A Pilot Study Testing the Dimensions of Safety Climate among Japanese Nurses

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Abstract: To investigate the dimensions of safety climate among Japanese nurses, an anonymous self-administered questionnaire survey was conducted. The subjects involved in the survey included 293 full-time nurses (registered nurses and licensed practical nurses) working in a public hospital, excluding directors of nursing. A total of 221 of the 293 nurses answered the questionnaires. Among 221 questionnaires, the questionnaires, which had missing values in the question items used in this study, were excluded from the analyses. Consequently, a total of 201 questionnaires were analyzed. The average age of the subjects was 34.7 yr. As a result of exploratory factor analysis, 5 factors were extracted as follows: intellectual development regarding medical safety among nurses, accumulated fatigue, nursing conditions, supervisors’ attitudes, and communication with physicians. All the values of Cronbach’s coefficient alpha among these 5 factors were between 0.804 and 0.892. As a result of the confirmatory factor analysis of the 5 factors, the value of the GFI (Goodness of Fit Index) was 0.868. The value of the CFI (Comparative Fit Index) was 0.943. The value of the RMSEA (Root Mean Square Error of Approximation) was 0.062. The results of this study will contribute to the investigation of the dimensions of a nurses’ safety climate scale in the future. The associations between the dimensions of the safety climate and the motivation to work toward improving patients’ safety among Japanese nurses will need to be examined, as will those between the dimensions of the safety climate and actual clinical mistakes.

Key words: Safety climate scale, Patient safety, Nurse, Anonymous self-administered questionnaire

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Introduction

The Institute of Medicine published “To Err is Human: Building a Safer Health System”1). According to this institute, one of the greatest contributions to accidents is human error. However, because most human errors are induced by system failure of organizations, it is extremely important to improve the safety system of organizations to pursue patient safety.

Zohar gauged the safety climate that reflects workers’ perceptions of safety in industries other than the medical industry2). There were high correlations between the safety climate and the ranking of organizational safety made by experienced safety inspectors. When building a safety system of organizations is being considered, the safety climate proposed by Zohar could be one of the useful tools to improve the safety system of organizations. Since Zohar proposed safety climate2), safety climate scales have been developed in various industries and researchers have examined the associations between the safety climate and actual accident occurrences and workers’ safety-oriented behavior in other than the medical industry3–12).

Masuchi12) reviewed the studies2–11) that discussed the associations between each dimension of the safety climate and workers’ safety behavior and actual accident occurrences. Then, the main factors in affecting workers’ safety...
ty-oriented behavior and actual accident occurrences are: 1. institutional safety measures and administrators’ attitudes for securing safety, 2. communication, and 3. workers’ commitment to safety, among the dimensions of the safety climate. \cite{12}

Reports of safety climate have begun to emerge in healthcare organization recently and these reports have reviewed the dimensions of safety climates such as communication and reporting, focusing on health care workers. \cite{13} However, the division of occupational roles differs greatly among occupations such as physicians and nurses, which may produce a discrepancy of perceptions concerning patient safety.

In Japan, only Matsubara et al. produced a safety climate scale for Japanese nurses and conducted a factor analysis concerning their original scale. \cite{14} They produced the original safety climate questionnaire with reference to literature in the medical and other industries. However, the job contents in the medical industry differ from those in other industries. Therefore, there is a possibility that the dimensions of safety climate in the medical industry are definitely different from those in other industries.

Once the dimensions of safety climate are grasped, the factors significantly affecting outcomes such as nurses’ safety-oriented behavior can be found. However, the accumulation of the data was too scarce to comprehend the complete dimensions of a safety climate.

There is a possibility that the nurses’ dimensions regarding safety climate are definitely different from those in other industries \cite{3-12, 14, 15} and among the division of occupational roles. \cite{13} Therefore, it is important to produce an original questionnaire assuming the indigenous dimensions regarding safety climate considering the work environment of nurses, and accumulate its data. In this study, we investigated the dimensions regarding a safety climate that are necessary for discussing the associations between each dimension of the safety climate and the motivation to improve the patients’ safety and reducing actual clinical mistakes among Japanese nurses.

