# Critical Demographic Variables on Affecting Patient Safety Culture from Medical Staffs' Viewpoints

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**Abstract**—This study intends to identify critical demographic variables that would significant influence on each dimension of the patient safety culture. The internal survey data sets in 2015 and 2016 from the entire medical staffs' viewpoints are used. Linear regression with forward selection is applied where ten demographic variables are the input variables, while each dimension of the Chinese version of the safety attitudes questionnaire is the dependent variable. Supervisor/manager is the most essential demographic variable that has significant impacts on six dimensions. Experience in position is the other critical demographic variable. Therefore, hospital management needs to focus on medical staffs who are not supervisors/managers first in order to improve the patient safety culture in this regional teaching hospital.

**Index Terms**—safety attitudes questionnaire, Chinese version of safety attitudes questionnaire, linear regression with forward selection, demographic variable, patient safety culture

## I. INTRODUCTION

Medical errors are commonly seen in healthcare organizations on account of a defective system or human negligence. These adverse events have been recognized a significant threat to patient safety and the quality of provided healthcare [1]-[3]. National Patient Safety Agency in England advocated healthcare organizations are supposed to establish a "patient safety culture" to detect, lessen, and prevent harms to patients [4], [5]. Assessing the existing patient safety culture provides a valuable message for creating the culture [6]. To meliorate the healthcare quality, various measures have been created for measuring the patient safety culture. The safety attitudes questionnaire (SAQ) developed by Sexton et al. [7] possesses good psychometric

properties with good validity and reliability for healthcare workers in many settings and is recommended as one of three effective tools to be used in patient safety assessment by The European Network for Patient Safety [8]-[11].

Some studies with respect to the patient safety culture assessment on healthcare providers revealed that different demographic variables might result in different perceptions of patient safety. A research from Abdou and Saber [5] identified that nurses who worked in intensive care units had the highest means score of the overall safety culture dimensions compared with those worked in coronary care units. Lee at al. [12] concluded that physicians and nurses with different demographic variables perceived different emotional exhaustion from the 2014 internal surveyed data based on the Chinese version of the SAQ. In addition, Kim et al. [13] stated that nurses on the front line had more problems than those worked in management positions. These researches pointed out demographic variables were to be associated with patient safety outcomes.

Physicians and nurses are the core staffs who have high frequent contacts with patients in healthcare organizations. The problem of nursing shortage has on the clock since 1990s including in Taiwan [12]. In addition, nursing is a critical element in determining the quality of healthcare in hospitals reported by Institute of Medicine's Committee [14]. Besides, less attention has been paid to other team workers of the healthcare organizations. Thus, it would be of interest to examine the perceptions of the entire healthcare providers with different demographic characteristics toward the patient safety culture. This study intends to explore the influences and identify critical elements from various demographic variables of all the healthcare staffs that would significant impact the patient safety culture in a regional teaching hospital in Taiwan.

## II. PATIENT SAFETY CULTURE AND SAFETY ATTITUDES QUESTIONNAIRE

Patient safety culture is "an integrated pattern of individual and organizational behavior, based upon shared beliefs and values that continuously seeks to minimize patient harm, which may result from the processes of care delivery" defined by the European Society for Quality in Health Care [15]. The definition reflects a hospital with a better patient safety culture shows the lower number of adverse hospital events and also manifested in prior researches. Ulrich and Kear [16] concluded that the high level of patient safety has positive influences on assessments of care by patients. Nieva and

Sorra [17] also claimed that a positive safety culture recognizes the inevitability of errors and proactively seeks to identify latent threats.

The safety attitudes questionnaire developed by Sexton et al. [7] has been widely utilized across many intensive care units [7], [18], [19]. The validity and reliability of the SAQ have been documented in previous studies. In addition, Lee et al. [20] showed that the Chinese version of the SAQ has verified good psychometric properties. Nguyen et al. [11] delivered Italian version of the SAQ to two teaching hospitals which showed a good questionnaire validation as well. It has been cross-culturally validated in different languages, including English, Norwegian, Turkish, Dutch, Swedish, Arabic, Italian, and Chinese [7]-[11], [20]-[22].

The safety attitudes questionnaire was derived from flight management attitudes questionnaire (FMAQ). Twenty-five percent of the FMAQ items are retained on the SAQ because they demonstrated utilities in medical settings (Sexton et al., 2006). There are six dimensions in the SAQ including teamwork climate (perceived quality of collaboration between personnel), safety climate (perceptions of a strong and proactive organizational commitment to safety), perceptions of management (approval of managerial action), job satisfaction (positivity about the work experience), working conditions (perceived quality of the work environment and logistical support), and stress recognition (acknowledgement of how performance is influenced by stressors) [7], [16], [23], [24].

The Joint Commission of Taiwan developed the Chinese version of the SAQ by using forward and backward translation to examine the quality of the translation. The intelligibility and item applicability of the questionnaire was deliberated by an expert panel [25], [26]. The original questionnaire has been modified from six dimensions and 30 questions to nine dimensions and 41 questions by considering three dimensions from the Agency for Healthcare Research and Quality. These three dimensions include hospital management support for patient safety, teamwork across hospital units, and hospital handoffs and transitions [23], [27]. The latest Chinese version of the SAQ in 2014 retained the six dimensions of the original SAQ from Sexton et al. and combined two new aspects with nine and seven questions, respectively, which are emotional exhaustion and work-life balance [7], [28], [30]. The latest Chinese version of the SAQ depicted in Table I has eight dimensions and 46 items. All responses of the SAQ developed by Sexton et al. [7] and emotional exhaustion use a five-point Likert's scale. The other dimension, work-life balance, uses a four-point scale to measure the frequency of each item.

