having similar labels—suggested by former studies not only on safety culture, e.g., communication, teamwork, leadership and management issues, but also on national culture (Hofstede 1991), e.g., power distance and collectivism-individualism. In addition, labels of several dimensions involved important issues in patient safety and safety culture studies such as blame-free or just culture (Reason 1997) and human factors elements, e.g., workload and stress (Kohn et al. 1999).

3.2 *Internal reliability*

As another important aspect, Cronbach's alpha was calculated for each dimension to examine internal reliability of the construct As can be seen in Table 3, Cronbach's alpha was higher than

Table 3. Safety climate dimensions elicited by principal component analysis.

Dimensions	Items highly loaded	Loading
Label [Variance (Cumulative variance)] Cronbach's α		
I. Communication & coordination [11% (11%)] α = 0.700		
	Regular debriefing is important for effective team coordination.	0.768
	Team members should verbalise plans and be sure information is understood.	0.763
	Pre-session team briefing is important for patient safety and team management.	0.694
	To resolve conflicts, team members should openly discuss their differences.	0.412
	Team members should monitor each other for signs of stress or fatigue.	0.287
II. Motivation [6% (17%)] α = 0.733		
	I like my job.	0.803
	I enjoy working as part of a team.	0.742
	I am proud to work for this hospital.	0.730
	Working for my hospital is like a large family.	0.547
	I get the respect from person of my profession.	0.300
III. Power distance [6% (22%)] α = 0.647		
	Successful hospital management is primarily function of Dr's medical proficiency.	0.613
	Only people qualified to give me feedback are others of my own profession.	0.549
	Team members should not question senior staff except when they threaten safety.	0.547
	Errors are a sign of incompetence.	0.538
	Junior team members should not question decisions made by senior staff.	0.516
	As long as the work gets done, I don't care what others think of me.	0.509
	Doctors who encourage suggestions from team members are weak leaders.	0.489
	It is better to agree with other team members than to voice a different opinion.	0.467
IV. Efforts against stress [4% (27%)] α = 0.637		
	I am more likely to make errors in intense or hostile situations.	–0.667
	Even when fatigued, I perform effectively during critical phases.	0.643
	My decision-making is as good in emergencies as in routine situations.	0.631
	Personal problems can affect my performance.	–0.493
	I am less effective when stressed or fatigued.	–0.487
	In critical situations, I rely on my superiors to tell me what to do.	–0.427
	I do my best work when people leave me alone.	0.381
	Professional member can forget personal problems during task performance.	0.276
V. Trust in manage./organisation [3% (30%)] α = 0.648		
	Department provides adequate, timely information about events in hospital.	0.712
	Mistakes are handled properly in my hospital.	0.704
	The concept of all personnel working as team doesn't work in our hospital.	–0.571
	Department leadership listens to staff and cares about our concerns.	0.494
	There are no circumstances where junior member should control of patient management.	0.300
	I am proud to work for this hospital.	0.221
VI. Safety awareness [3% (32%)] α = 0.540		
	I always ask questions when I feel there is something I don't understand.	0.646
	I let other team members know when my workload is becoming excessive.	0.577
	Team members share responsibility for prioritising activities in high workload.	0.533
	I will speak up pt. management problem, regardless of who might be affected.	0.501
	I am encouraged to report any incident.	0.451
VII. Competence awareness [2% (34%)] α = 0.586		
	I value compliments about my work.	0.744
	Good reputation of professional activities is important to me.	0.533
	It is important my competence be acknowledged.	0.506
	Doctor's responsibilities include coordination between work team and other support areas.	0.320
	All members are qualified to give me feedback.	0.315
	I care others see me friendly and cooperative.	0.303
	It bothers me when others do not respect my professional capabilities.	0.267
VIII. Collectivism-individualism [2% (37%)] α = 0.550		
	I care others see me friendly and cooperative.	0.709
	I am ashamed when I make a mistake in front of other team members.	0.560
	I feel uncomfortable telling members from other disciplines to take actions.	0.475
	I try to do that others will enjoy working with.	0.458
	As long as work gets done, I don't care what others think of me.	–0.436
	I value compliments about my work.	0.211
	Good reputation of professional activities is important to me.	0.185
IX. Member-conflicting attitudes [2% (39%)] α = 0.502		
	I am irritated working with inexperienced staff.	0.726
	My performance is not adversely affected by working with inexperienced team member.	–0.662
	It is an insult to be forced to wait unnecessarily for other members.	0.502
	I am less effective when stressed.	0.316
	Personal problems can affect my performance.	0.312
	It bothers me when others do not respect my professional capabilities.	0.271
	I am ashamed when I make a mistake in front of other team members.	0.262