**Methods**

**Subjects**

The subjects involved in the survey included 293 full-time nurses (registered nurses and licensed practical nurses) working in a public hospital, excluding the director of nursing. This hospital is composed of several groups in internal medicine and surgery.

In October 2006, the nursing director of this hospital distributed anonymous self-administered questionnaires, envelopes for the return of the questionnaires and the description of this study, to the persons in charge of each section, e.g., wards and clinical departments. Subsequently, these people distributed the questionnaires, envelopes, and the description of the study to the nurses in their sections. Approximately 1 wk after the distribution, the same people collected the completed questionnaires in the anonymous sealed envelopes.

The description included: 1. the purpose and methods of the study, 2. clarification of the concept of voluntary cooperation in this study, 3. the fact that submitting the questionnaire indicates the respondent’s consent to cooperate, 4. a statement of privacy protection, 5. the fact that the information collected in this study will be disclosed to nurses involved in the study unless there is a risk that such disclosure would intrude on someone’s privacy, 6. the fact that the outcome of this study will be published in academic journals and/or presented at academic conferences, 7. the method for managing the data, 8. the fact that examinees will not incur any charges, 9. the names and positions of researchers, and 10. contact information. The study was approved by the Ethical Committee of this public hospital.

**Questions and data analyses**

**Safety climate scale**

We prepared 25 original questions for the safety climate scale with reference to the opinions of the nurses familiar with nursing site and literature regarding work environment of nurses \cite{16} (Appendix). We hypothesized that the following six factors was extracted by exploratory factor analysis: factors related to: superiors’ attitudes, relationships among nurses, communication with physicians, nursing conditions, accumulated fatigue, and reporting.

The understanding of the words “near miss” and “mistake” may vary according to each health care worker. In this study, these words are defined below, and nurses were instructed to answer the questions based on these definitions.

Near miss: A case in which an incorrect practice by a health care worker was discovered before such practice resulted in harming a patient, or a case in which an incorrect practice by a health care worker was actually used on a patient but did not harm the patient in a daily health care setting.

Mistake: A case in which a health care worker used an incorrect practice on a patient and adversely affected the patient’s condition, e.g., necessitating some additional treatment, in a daily health care setting.

We asked questions about the overall safety climate (item 1), age, gender, job rank (i.e., registered nurse or licensed practical nurse), and marital status (i.e., married...
or single), in addition to 25 original questions for the safety climate scale. The overall safety climate, job rank, and marital status will not employ the data analyses because the aim of this paper is to investigate the dimensions of the safety climate among nurses.

**Statistical analyses**

Mean, standard deviation, skewness, and kurtosis of the 25 question items regarding safety climate were calculated. Exploratory factor analysis (maximum likelihood solution and promax rotation) of the 25 question items for the safety climate scale was performed, and factors with an eigenvalue of ≥1 were extracted. Subsequently, items with a factor loading of <0.4 were excluded. And then, factor analysis (maximum likelihood solution and promax rotation) was performed again. Subsequently, for each item with a factor loading of ≥0.4, explanation was performed. After that, confirmatory factor analysis was performed and Cronbach’s coefficient alpha was calculated. For each of the 25 questions, the subjects selected among a 5-point scale from (1) “definitely disagree” to (5) “definitely agree” and, in statistical analyses, 1 to 5 points were given in that order, respectively. Amos 5.0 was used for confirmatory factor analysis. SPSS 11.5 J was used for other statistical analyses.

**Analyzed subjects**

A total of 221 of the 293 nurses answered questionnaires (75.4%). Among 221 questionnaires, the questionnaires, which had missing values in the question items used in this study, were excluded from the analyses. Consequently, a total of 201 questionnaires were analyzed. The average age of the subjects was 34.7 yr (range, 20–60 yr) (Table 1).

**Results**

Mean, standard deviation, skewness and kurtosis of each item are shown in Table 2. The mean scores of each item were between 2.00 and 4.09. The values of skewness of each item were between −1.16 and 0.88. The values of kurtosis of each item were between 2.00 and 4.09. The values of skewness of each item were between −0.91 and 1.26.