TABLE I
THE CHINESE VERSION OF THE SAFETY ATTITUDES QUESTIONNAIRE

| Dimension | Item |
|---|---|
| Teamwork Climate | 1. Nurse input is well received in this clinical area.<br>2. In this clinical area, it is difficult to speak up if I perceive a problem with patient care.<br>3. Disagreements in this clinical area are resolved appropriately (i.e., not who is right, but what is best for the patient).<br>4. I have the support I need from other personnel to care for patients. |
| | 5. It is easy for personnel here to ask questions when there is something that they do not understand.<br>6. The physicians and nurses here work together as a well-coordinated team. |
| Safety Climate | 7. I would feel safe being treated here as a patient.<br>8. Medical errors are handled appropriately in this clinical area.<br>9. I know the proper channels to direct questions regarding patient safety in this clinical area.<br>10. I receive appropriate feedback about my performance.<br>11. In this clinical area, it is difficult to discuss errors.<br>12. I am encouraged by my colleagues to report any patient safety concerns I may have.<br>13. The culture in this clinical area makes it easy to learn from the errors of others. |
| Job Satisfaction | 14. I like my job.<br>15. Working here is like being part of a large family.<br>16. This is a good place to work.<br>17. I am proud to work in this clinical area.<br>18. Morale in this clinical area is high. |
| Stress Recognition | 19. When my workload becomes excessive, my performance is impaired.<br>21. I am less effective at work when fatigued.<br>25. I am more likely to make errors in tense or hostile situations.<br>26. Fatigue impairs my performance during emergency situations (e.g. emergency resuscitation, seizure). |
| Perceptions of Management | 27. Management supports my daily efforts.<br>28. Management doesn't knowingly compromise patient safety.<br>29. I get adequate, timely information about events that might affect my work.<br>30. The levels of staffing in this clinical area are sufficient to handle the number of patients. |
| Working Conditions | 31. Problem personnel are dealt with constructively by our unit.<br>32. This hospital does a good job of training new personnel.<br>33. All the necessary information for diagnostic and therapeutic decisions is routinely available to me.<br>34. Trainees in my discipline are adequately supervised. |
| Emotional Exhaustion | 20. I feel like I'm at the end of my rope.<br>22. I feel burned out from my work.<br>23. I feel frustrated by my job.<br>24. I feel I'm working too hard on my job.<br>35. I feel emotionally drained from my work.<br>36. I feel used up at the end of the workday.<br>37. I feel fatigued when I get up in the morning and have to face another day on the job.<br>38. Working with people all day is really a strain for me.<br>39. Working with people directly puts too much stress on me. |
| Work-Life Balance | 40. Miss meals.<br>41. Have a hasty meal.<br>42. Work all day without break.<br>43. Change the individual or family plan because of the work.<br>44. Could not sleep well.<br>45. Sleep less than five hours at night.<br>46. Work overtime. |

Plenty of researches of the SAQ with respect to patient safety culture tend to assess the overall performance of the healthcare organizations [7]-[9]. Nowadays, the researches applied the SAQ attempt to figure out the feeble parts of the dimensions over and above the respondents with specific traits. The research from Lee et al. [12] employed Mann-Whitney U test for two independent samples test and

analysis of variance to observe if physicians and nurses with different demographic variables have different perceptions in patient safety culture based on the Chinese version of the SAQ. Shie et al. [31] evaluated the patient safety culture among respiratory therapists by adapted nationwide survey through the SAQ in several hospital settings from pharmacists' viewpoints. Samsuri et al. [32] utilized Spearman's correlation coefficient to evaluate the overall and scores of each domain regarding the SAQ from the staffs between hospitals and health clinics. Plenty of researches concerning patient safety attitudes from various professions of healthcare staffs have been conducted by scholars, but not the overall professions. Further, keep following up the patient safety outcomes of the particular respondent year after year can detect the different results and to explore causes and trends of the patient safety culture. The effects of policies or practices concerning patient safety improvement can be examined by comparisons [33]-[35].

## III. RESEARCH METHOD

The study was conducted in a regional teaching hospital in Taiwan. The regional teaching hospital has a bed capacity of 500 with all major medical specialties and services. All professional groups working in this hospital were invited to participate in the study, including physicians, nurses, technicians, pharmacists, medical administrators, respiratory therapists, and others. The demographic variables in the survey include gender, age, supervisor/manager, job position, job status, experience in organization, and experience in position, education, and direct patient contact. The numbers of the final valid questionnaires in 2015 and 2016 are 618 and 620, respectively. Descriptive statistics of the respondents' demographic characteristics in 2015 and 2016 are provided in Table II.