(*Continued*)

Table 3. (*Continued*)

X. Team/stress management [2% (41%)] α = 0.530	
Own psychological stress or physical problems should be obliged to mention.	0.622
Team members should monitor each other for signs of stress or fatigue.	0.520
We should be aware of the personal problems of other team members.	0.477
Leader should rest with medical or nursing staff.	0.477
To resolve conflicts, team members should openly discuss their differences.	0.216
Mistakes are handled properly in my hospital.	0.176
Working for my hospital is like a large family.	0.146
XI. Seniority dependency [2% (43%)] α = 0.460	
Senior staff deserves extra privileges.	0.653
Senior person should take over and make all decisions in emergencies.	0.597
Senior staff should encourage questions from juniors during task performance.	0.581
We should be aware of the personal problems of other team members.	0.214
I do my best work when I was left alone.	0.207
XII. Blame-free atmosphere [2% (44%)] α = 0.588	
Human error is inevitable.	0.825
Effective team coordination requires staff to take into account members' personalities.	0.377
Errors are a sign of incompetence.	–0.355
Doctors who encourage suggestions from team members are weak leaders.	–0.342
Members should not question senior staff.	–0.231
Junior team members should not question decisions made by senior staff.	–0.222

0.5 for every dimension except for Dimension 11, seniority dependency. There were only two dimensions exceeding 0.7, which is a regular limit of acceptable reliability, and most of other dimensions ranged between 0.53 and 0.65. However, Spiliotopoulou (2009) suggested that internal consistency of a measure should be carefully checked whether it is acceptable in practice even if its Cronbach's alpha is below 0.7 because of characteristics of the sample, e.g., the number of items composing a dimension, sample size, heterogeneity/homogeneity of sample and normality and linearity of data. For instance, a smaller number of items, homogeneous sample, and data which cannot be assumed normality are likely to result in underestimation of the internal reliability. In case of the small number of items, e.g., smaller than 8, the mean inter-item correlation is also suggested to check, and its recommended value is between 0.15 and 0.20 for broad characteristics and between 0.40 and 0.50 for narrower ones (Spiliotopoulou 2009). Regarding effects of sample size, a large sample is often pointed out to have a possibility of increasing the alpha estimates, but Helms et al. (2006) reported that a small sample can also provide a large reliability coefficient.

In the safety climate construct elicited in this study, most dimensions composed a small number of items, and in particular there were five or six items for those having lower Cronbach's alpha, e.g., Dimension 6, 10 and 11. In addition, the mean inter-item correlations were fallen into a recommended area, i.e., between 0.15 and 0.20, for nine out of ten dimensions having Cronbach's alpha below 0.7. The sample used in this study was very large having more than 20,000 responses. In addition, statistical tests, i.e., Kolmogorov-Smirnov test, of normality rejected for all items composed the dimensions. For these reasons, the Cronbach's alpha of the safety climate dimensions may be underestimated and therefore the internal reliability of most dimensions elicited in this study can be close to an acceptable level.

3.3 *Overall trend in Japanese Hospitals*

Percentage agreement and disagreement with each safety climate dimension for doctors, nurses, pharmacists and medical technicians are shown in Table 4, which also includes significance levels between the four professional groups derived by the

Table 4. Differences in safety climate across professional groups (upper row: % agreement, lower row: % disagreement).