Table 1 shows 5 factors extracted by factor analysis of the 25 items for the safety climate scale. The first factor was composed of the following items: 24. Raising awareness, 23. Teaching materials, 22. Feedback, 25. Sudden occurrence, and 7. Information-sharing among nurses. This factor was interpreted as “intellectual development regarding medical safety among nurses”.

The second factor was composed of the following items: 19. Free time, 21. Physical fatigue, 18. Sleep, and 20. Mental fatigue. This factor was interpreted as “accumulated fatigue”.

The third factor was composed of the following items: 17. Priority to patient safety, 16. Proper staffing, 14. Securing manpower, and 15. Break time. This factor was interpreted as “nursing conditions”.

The fourth factor was composed of the following items: 3. Instructions by superiors, 1. Superiors’ dedication to subordinates, 4. Superiors’ attitudes toward listening to subordinates’ comments, and 2. Superiors’ ways of communicating with subordinates. This factor was interpreted as “superiors’ attitudes”.

The fifth factor was composed of the following items: 10. Physicians’ attitudes, 9. Instructions by physicians, 12. Physicians’ ways of communicating with nurses, and 11. Open communication with physicians. This factor was interpreted as “communication with physicians”.

Table 4 shows Cronbach’s coefficient alpha. The values of all the Cronbach’s coefficient alpha were between 0.804 and 0.892. The results of the confirmatory factor analysis are shown in Fig. 1. The numerical characters in squares represent the No. of the question items. For example, “Q24” indicates, “24. Raising awareness” in Tables 2 and 3. The value of GFI (Goodness of Fit Index) was 0.868. The value of CFI (Comparative Fit Index) was 0.943. The value of RMSEA (Root Mean Square Error of Approximation) was 0.062.

**Discussion**

From a series of studies3–12), it was evident that it is necessary to scientifically grasp the idea of and improve the workers’ safety climate in order to develop a safe organization. As stated in the introduction of Masuchi’s report12), for the research into safety climate, it is necessary to grasp workers’ dimensions regarding safety climate by clarifying the associations between workers’ dimensions regarding safety climate and workers’ safety behavior and actual accident occurrences. Although the contents of a questionnaire regarding safety climate are uniquely produced by each researcher, the common dimensions of the safety climate were covered: 1. management/supervision, 2. safety system, 3. risk, 4. work pressure, and 5. competence as the common scales of safety climate in the industries other than the medical...
Colla et al. reviewed surveys that focused on the safety climate in health care organizations. According to their report, nearly all of the surveys covered the 5 common dimensions of the safety climate: leadership, policies and procedures, staffing, communication, and reporting. However, the working environment of nurses definitely is different from those of other occupations. Therefore, it is important to produce a questionnaire assuming the dimensions regarding safety climate for each occupation and to collect the necessary data.

There have been few studies on safety climate among only nurses, however, there is the report of Matsubara et al. They attempted to develop a safety climate scale for Japanese nurses with reference to literature regarding the safety climate conducted in the medical and other industries. They assumed the following 6 dimensions as nurses’ safety climate: the climate in which nurses proactively improve medical safety, the climate in which the goals and outcomes regarding medical safety are clarified, the climate in which nurses take responsibilities for patients’ safety, the climate in which nurses pursue the fundamental cause of a medical error, instead of blaming the error on the person who induced it, the climate in which safety is prioritized over work efficiency, and the climate in which nurses can communicate with others freely without concern for organizational hierarchy.

As a result of the factor analysis, the 2 factors, “attitude toward patient safety” and “responsibility for patient safety”, were extracted. From the report of Matsubara et al., it can be considered that the nurses’ dimensions regarding safety climate as pointed out in industries other than the medical industry may not exist. Therefore, for the research into safety climate among only nurses, it is important to produce an original questionnaire assuming the dimensions not reported in industries other than the medical industry and to collect the appropriate corresponding data.