TABLE II
DEMOGRAPHIC INFORMATION OF THE ENTIRE MEDICAL STAFFS IN 2015 AND 2016

| Demographic Variable | 2015 | | 2016 | |
|---|---|---|---|---|
| | FREQUENCY | PERCENTAGE | FREQUENCY | PERCENTAGE |
| **Gender** | | | | |
| Male | 118 | 19.1 | 102 | 16.5 |
| Female | 500 | 80.9 | 518 | 83.5 |
| **Age** | | | | |
| Less than 20 years old | 9 | 1.5 | 13 | 2.1 |
| 21-30 years old | 214 | 34.6 | 211 | 34.0 |
| 31-40 years old | 226 | 36.6 | 223 | 36.0 |
| 41-50 years old | 129 | 20.9 | 130 | 21.0 |
| 51-60 years old | 37 | 6.0 | 40 | 6.5 |
| 61 years old and above | 3 | 0.5 | 3 | 0.5 |
| **Supervisor/Manager** | | | | |
| Yes | 64 | 10.4 | 73 | 11.8 |
| No | 554 | 89.6 | 547 | 88.2 |
| **Respondents reporting events in the past 12 months** | | | | |
| No | 395 | 63.9 | 407 | 65.6 |
| 1-5 | 189 | 30.6 | 197 | 31.8 |
| 6-10 | 26 | 4.2 | 11 | 1.8 |
| 11-15 | 5 | 0.8 | 4 | 0.6 |
| More than16 | 3 | 0.5 | 1 | 0.2 |
| **Job Position** | | | | |
| Physician | 42 | 6.8 | 48 | 7.7 |
| Nurse | 334 | 54.0 | 384 | 61.9 |
| Technician | 68 | 11.0 | 70 | 11.3 |
| Pharmacist | 28 | 4.5 | 9 | 1.5 |
| Medical Administrator | 93 | 15.0 | 63 | 10.2 |
| Respiratory Therapist | 14 | 2.3 | 10 | 1.6 |
| Other | 39 | 6.3 | 36 | 5.8 |
| **Job Status** | | | | |
| Full Time | 561 | 90.8 | 559 | 90.2 |
| Contract | 33 | 5.3 | 28 | 4.5 |
| Part Time | 7 | 1.1 | 10 | 1.6 |
| Agency | 17 | 2.8 | 23 | 3.7 |
| **Experience in Organization** | | | | |
| Less than 6 months | 82 | 13.3 | 75 | 12.1 |
| 6 to 11 months | 20 | 3.2 | 53 | 8.5 |
| 1 to 2 years | 96 | 15.5 | 103 | 16.6 |
| 3 to 4 years | 98 | 15.9 | 75 | 12.1 |
| 5 to 10 years | 135 | 21.8 | 133 | 21.5 |
| 11 to 20 years | 161 | 26.1 | 157 | 25.3 |
| 21 years or more | 26 | 4.2 | 24 | 3.9 |
| **Experience in Position** | | | | |
| Less than 6 months | 94 | 15.2 | 86 | 13.9 |
| 6 to 11 months | 19 | 3.1 | 56 | 9.0 |
| 1 to 2 years | 108 | 17.5 | 110 | 17.7 |
| 3 to 4 years | 110 | 17.8 | 85 | 13.7 |
| 5 to 10 years | 138 | 22.3 | 141 | 22.7 |
| 11 to 20 years | 129 | 20.9 | 128 | 20.6 |
| 21 years or more | 20 | 3.2 | 14 | 2.3 |
| **Education** | | | | |
| Junior High School and below | 5 | 0.8 | 1 | 0.2 |
| Senior High School | 28 | 4.5 | 21 | 3.4 |
| College/University | 535 | 86.6 | 554 | 89.4 |
| Graduate School and above | 50 | 8.1 | 44 | 7.1 |
| **Direct Patient Contact** | | | | |
| No | 63 | 10.2 | 52 | 8.4 |
| Rare | 94 | 15.2 | 68 | 11.0 |
| Very Often | 461 | 74.6 | 500 | 80.6 |

The data for the study were collected by the Chinese version of the SAQ in 2015 and 2016 which consists of 46 items that examine medical staffs' attitude toward eight dimensions including teamwork climate, safety climate, job satisfaction, stress recognition, perceptions of management, working conditions, emotional exhaustion, and work-life balance. All responses except for work-life balance using a 4-point scale to measure the frequency were recorded using a 5-point Likert's scale, ranging from 1 = strongly disagree to 5 = strongly agree. Each respondent's answer of reversed questions such as Items 2, 11, 20, 22, 23, 24, 35, 36, 37, 38, and 39 is adjusted. Not all of the staffs have to fill out the entire questions when answering the Chinese version of the SAQ. For instance, physicians and nurses are required to fill out forty-six questions. Question items 2, 4, 6, and 33 are not required for technicians and pharmacists, and the number of questions is forty-two. For medical administrators and others, question items 2, 3, 4, 6, 8, 30, and 33 are not required, and the number of questions is thirty-nine. Finally, for respiratory therapists, only question item 6 is not required. In order to assess the perceptions of the patient safety culture from the entire medical staffs, the coherent questions are adopted among all of the different professions. Moreover, individual questionnaire responses were aggregated by calculating the score of the items for each dimension.

After completing the data collection, data were exported into the file type suitable for analyses by SPSS version 18. Analysis of collected data was performed through the use of linear regression analysis with forward selection. Lalis [36]

stated that linear regression has been widely used in prediction and modeling by finding the best-fitting straight line. That is, linear regression aims to derive a linear function and reveal the linear relationship between the dependent variable(s) and the independent variable.

Linear regression with forward selection starts with an empty set and adds an attribute one at a time continually. At each step, only the attribute which gives the highest correlation with the dependent variable is added into the selection. That is, variables with greater theoretical importance are entered first. Moreover, forward selection is unable to include attributes that are interdependent but it allows the decision maker to understand which attribute has a greater impact directly on the dependent variable [30], [37]. The model selection criteria of this technique are tractable and disclose which dependent variable(s) (demographic variable(s)) are critical to a particular dimension. The criterion of adding a variable into a linear regression model is to use the probability of F to enter less than 0.050. A comparison is also performed to identify the differences based on the results from 2015 and 2016.