Dimensions	Dr.	Ns.	Phar.	Tech.	*p*
I. Communication & coordination	93%	94%	96%	96%	***
	0%	0%	0%	0%	
II. Motivation	56%	33%	39%	44%	***
	7%	17%	14%	10%	
III. Power distance	1%	1%	0%	2%	***
	83%	84%	87%	79%	
IV. Efforts against stress	31%	19%	18%	27%	***
	13%	16%	17%	10%	
V. Trust in mgt./ organisation	46%	40%	33%	35%	***
	13%	13%	21%	18%	
VI. Safety awareness	57%	73%	59%	58%	***
	3%	1%	3%	3%	
VII. Competence awareness	55%	44%	43%	45%	***
	3%	3%	3%	3%	
VIII. Collectivism-individualism	49%	50%	49%	46%	***
	5%	3%	3%	3%	
IX. Member conflicting attitudes	41%	27%	33%	27%	***
	4%	6%	3%	8%	
X. Team/stress management	55%	55%	50%	56%	**
	2%	1%	2%	1%	
XI. Seniority dependency	91%	73%	81%	82%	***
	0%	1%	0%	1%	
XII. Blame-free atmosphere	94%	90%	95%	92%	***
	0%	0%	0%	0%	

*$p < 0.05$, **$p < < 0.01$, ***$p < 0.001$.

Kruskal-Wallis test. The percentage [dis]agreement was computed as follows: Before calculation of the indices, an item that has a negative loading for a given dimension had its figure reversed, i.e., 5 and 4 responses were reversed to 1 and 2, and vice versa. A mean score of a dimension is calculated across all its component items for each respondent, and the degree of agreement is classified into five levels based on its score: (1) strong disagreement [1.0, 1.5]; (2) weak disagreement (1.5, 2.5]; (3) neutral (2.5, 3.5); (4) weak agreement [3.5, 4.5]; and (5) strong agreement [4.5, 5.0]. The percentage [dis]agreement is represented as a proportion of respondents expressing strong [dis]agreement or weak [dis]agreement for a specific safety climate dimension.

There were significant differences between doctors, nurses, pharmacists and medical technicians for all twelve safety climate dimensions. Yet, some common trends of safety climate were observed in Japanese hospitals across these professional groups: Most of Japanese healthcare professionals indicate extremely strong awareness of communication and coordination within their organisations. There were also a large proportion of employees who were well aware of safety, their own competence, and team and stress management, whereas only a few percents of respondents exhibited low awareness of these dimensions. Power distance was perceived relatively small by a majority of respondents, and blame-free atmosphere was shared in an organisation regardless of the professional groups. However, only a third of healthcare employees were likely to take member conflicting attitudes, and instead it was five to ten times larger for healthcare staff to exhibit the other extreme to this dimension, i.e., member "friendly" attitudes. It is common for hospital employees to share seniority dependency views for any professional group.

Among the differences between the professional groups, one may notice that doctors indicated much higher level of motivation, awareness of own competence, and attitudes of seniority dependency than the other professional groups—in particular than nurses. In contrast, nurses' safety awareness was far stronger than that of the other groups.

4 CORRELATIONS WITH SAFETY OUTCOME

4.1 *Dimensions contributing to self-reported attitudes*

We examine criterion validity of the safety climate dimensions by applying correlation analyses to two types of risk-related data. We first mention analysis results by use of self-reported attitudes to incident reporting, and then demonstrate correlations with safety performance measures using the actual rate of incident reporting in the next subsection.