We discussed these matters with the nurses familiar with nursing sites, with reference to the literature regarding nurses’ working environments. They discussed what kinds of dimensions regarding safety climate exist, considering nurses’ environments. Consequently, the following three key words were enumerated: interpersonal relationships, feeling overworked, and reporting of near misses and mistakes. After further discussions, it was concluded that the interpersonal relationships have the following three dimensions: supervisors’ attitudes, relation-
It was also concluded that “feeling overworked” has the following two dimensions: accumulated fatigue and nursing conditions. Lastly, it was concluded that “reporting of near misses and mistakes” should be used as a dimension. Of course, these items were designed tentatively and have no scientific basis. Therefore, exploratory factor analysis (maximum likelihood solution and promax rotation) of the 25 question items for the safety climate scale was performed. After that, confirmatory factor analysis was performed and Cronback’s coefficient alpha was calculated.

As a result of statistical analyses, the following 5 factors are supported: Factor 1 (intellectual development regarding medical safety among nurses), Factor 2 (accumulated fatigue), Factor 3 (nursing conditions), Factor 4 (superiors’ attitudes), and Factor 5 (communication with physicians). Thus, the 5 factors in the present study differ from the 5 factors reported by Flin et al.\textsuperscript{15}), the 2 factors reported by Matsubara et al.\textsuperscript{14}), and the 5 factors reported by Colla et al.\textsuperscript{13}). This is likely because the processes for preparing questions for a questionnaire are quite different. It can be considered that there are no differences between the contents of questionnaire and the recognition of nursing sites. However, we did not hypothesize these factors.

<table>
<thead>
<tr>
<th>Table 3. Factor loadings of the safety climate scale by exploratory factor analysis</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
<th>Factor 4</th>
<th>Factor 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 1 (Intellectual development regarding medical safety among nurses)</td>
<td></td>
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<tr>
<td>24. Raising awareness</td>
<td>\textbf{0.944}</td>
<td>\textbf{-0.039}</td>
<td>0.040</td>
<td>-0.091</td>
<td>-0.036</td>
</tr>
<tr>
<td>23. Teaching materials</td>
<td>\textbf{0.826}</td>
<td>\textbf{-0.059}</td>
<td>0.094</td>
<td>0.056</td>
<td>-0.006</td>
</tr>
<tr>
<td>22. Feedback</td>
<td>\textbf{0.823}</td>
<td>0.012</td>
<td>0.054</td>
<td>0.044</td>
<td>-0.048</td>
</tr>
<tr>
<td>25. Sudden occurrence</td>
<td>0.763</td>
<td>0.168</td>
<td>-0.203</td>
<td>-0.064</td>
<td>0.020</td>
</tr>
<tr>
<td>7. Information-sharing among nurses</td>
<td>\textbf{0.588}</td>
<td>-0.049</td>
<td>0.025</td>
<td>0.029</td>
<td>0.137</td>
</tr>
<tr>
<td>Factor 2 (Accumulated fatigue)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Free time</td>
<td>0.047</td>
<td>\textbf{0.898}</td>
<td>-0.094</td>
<td>0.072</td>
<td>0.006</td>
</tr>
<tr>
<td>21. Physical fatigue</td>
<td>0.006</td>
<td>\textbf{0.736}</td>
<td>0.023</td>
<td>-0.024</td>
<td>0.019</td>
</tr>
<tr>
<td>18. Sleep</td>
<td>0.004</td>
<td>\textbf{0.710}</td>
<td>0.158</td>
<td>0.009</td>
<td>0.087</td>
</tr>
<tr>
<td>20. Mental fatigue</td>
<td>-0.013</td>
<td>\textbf{0.630}</td>
<td>0.163</td>
<td>0.036</td>
<td>0.009</td>
</tr>
<tr>
<td>Factor 3 (Nursing conditions)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Priority to patient safety</td>
<td>0.018</td>
<td>-0.065</td>
<td>\textbf{0.807}</td>
<td>-0.040</td>
<td>0.160</td>
</tr>
<tr>
<td>16. Proper staffing</td>
<td>-0.064</td>
<td>0.076</td>
<td>\textbf{0.786}</td>
<td>0.130</td>
<td>-0.019</td>
</tr>
<tr>
<td>14. Securing manpower</td>
<td>0.032</td>
<td>0.134</td>
<td>\textbf{0.726}</td>
<td>-0.049</td>
<td>-0.059</td>
</tr>
<tr>
<td>15. Break time</td>
<td>-0.012</td>
<td>0.353</td>
<td>\textbf{0.621}</td>
<td>-0.088</td>
<td>-0.142</td>
</tr>
<tr>
<td>Factor 4 (Superiors’ attitudes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Instructions by superiors</td>
<td>-0.014</td>
<td>-0.129</td>
<td>0.060</td>
<td>\textbf{0.923}</td>
<td>0.015</td>
</tr>
<tr>
<td>1. Superiors’ dedication to subordinates</td>
<td>0.072</td>
<td>-0.075</td>
<td>0.055</td>
<td>\textbf{0.728}</td>
<td>-0.016</td>
</tr>
<tr>
<td>4. Superiors’ attitudes toward listening to subordinates’ comments</td>
<td>0.119</td>
<td>0.162</td>
<td>-0.084</td>
<td>\textbf{0.688}</td>
<td>-0.032</td>
</tr>
<tr>
<td>2. Superiors’ ways of communicating with subordinates</td>
<td>-0.156</td>
<td>0.163</td>
<td>-0.076</td>
<td>\textbf{0.542}</td>
<td>0.002</td>
</tr>
<tr>
<td>Factor 5 (Communication with physicians)</td>
<td></td>
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<td></td>
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<tr>
<td>10. Physicians’ attitudes</td>
<td>-0.075</td>
<td>-0.025</td>
<td>0.041</td>
<td>-0.010</td>
<td>\textbf{0.852}</td>
</tr>
<tr>
<td>9. Instructions by physicians</td>
<td>0.056</td>
<td>-0.055</td>
<td>0.093</td>
<td>0.004</td>
<td>\textbf{0.754}</td>
</tr>
<tr>
<td>12. Physicians’ ways of communicating with nurses</td>
<td>0.019</td>
<td>0.163</td>
<td>-0.118</td>
<td>0.046</td>
<td>\textbf{0.653}</td>
</tr>
<tr>
<td>11. Open communication with physicians</td>
<td>0.049</td>
<td>0.009</td>
<td>0.004</td>
<td>-0.054</td>
<td>\textbf{0.605}</td>
</tr>
</tbody>
</table>