## IV. RESEARCH RESULTS

For the data set in 2015, quantile-quantile plot (Q-Q plot) is used to assess if the data set is normally distributed [38]. Figure 1 shows the graphs did not stray from the line in an obvious fashion indicating the data sets might not depart from the normal distribution severely, where "D" represents dimension. That is, D1 stands for the first dimension (teamwork climate), D2 is safety climate, and so on. Variance inflation factor (VIF) is performed to evaluate the severity of multicollinearity of input variables (ten demographic variables). The VIF values are from 1.018 to 1.417 which are less than 10, indicating linear regression models have low multicollinearity [39]. Durbin-Watson statistic is also performed to check if the residuals of variables in a linear regression are independent. The statistic values of eight dimensions are 1.948, 1.937, 1.975, 1.990, 2.029, 2.015, 2.045, and 1.944, indicating residuals are not correlated when the test statistic value is close to 2 [40]. The results of using linear regression with forward selection based on eight dimensions are summarized in Table III. The adjusted R-square values are from 0.037 to 0.127.
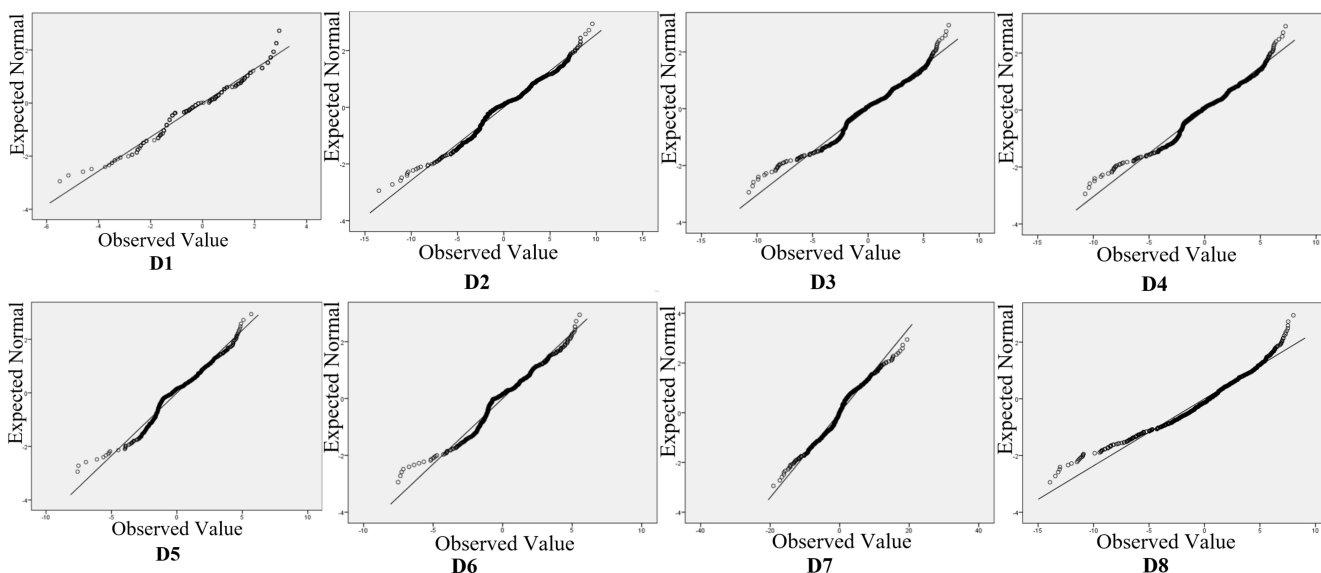


Fig. 1. Quantile-quantile plot plots in 2015

### TABLE III
LINEAR REGRESSION WITH FORWARD SELECTION FOR ALL MEDICAL STAFFS IN 2015

| Dimension | Demographic Variable | Standardized Coefficients | t | p |
|---|---|---|---|---|
| Teamwork climate | Supervisor/ Manager | -.258 | -6.468 | <.001 |
| | Experience in position | -.118 | -2.947 | .003 |
| Safety climate | Supervisor/ Manager | -.323 | -8.246 | <.001 |
| | Experience in position | -.116 | -2.974 | .003 |
| | Direct patient contact | .087 | 2.286 | .023 |
| Job satisfaction | Supervisor/ Manager | -.282 | -7.025 | <.001 |
| | Age | .236 | 5.119 | <.001 |
| | Experience in position | -.213 | -4.646 | <.001 |
| Stress recognition | Supervisor/ Manager | .092 | 2.117 | .035 |
| | Age | -.125 | -3.053 | .002 |
| | Experience in position | -.106 | -2.519 | .012 |
| Perceptions of management | Supervisor/ Manager | -.238 | -5.479 | <.001 |
| | Experience in position | -.184 | -4.199 | <.001 |
| | Education | .107 | 2.600 | .010 |
| | Age | .099 | 2.175 | .030 |
| Working conditions | Supervisor/ Manager | -.267 | -6.499 | <.001 |
| | Experience in position | -.208 | -4.452 | <.001 |
| | Age | .124 | 2.633 | .009 |
| Emotional exhaustion | Job position | .108 | 2.721 | .007 |
| | Age | .189 | 3.950 | <.001 |
| | Experience in position | -.149 | -3.123 | .002 |
| Work-life balance | Job position | .213 | 5.474 | <.001 |
| | Job status | .105 | 2.615 | .009 |

| | | | | |
|---|---|---|---|---|
| | Respondents reporting events in the past 12 months | -.085 | -2.167 | .031 |
| | Experience in organization | -.088 | -2.167 | .031 |

Supervisor/manager, experience in position, and age are the three critical demographic variables that show significant influences on the Chinese version of the SAQ in 2015. Specifically, medical staffs who are supervisors/managers have better perceptions in teamwork climate, safety climate, job satisfaction, perceptions of management, and working conditions. In contrast, medical staffs who are not supervisors/managers perceive stress recognition better. On the other hand, medical staffs with less experience in position tend to have a higher satisfaction in teamwork climate, safety climate, job satisfaction, stress recognition, perceptions of management, working conditions, and emotional exhaustion

apparently. Besides, elderly medical staffs tend to have a higher satisfaction in job satisfaction, perceptions of management, working conditions, and emotional exhaustion, aside from stress recognition.