Selecting the nurse sample, which included more than 17,000 responses from 82 hospitals, we calculated a mean score of each safety climate dimension for every hospital. We also took the same procedure for each item of reactions—responses to the Part 2 questions of the questionnaire. Spearman's rho derived by applying to the 82 hospital-based data is shown in Table 5 for each combination of the safety climate dimensions and the staff reactions. To visualise such a correlation between safety climate and reporting attitude, Figure 1 indicates a graph plotting all 82 hospitals in terms of the mean score of "power distance" and the mean rate of responses to reporting about the event to the local system. As can be seen in Table 5, power distance (Dimension 3) was significantly correlated with any reaction related to error reporting and interactions with the patient regardless the outcome severity: negative correlation with "keeping the event own secret" and positive with the other reactions. This indicates that, the smaller a power distance becomes within a hospital, the more positive attitudes its staff takes to error reporting, i.e., less likely to keep the event to himself or herself, and more willing to report it to his/her leader or the doctor in charge, to submit it to the local reporting system, to inform the patient about it and the future risk, and to apologise the patient about the event.

Significant correlations were also observed for blame-free atmosphere (Dimension 12) with all the reactions like the power distance. This means that a blame-free work setting could contribute positively to staff attitudes to error reporting and interactions with patients. In addition to these two dimensions, each component of safety climate was correlated with one or a few reactions which should be taken after an incident case. In these correlations, it is suggested that taking a larger value for each dimension contributes to positive staff actions. For instance, higher motivated nurses and those having stronger safety awareness were more willing to report to the leader and to the reporting system. The stronger becomes staff trust in management and organisation, the more likely is he or she to inform about the event and the future risk, and to apologise to the patient by staff having.

4.2 *Correlations with actual rates of incident reporting*

Using incident data mentioned in Section 2.2, we calculated annual reporting rates per nurse and their mean rates between 2004 and 2006 for all 18 work units, using two types of incident severity, i.e., all cases and Level 2+ cases. Results of correlation analyses are shown in Table 6 in terms of

Table 5. Correlations of safety climate dimensions with nurse attitudes to error reporting and interaction with patients (upper row: near-miss; middle: mild outcome case; lower: severe outcome case).

Staff actions	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Keep it to him/herself	–0.26*	–0.24*	0.30**	–0.31**	–0.09	–0.31**	0.09	0.13	0.20	–0.11	0.19	–0.23*
	–0.17	–0.05	0.54**	–0.03	–0.14	–0.17	–0.01	0.07	0.08	0.00	–0.27*	–0.55**
	–0.13	–0.09	0.50**	–0.15	–0.12	–0.15	–0.10	–0.03	0.08	–0.03	–0.19	–0.46**
Report to leader or Dr in change	0.33**	0.26*	–0.41**	0.22*	0.16	0.32**	–0.05	–0.09	–0.25*	0.14	–0.01	0.32**
	0.07	–0.07	–0.55**	–0.18	0.11	–0.03	0.01	0.00	0.13	–0.18	0.33**	0.58**
	–0.03	–0.04	–0.50**	–0.02	0.09	–0.06	0.08	0.01	0.04	–0.21	0.27*	0.49**
Report to the reporting system	0.29**	0.28*	–0.28*	0.31**	0.12	0.33**	–0.07	–0.16	–0.27*	0.14	0.00	0.24*
	0.06	–0.04	–0.59**	–0.14	0.19	0.07	0.05	0.02	0.09	–0.11	0.34**	0.65**
	–0.07	–0.05	–0.52**	–0.05	0.18	–0.01	0.06	–0.02	0.04	–0.17	0.31**	0.54**
Inform to pt. about event & risk	(No response to the near-miss case)											
	0.05	0.14	–0.49**	0.02	0.30**	0.19	0.13	0.05	0.07	0.10	0.26*	0.50**
	0.05	0.12	–0.58**	–0.01	0.31**	0.14	0.14	0.04	0.09	0.08	0.25*	0.60**
Apology to pt. about event	(No response to the near-miss case)											
	0.01	–0.03	–0.39**	–0.09	0.19	0.10	0.08	0.01	0.04	0.10	0.21	0.38**
	0.06	0.05	–0.49**	–0.03	0.22*	0.14	0.17	0.11	0.10	0.11	0.20	0.46**

I–XII: Safety climate dimensions (see Table 3). *$p < 0.05$, **$p < 0.01$.