Bold-faced type shows factor loadings over 0.400.

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Factor 1 (Intellectual development regarding medical safety among nurses)</td>
<td>\textbf{1}</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Factor 2 (Accumulated fatigue)</td>
<td>0.449</td>
<td>\textbf{1}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factor 3 (Nursing conditions)</td>
<td>0.479</td>
<td>0.657</td>
<td>\textbf{1}</td>
<td></td>
</tr>
<tr>
<td>Factor 4 (Superiors’ attitudes)</td>
<td>0.548</td>
<td>0.366</td>
<td>0.428</td>
<td>\textbf{1}</td>
</tr>
<tr>
<td>Factor 5 (Communication with physicians)</td>
<td>0.277</td>
<td>0.166</td>
<td>0.153</td>
<td>0.218</td>
</tr>
</tbody>
</table>
Table 4. Internal consistency of each factor of the safety climate scale

<table>
<thead>
<tr>
<th>Factor</th>
<th>Cronback’s coefficient alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 1 (Intellectual development regarding medical safety among nurses)</td>
<td>0.892</td>
</tr>
<tr>
<td>Factor 2 (Accumulated fatigue)</td>
<td>0.882</td>
</tr>
<tr>
<td>Factor 3 (Nursing conditions)</td>
<td>0.880</td>
</tr>
<tr>
<td>Factor 4 (Superiors’ attitudes)</td>
<td>0.804</td>
</tr>
<tr>
<td>Factor 5 (Communication with physicians)</td>
<td>0.814</td>
</tr>
</tbody>
</table>

Fig. 1. Confirmatory factor analysis of the safety climate among Japanese nurses.
Our results is not confirmable.