Q-Q plot is used to assess if the data set in 2016 is normally distributed. Figure 2 shows the graphs did not stray from the line in an obvious fashion representing the data sets might not depart from the normal distribution severely. The VIF values of the data set in 2016 are from 1.010 to 1.270, which demonstrate the low multicollinearity of linear regression models in this research [39]. The test statistic values of Durbin-Watson statistic of the data set for eight dimensions are 1.772, 1.771, 1.675, 2.001, 1.825, 1.774, 1.950, and 1.941. These test statistic values are close to 2, and all the residuals can be assumed to be independent [40]. Table IV summarizes the results of applying linear regression with forward selection, where the adjusted R-square values are from 0.023 to 0.087.
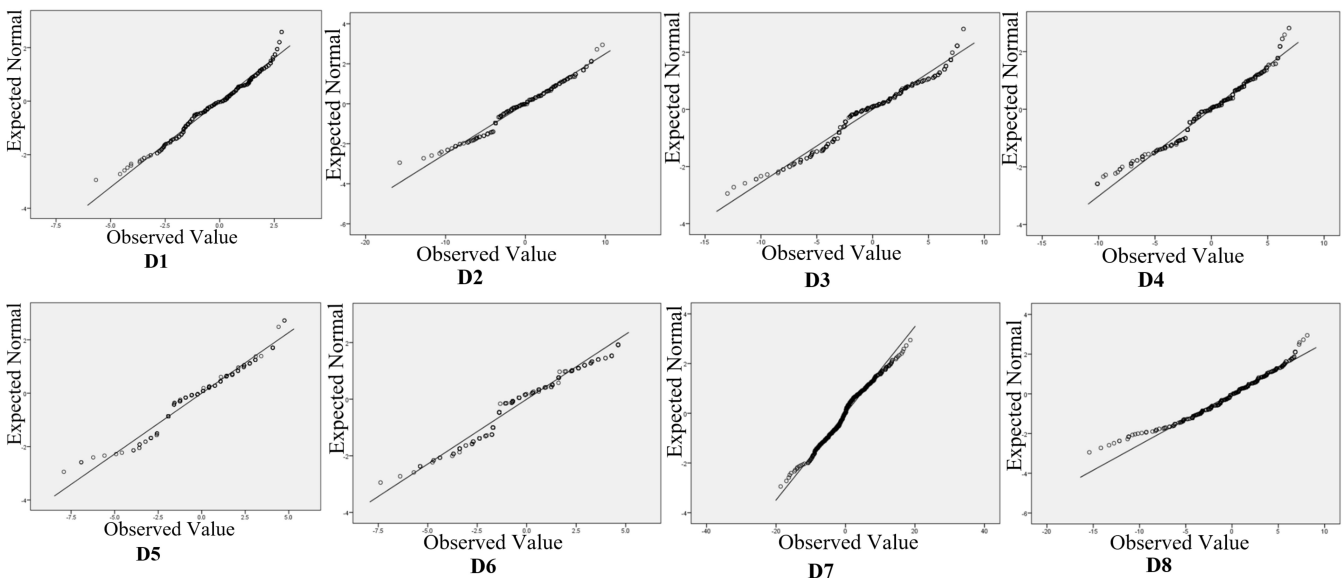


Fig. 2. Quantile-quantile plot plots in 2016

TABLE IV
LINEAR REGRESSION WITH FORWARD SELECTION FOR ALL MEDICAL STAFFS IN 2016

| Dimension | Demographic Variable | Standardized Coefficients | t | p |
|---|---|---|---|---|
| Teamwork climate | Supervisor/ Manager | -.213 | -5.296 | <.001 |
| | Respondents reporting events in the past 12 months | .140 | 3.546 | <.001 |
| | Experience in position | -.110 | -2.755 | .006 |
| Safety climate | Supervisor/ Manager | -.268 | -6.938 | <.001 |
| | Direct patient contact | .101 | 2.606 | .009 |
| Job satisfaction | Supervisor/ Manager | -.229 | -5.639 | <.001 |
| | Age | .134 | 3.302 | .001 |
| Stress recognition | Supervisor/ Manager | -.141 | -3.543 | <.001 |
| | Job position | -.091 | -2.278 | .023 |
| Perceptions of | Supervisor/ | -.234 | -6.001 | <.001 |
| management | Manager Direct patient contact | .090 | 2.297 | .022 |
| Working conditions | Supervisor/ Manager | -.198 | -4.957 | <.001 |
| | Respondents reporting events in the past 12 months | .081 | 2.039 | .042 |
| Emotional exhaustion | Age | .172 | 3.832 | <.001 |
| | Experience in position | -.134 | -2.996 | .003 |
| Work-life balance | Job position | .160 | 4.024 | <.001 |
| | Respondents reporting events in the past 12 months | -.127 | -3.193 | .001 |

Supervisor/manager is the most important variable in 2016. Medical staffs who are supervisors/managers are more satisfied in teamwork climate, safety climate, job satisfaction, stress recognition, perceptions of management, and working conditions. The respondents who have reported events in the

past 12 months positively influence teamwork climate, working conditions, and work-life balance. That is, the more events reported by medical staffs, the higher satisfaction the medical staffs have. Medical staffs who have different experience in position perceive a negative satisfaction in teamwork climate and emotional exhaustion. The elderly medical staffs have a better perception in job satisfaction and emotional exhaustion. The higher frequency that the medical staffs have contacts with patients, the greater perception of the patient safety culture they have in safety climate and perceptions of management. It is worth noting that job position has a negative influence on stress recognition but conversely positively affected work-life balance.