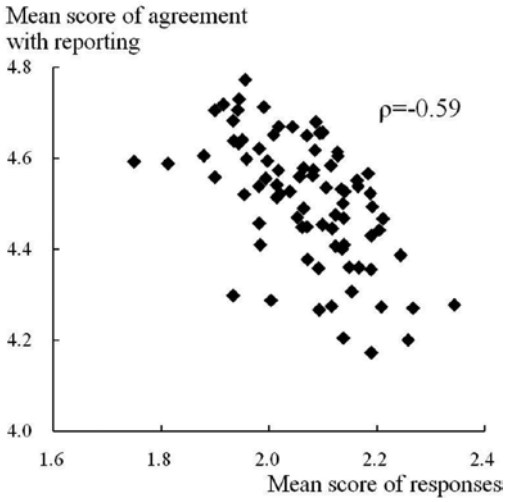

Figure 1. Correlation of power distance with self-reported rate of submitting the mild outcome case to the reporting system.

Table 6. Spearman's rho of each safety climate dimension with actual reporting rates of incidents (in 2004–2006).

Dimensions	All cases	Level 2+
I. Communication & coordination	–0.50*	–0.74**
II. Motivation	–0.24	–0.52*
III. Power distance	0.39	0.55*
IV. Efforts against stress	–0.51*	–0.69**
V. Trust in mgt./organisation	0.14	0.09
VI. Safety awareness	0.00	–0.28
VII. Competence awareness	–0.53*	–0.68**
VIII. Collectivism-individualism	–0.47*	–0.32
IX. Member-conflicting attitudes	0.17	0.24
X. Team/stress management	–0.38	–0.58*
XI. Seniority dependency	–0.10	–0.15
XII. Blame-free atmosphere	–0.48*	–0.58*

* $p < 0.05$, ** $p < 0.01$.

Spearman's rho (with significance level) of each safety climate dimension with the mean reporting rate of all cases and that of Level 2+ cases. There were significant correlations with reporting rate of Level 2+ cases as well as that of all cases for several dimensions. A trend of correlations of safety climate with the reporting rate of all cases was similar to that with Level 2+ cases: Positive or preferable level of each dimension, e.g., higher motivation, smaller power distance and blame-free atmosphere, contributes to fewer frequency of reporting incidents from a work unit both for all and Level 2+ case. It is also seen that the reporting index of higher severity cases, i.e., Level 2+, can exhibit the relationships with safety climate more clearly than that of all cases: more dimensions significant correlated and larger Spearman's rho. This may be related to the data reliability of risk or safety performance as suggested by risk managers that they believed, as mentioned previously, there is no case that nurses hold back submitting

incident reports for all events at Level 2 or higher in Japan.

To look into effects of safety climate on the actual reporting behaviour, correlations of one safety climate dimension, communication and coordination are depicted with the reporting rate of all cases in Figure 2 and with that of Level 2+ cases in Figure 3. As can be seen in these figures, the actual rate of incident reporting was negatively correlated with the level of staff awareness of communication and coordination. Assuming the reporting rate of Level 2+ cases as a risk measure

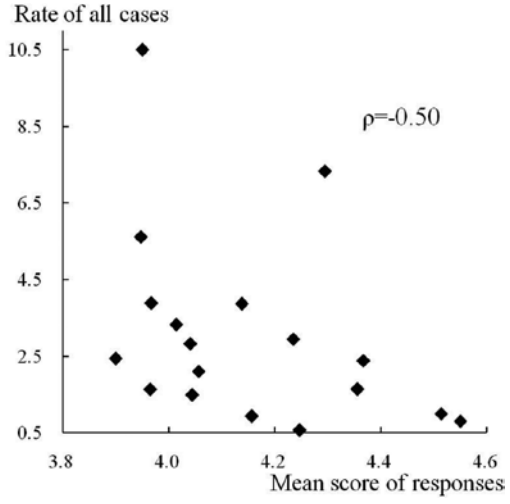

Figure 2. Correlation of communication and coordination with actual rate of reporting all incident cases.