Analyses. The second limitation lies in the fact that the opinions of 92 respondents were not included in these questionnaires being analyzed for a rate of 68.6%. Thus, the were excluded, which resulted in a final total of 201 questionnaires with missing values (75.4% response rate), questionnaires with missing values might have answered the questionnaire halfheartedly. The study of safety climate still does not have any theory. For example, in the field of study of workers’ subjectivity as well as safety climate, job satisfaction is very well known. Job satisfaction already has effective theories, such as the two-factor theory and Theory X and Theory Y, which are utilized by managers of many business organization. In the future we will attempt to formulate a theory of safety climate that could be applied to other industries and not only the medical industry. In this study, during the collection of data, voluntary cooperation for the participation in the research was secured so as not to induce coercion. However, if subjects had participated in this research reluctantly, they might have answered the questionnaire halfheartedly. This point may be necessary to take into account.

The first limitation in the present study lies in the fact that although 221 of 293 questionnaires were collected (75.4% response rate), questionnaires with missing values were excluded, which resulted in a final total of 201 questionnaires being analyzed for a rate of 68.6%. Thus, the opinions of 92 respondents were not included in these analyses. The second limitation lies in the fact that the sampling method did not employ random sampling, thus limiting the subjects. Therefore, the generalizability of our results is not confirmable.

Conclusions

As results of data analyses, the following 5 factors were extracted: intellectual development regarding medical safety among nurses, accumulated fatigue, nursing conditions, supervisors’ attitudes, and communication with physicians. The results of this study are expected to help contribute to determining the dimensions of nurses’ safety climate for future studies. However, the factors we hypothesized were not definitively extracted. We will continue to improve the questionnaire of the safety climate. The associations between the dimensions of the safety climate and the motivation to work toward improving patients’ safety and reducing actual clinical mistakes will need to be examined among Japanese nurses.

References

17) Herzberg F, Mausner B, Snyderman B (1958) The

Appendix: Dimensions of safety climate scale items (The original version is in Japanese).

Factors related to supervisors’ attitudes
1. Even if I make a “near miss” or a mistake, my superiors attempt to discover the cause with me.
2. Even if I make a “near miss” or a mistake, my superiors do not reprimand me without hearing my side of the story.
3. My superiors give me appropriate instructions about my nursing skills.
4. When subordinates propose some measure for patients’ safety, my superiors discuss it with me frankly.

Factors related to relationships among nurses
5. When “near miss” and/or mistakes occur, nurses discuss them with each other to attempt to discover improvements.
6. There is an atmosphere among nurses for improving problems proactively to prevent mistakes.
7. The information regarding any “near misses” and mistakes is shared among nurses.
8. Nurses help one another.

Factors related to communication with physicians
9. Physicians generally do not give vague instructions to nurses.
10. Physicians generally do not take an overbearing attitude toward nurses.
11. I can generally communicate openly with physicians about medical issues.
12. Even if I make “near miss” or make a mistake, physicians do not reprimand me without hearing my side of the story.

Factors related to nursing conditions
13. In my section, a lot of work is completed within sufficient time.
14. In my section, the manpower necessary for securing patients’ safety is well assured.
15. In my section, a sufficient amount of break time is provided during the working period.
16. In my section, appropriate personnel allocation is made considering each nurse’s abilities in a well-balanced manner.
17. In my section, the patients’ safety is never sacrificed in order to deal with a large number of jobs.

Factors related to accumulated fatigue
18. I work in this hospital but have adequate sleeping time.
19. I work in this hospital but have free time to refresh myself.
20. I work in this hospital but do not feel mentally fatigued.
21. I work in this hospital but do not feel physically fatigued.

Factors related to reporting
22. The contents of “near miss” and mistake reports in this hospital are reflected in on-site work.
23. The reports of “near misses” and mistakes in this hospital are linked to our safety education and training.
24. The reports of “near misses” and mistakes in this hospital enhance the awareness of medical safety for patients.
25. The reports of “near misses” and mistakes in this hospital enable us to learn that mistakes happen suddenly.