## V. DISCUSSIONS

Supervisor/manager is the most essential demographic variable that significant influences on the patient safety culture in both 2015 and 2016 from the viewpoints of the entire medical staffs as shown in Table V, where + and − represent positive and negative impacts, respectively. Supervisor/manager shows negative correlations in six dimensions, except for stress recognition in 2015, emotional exhaustion and work-life balance, indicating medical staffs who are supervisors/managers have better perceptions than those who are not supervisors/managers. It is interesting to note that medical staffs who are supervisors/managers are more stressful in 2015. On the basis of some researches, the leaders are the one who comprehend the patient safety issues utterly and are able to create the culture [41], [42]. Their recognition of the patient safety culture will be changed whether or not the hospital policies can be practiced well. The overall performance of the patient safety culture will be affected by the above situation happened. Furthermore, some scholars do validate the leadership that is associated with safety outcomes [43]. The leader can have an immense effect on individual employee behaviors in relation to safety. The hospital management should make some appropriate interventions to enhance the leader's effectiveness in engaging their subordinates' commitment.

Experience in position is the second important demographic variable. Experience in position has negatively influences on teamwork climate and emotional exhaustion in both 2015 and 2016. That is, medical staffs who have much experience in their current positions tend to have a less satisfaction on teamwork climate and emotional exhaustion. Moreover, medical staffs who have much experience in their current positions are less satisfied in safety climate, job satisfaction, stress recognition, perceptions of management, and working conditions in 2015. The elderly staffs in this hospital have relatively poor perceptions of the patient safety culture. These consequences are contrasting with the research from Khater et al. [44] which explores nurses' perceptions of the patient safety culture. Their study pointed out the more the total years of experience the nurses have, the better perception of the patent safety culture they have.

Age shows positive relationships in job satisfaction and emotional exhaustion in both 2015 and 2016. That is, elderly medical staffs perceive a higher satisfaction. Different age groups revealed diverse perceptions of the patient safety culture. The elderly healthcare workers in this hospital have a tendency to have greater patient safety culture. This result was also supported by a research in South Australia [45]. We can infer that the elderly respondents may have a higher possibility to work in a better working environment. It will increase their perceptions of the patient safety culture. Another explanation might be the old ethic of Asian culture. In the Chinese traditional culture, maintaining the harmony is always the top priority in the workplace which might cause the staffs to conceal their real thoughts. This might not be apparently happened on the younger generation.

It is worth noting that job position demonstrates positive correlations in work-life balance in both 2015 and 2016, indicating that medical staffs have a better work-life balance. The coefficient between direct patient contact and safety climate exhibits positive in two years. In addition, direct patient contact has a positive influence on perceptions of management in 2016. Respondents reporting events in the past 12 months presents negative correlations in work-life balance in two years. This might indicate medical staffs who report fewer events are more satisfied in work-life balance. In contrast, staffs who report more events have better perceptions on teamwork climate and working conditions in 2016.

## VI. CONCLUSIONS

Many countries are making a major effort to enhance the patient safety culture and healthcare organizations have been encouraged to assess the existing culture in recent years. The assessment of the current culture provides a significant value of enhancing the perceptions of the patient safety culture. The hospital management would have the clue to make out the flaw of the hospital and then redesign the system if needed.

TABLE V
A SUMMARY OF DEMOGRAPHIC VARIABLES AND DIMENSIONS OF THE CHINESE VERSION OF SAQ IN 2015 AND 2016

| Dimension | Teamwork Climate 2015 | Teamwork Climate 2016 | Safety Climate 2015 | Safety Climate 2016 | Job Satisfaction 2015 | Job Satisfaction 2016 | Stress Recognition 2015 | Stress Recognition 2016 | Perceptions of Management 2015 | Perceptions of Management 2016 | Working Conditions 2015 | Working Conditions 2016 | Emotional Exhaustion 2015 | Emotional Exhaustion 2016 | Work-Life Balance 2015 | Work-Life Balance 2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gender | | | | | | | | | | | | | | | | |
| Age | | | | | + | + | − | | + | | | | + | | + | + |
| Supervisor/Manager | − | − | − | − | − | − | + | − | − | − | − | − | | | | |
| Job position | | | | | | | − | | | | | | | + | + | + |
| Job status | | | | | | | | | | | | | | + | | |
| Experience in organization | | | | | | | | | | | | | | | − | |
| Experience in position | − | − | − | | − | | − | | − | | − | | − | − | | |
| Education | | | | | | | | | + | | | | | | | |
| Direct patient contact | | | + | + | | | | | | + | | | | | | |
| Respondents reporting events in the past 12 months | | + | | | | | | | | | | + | | | − | − |

This study depicts the perceptions from all of the medical staffs on each of eight dimensions of the Chinese version of the SAQ with different demographic variables. By applying linear regression with forward selection, the critical demographic variable(s) for each dimension can be found. Moreover, with the data sets in 2015 and 2016, the identified critical demographic variable(s) for each dimension can be compared to see the changes.

This study revealed that supervisor/manager is the most important demographic variable that influences the patient safety culture in terms of teamwork climate, safety climate, job satisfaction, stress recognition, perceptions of management, and working conditions in both 2015 and 2016. Experience in position is the second important demographic variable that affects teamwork climate and emotional exhaustion in both 2015 and 2016 and impacts safety climate, job satisfaction, stress recognition, perceptions of management, and working conditions in 2015. Therefore, hospital management needs to pay much attention to medical staffs who are not supervisors/managers first in order to improve the patient safety culture in this regional teaching hospital. Experience in position and age are the other critical demographic variables for hospital management to relentlessly enhance the patient safety culture.

REFERENCES

[1] S. M. Dovey, D. S. Meyers, R. L. Phillips, Jr, L. A. Green, G. E. Fryer, J. M. Galliher, J. Kappus, and P. Grob, "A preliminary axonomy of medical errors in family practice," *Qual. Saf. Health. Care*, vol. 11, pp. 233-238, 2002.

[2] M. Elliott, K. Page, and L. Worrall-Carter, "Factors associated with post-intensive care unit adverse events: A clinical validation study," *Brit. Assoc. Crit. Care Nurs.*, vol. 19, no. 5, pp. 228-235, 2014.