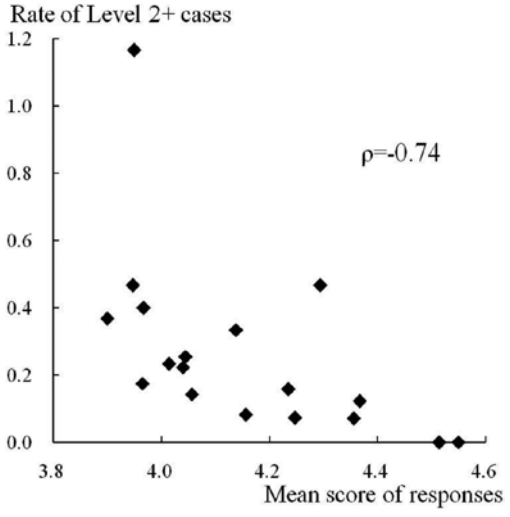

Figure 3. Correlation of communication and coordination with actual rate of reporting Level 2+ incident cases.

according to the above-mentioned statement by risk managers, it may be suggested that open, more active communication and coordination contributes to a lower risk of adverse events in a hospital.

Similarly, as for other dimensions correlated with the reporting rate of Level 2+ cases, it is natural to interpret that staff motivation, small power distance, awareness of own competence and recognition of team and stress management contribute to reduction of risk level in healthcare. From a negative correlation of efforts against stress, it may also be suggested that staff attitudes to making efforts even under a stressful condition, e.g., "even when fatigued, I perform effectively during critical phases", facilitates a lower error rate in a hospital.

5 CONCLUSION

This paper reported the integrated results from a questionnaire-based survey of safety climate and analysis of the rates of incident reporting. The aim of this investigation was to establish a construct of safety climate, which can be applied to its measurement and diagnosis for hospitals in Japan. The elicited dimensions are: communication and coordination; motivation; power distance; efforts against stress; trust in management/organisation; safety awareness; competence awareness; collectivism-individualism; member conflicting attitudes; team/stress management; seniority dependency; and blame-free atmosphere.

We examined criterion validity of the developed construct through analyses of its correlations with two different outcome data: self-reported data about error reporting behaviours from 82 hospitals, and statistics of reported incidents for 18 work units in a single hospital. From these analyses, contributions of safety climate dimensions were identified to positive staff reporting behaviours, and their correlations with occurrence frequencies of very minor events, i.e., the rate of Level 2+ incidents, were also obtained. The results of these analyses implied that the criterion validity of the construct was partly established for some dimensions.

A major outcome of the present study has been to clarify a possibility that safety climate makes positive contributions to staff attitudes to error reporting and in turn improvement of the safety level in an organisation and work unit. In particular, the analysis results seem to indicate that a nurse group working in a small power distance and blame-free atmosphere—these two dimensions are also inter-correlated—will be more willing to report their errors and to give positive interactions with a patient even after an adverse event. It is also suggested that staff motivation, safety awareness and communication and coordination were also

possible sources to positive staff attitudes to error reporting. In addition, positive safety climate was implied to contribute to reducing an error rate since many of the dimensions had negative correlations with the rate of Level 2+ incidents: strong awareness of communication and coordination, high motivation, efforts against stress, proper awareness of own competence, awareness of team and stress management and blame-free atmosphere.

From these results, we believe the safety climate measurement may be a useful method as its proactive use for risk reduction by periodically tracking its level. This process is also allowed to identify problems related to patient safety in an organisation and its work units. Finally, power distance and blame free atmosphere are of critical importance to improve staff attitudes more open and risk conscious. Therefore, we suggest that a mature healthcare management should be established, including policies, procedures, etc. for enhancing blame free atmosphere, and it is, in turn, expected to contribute to reducing power distance within a hospital and its work units.

ACKNOWLEDGMENTS

This work was in part supported by Grant-in-Aid for Scientific Research A (2) (No. 18201029), Japan Society for the Promotion of Science. We would like to acknowledge the risk managers in the hospitals participating in the survey.

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