[3] M. Riga, A. Vozikis, Y. Pollalis, and K. Souliotis, "MERIS (Medical Error Reporting Information System) as an innovative patient safety intervention: A health policy perspective," *Health Policy*, vol. 119, pp. 539-548, 2015.

[4] C. C. Yang, Y. S. Wang, S. T. Chang, S. E. Guo, and M. F. Huang, "A study on the leadership behavior, safety culture, and safety performance of the healthcare industry," *Proceedings of World Academy of Science: Engineering & Technology*, vol. 53, 1148, 2009.

[5] H. A. Abdou and K. M. Saber, "A baseline assessment of patient safety culture among nurses at student university hospital," *World J. Med. Sci.*, vol. 6, no. 1, pp. 17-26, 2011.

[6] V. Mikušová, V. Rusnáková, K. Naďová, J. Boroňová, and M. Beťková, "Patient safety assessment in Slovak hospitals," *International Journal of Collaborative Research on Internal Medicine & Public Health*, vol. 4, no. 6, pp. 1236-1244, 2012.

[7] J. B. Sexton, R. L. Helmreich, T. B. Neilands, K. Rowan, K. Vella, J. Boyden, P. R. Roberts, and E. J. Thomas, "The safety attitudes questionnaire: Psychometric properties, benchmarking data, and emerging research," *BMC Health Serv. Res.*, vol. 6, 44, 2006.

[8] E. T. Deilkås and D. Hofoss, "Psychometric properties of the Norwegian version of the safety attitudes questionnaire (SAQ), generic version (short form 2006)," *BMC Health Serv. Res.*, vol. 8, 191, 2008.

[9] S. Kaya, S. Barsbay, and E. Karabulut, "The Turkish version of the safety attitudes questionnaire: Psychometric properties and baseline data," *Qual. Saf. Health Care*, vol. 19, no. 6, pp. 572-577, 2010.

[10] H. Hamdan, "Measuring safety culture in Palestinian neonatal intensive care units using the safety attitudes questionnaire," *J. Crit. Care*, vol. 28, no. 5, pp. 886.e7-886.e14, 2013.

[11] G. Nguyen, N. Gambashidze, S. A. Ilyas, and P. Pascu, "Validation of the safety attitudes questionnaire (short form 2006) in Italian in hospitals in the northeast of Italy," *BMC Health Serv. Res.*, vol. 15, 284, 2015.

[12] Y. C. Lee, S. J. Weng, C. H. Huang, W. L. Hsieh, and H. H. Wu, "Analyzing emotional exhaustion from viewpoints of physicians and nurses – A case of a regional teaching hospital," *TEM J.*, vol. 5, no. 2, pp. 231-235, 2016.

[13] J. Kim, K. An, M. K. Kim, and S. H. Yoon, "Nurses' perception of error reporting and patient safety culture in Korea," *Western J. Nurs. Res.*, vol. 29, no. 7, pp. 827-844, 2007.

[14] G. S. Wunderlich, F. Sloan, and C. K. Davis, *Nursing Staff in Hospitals and Nursing Homes: Is It Adequate*. Washington, DC: National Academy Press, 1996.

[15] J. J. E. van Everdingen, SIMPATIE (Project), and K. de gezondheidszorg, *Patient Safety Toolbox: Instruments for Improving Safety in Health Care Organisations*. Houten: Bohn Stafleu Van Loghum, 2007.

[16] B. Ulrich and T. Kear, "Patient safety and patient safety culture: Foundations of excellent health care delivery," *Nephrol. Nurs. J.*, vol. 41, no. 5, pp. 447-456 & 505, 2014.

[17] V. F. Nieva and J. Sorra, "Safety culture assessment: A tool for improving patient safety in healthcare organizations," *Qual. Saf. Health Care*, vol. 12, no. 2, pp. 17-23, 2003.

[18] D. T. Huang, G. Clermont, J. B. Sexton, C. A. Karlo, R. G. Miller, L. A. Weissfeld, K. M. Rowan, and D. C. Angus, "Perceptions of safety culture vary across the intensive care units of a single institution," *Crit. Care Med.*, vol. 35, no. 1, pp. 165-176, 2007.

[19] V. Raftopoulos and A. Pavlakis, "Safety climate in 5 intensive care units: A nationwide hospital survey using the Greek-Cypriot version of the safety attitudes questionnaire," *J. Crit. Care*, vol. 28, no. 1, pp. 51-61, 2013.

[20] W. C. Lee, H. Y. Wung, H. H. Liao, C. M. Lo, F. L. Chang, P. C. Wang, A. Fan, H. H. Chen, H. C. Yang, and S. M. Hou, "Hospital safety culture in Taiwan: A nationwide survey using Chinese version safety attitude questionnaire," *BMC Health Serv. Res.*, vol. 10, 234, 2010.

[21] E. Devriendt, K. Van den Heede, J. Coussement, E. Dejaeger, K. Surmont, D. Heylen, R. Schwendimann, B. Sexton, N. L. Wellens, S. Boonen, and K. Milisen, "Content validity and internal consistency of the Dutch translation of the safety attitudes questionnaire: An observational study," *Int. J. Nurs. Stud.*, vol. 49, no. 3, pp. 327-337, 2012.

[22] C. Göras, F. Y. Wallentin, U. Nilsson, and A. Ehrenberg, "Swedish translation and psychometric testing of the safety attitudes questionnaire (operating room version)," *BMC Health Serv. Res.*, vol. 13, 104, 2013.

[23] Y. C. Lee, C. H. Huang, S. J. Weng, L. P. Hsieh, and H. H. Wu, "Identifying critical factors of patient safety culture – A case of a regional hospital in Taiwan," *Int. J. Inno. Manage. Technol*, vol. 5, no. 3, pp. 183-188, 2014.

[24] Y. C. Lee, P. S. Zeng, C. H. Huang, and H. H. Wu, "Causal relationship analysis of the patient safety culture based on safety attitudes questionnaire in Taiwan," *J. Healthc. Eng*, vol. 2018, 4268781, 2018.

[25] C. Wagner, M. Smits, J. Sorra, and C. C. Huang, "Assessing patient safety culture in hospitals across countries," *Int. J. Qual. Health Care*, vol. 25, no. 3, pp. 213-221, 2013.

[26] Y. C. Lee, H. H. Wu, W. L. Hsieh, S. J. Weng, L. P. Hsieh, and C. H. Huang, "Applying importance-performance analysis to patient safety culture," *Int. J. Health Care Qual. Assur.*, vol. 28, no. 8, pp. 826-840, 2015.

[27] Y. C. Lee, S. J. Weng, C. H. Huang, W. L. Hsieh, L. P. Hsieh, and H. H. Wu, "A longitudinal study of identifying critical factors of patient safety culture in Taiwan," *J. Test. Eval.*, vol. 45, no. 3, pp. 1029-1044, 2017.

[28] C. H. Huang, H. H. Wu, C. Y. Chou, H. Dai, and Y. C. Lee, "The perceptions of physicians and nurses regarding the establishment of patient safety in a regional teaching hospital in Taiwan," *Iran. J. Public Health*, vol. 47, no. 6, pp. 852-860, 2018.

[29] C. H. Huang, H. H. Wu, and Y. C. Lee, "The perceptions of patient safety culture: A difference between physicians and nurses in Taiwan," *Appl. Nurs. Res*, vol. 40, pp. 39-44, 2018.

[30] C. Y. Chi, H. H. Wu, C. H. Huang, and Y. C. Lee, "Using linear regression to identify critical demographic variables affecting patient safety culture from viewpoints of physicians and nurses," *Hosp. Pract. Res.*, vol. 2, no. 2, pp. 47-53, 2017.

[31] H. G, Shie, W. C. Lee, H. F. Hsiao, H. L. Lin, L. L. Yang, and F. Jung, "Patient safety attitudes among respiratory therapists in Taiwan," *Respir. Care*, vol. 56, no. 12, pp. 1924-1929, 2011.

[32] S. E. Samsuri, L. P. Lin, and M. L. Fahrni, "Safety culture perceptions of pharmacists in Malaysian hospitals and health clinics: A multicentre assessment using the safety attitudes questionnaire," *BMJ Open*, vol. 5, no. 11, e008889, 2016.

[33] T. T. H. Wan, "Nursing care quality in nursing homes: Cross-sectional versus longitudinal analysis," *J. Med. Syst.*, vol. 27, 283, 2003.

[34] S. M. Handler, N. G. Castle, S. A. Studenski, S. Perera, D. B. Fridsma, D. A. Nace, and J. T. Hanlon, "Patient safety culture assessment in the

nursing home," *Qual. Saf. Health Care*, vol. 15, no. 6, pp. 400-404, 2006.

[35] A. J. Seago, A. Williamson, and C. Atwood, "Longitudinal analyses of nurse staffing and patient outcomes: More about failure to rescue," *J. Nurs. Admin*., vol. 36, no. 1, pp. 13-21, 2006.

[36] J. T. Lalis, "A new multiclass classification method for objects with geometric attributes using simple linear regression," *IAENG Int. J. Comp. Sci*, vol. 43, no. 2, pp. 198-203, 2016.

[37] M. Karagiannopoulos, D. Anyfantis, S. B. Kotsiantis, and P. E. Pintelas, "Feature selection for regression problems," *Proceedings of the 8th Hellenic European Research on Computer Mathematics & Its Applications (HERCMA '07)*, pp. 20-22, 2007.

[38] N. M. Razali and B. W. Yap, "Power comparisons of Shapiro-Wilk, Kolmogorov-Smirnov, Lilliefors and Anderson-Darling tests," *J. Stat. Model. Anal*, vol. 2, no. 1, pp. 21-33, 2011.

[39] M. H. Kutner, C. J. Nachtsheim, and J. Neter, *Applied Linear Regression Models*, 4th ed. McGraw-Hill Irwin, 2004.

[40] D. C. Montgomery, E. A. Peck, and G. G. Vining, *Introduction to Linear Regression Analysis*, 3rd ed. New York: John Wiley & Sons, 2001.

[41] S. Singer, M. Meterko, L. Baker, D. Gaba, A. Falwell, and A. Rosen, "Workforce perceptions of hospital safety culture: Development and validation of the patient safety climate in healthcare organizations survey," *Health Serv. Res*., vol. 42, no. 5, pp. 1999-2021, 2007.

[42] F. El-Jardali, H. Dimassi, D. Jamal, M. Jaafar, and N. Hemadeh, "Predictors and outcomes of patient safety culture in hospitals," *BMC Health Serv. Res*., vol. 11, 45, 2011.

[43] J. Barling, C. Loughlin, and E. K. Kelloway, "Development and test of a model linking safety-specific transformational leadership and occupational safety," *J. Appl. Psychol*., vol. 87, pp. 488-496, 2002.

[44] W. A. Khater, L. M. Akhu-Zaheya, S. I. AL-Mahasneh, and R. Khater, "Nurses' perceptions of patient safety culture in Jordanian hospitals," *Int. Nurs. Rev*., vol. 62, pp. 82-91, 2015.

[45] B. Gallego, M. T. Westbrook, A. G. Dunn, and J. Braithwaite, "Investigating patient safety culture across a system: Multilevel modelling of differences associated with service types and staff demographics," *Int. J. Qual. Health Care*, vol. 24, no. 4, pp. 311-320, 2012.