

Comprehensive interventions of safety culture to improve patient safety: A longitudinal follow-up in northeast China

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Abstract

Background: Safety culture in hospitals can affect patient disease processes and health status. However, comprehensive measures to improve patient safety and effective methods to precisely assess the outcomes are limited in China. **Methods:** A cohort study was carried out in a tertiary hospital in China. Medical caregivers received comprehensive interventions such as a study on emergency plans and professional skills training to improve safety culture at the beginning of January 2017. A total of 553 caregivers in March, 299 caregivers in June and 284 caregivers in December in the same year participated in the three evaluation surveys. The safety attitude questionnaire (SAQ), the dimension frequency and number of events reported in the hospital survey of patient safety culture (HSOPSC) and a questionnaire on barriers to reporting adverse events were used to examine the safety culture changes before, during and at the end of intervention implementation. **Results:** The scores for dimension teamwork climate, job satisfaction and perception of management in the SAQ were significantly increased ($p < 0.05$). The scores for the 17 items in the barriers to reporting adverse events questionnaire were significantly increased ($p < 0.05$). No significant changes were observed in the scores for the dimension frequency and number of events reported in the HSOPSC after the interventions. **Conclusion:** Our findings showed that the interventions improved safety attitudes, and the barriers to reporting adverse events decreased, suggesting that the comprehensive interventions used were helpful for improving the safety culture.

Background

Patient safety refers to a risk reduction in unnecessary harm associated with healthcare to an acceptable minimum ^[1]. As many as 251,000 people die in hospitals due to medical errors annually in the United States ^[2]. This results in a total cost of between 17 billion and 29 billion dollars per year. However, some of these costs could have been prevented or reduced to a low level. Another study from Britain in 2000 showed that the incidence of medical adverse events in hospitalized patients was up to 10%, with an economic loss of 3.2 billion pounds ^[3]. In China, at least 2.5 million people of 50 million hospitalized patients have adverse drug reactions annually, and medication errors account for 12% to 32% of all drug users. Therefore, the additional suffering and medical costs are significant in these patients ^[4]. Thus, special attention should be paid to patient safety.

Currently, diverse interventions have been implemented to improve patient safety, and many questionnaires have been constructed to evaluate their efficiency. Paine et al. used a unit-based safety program (CUSP) throughout an academic medical center and showed that the scores of the dimensions in the safety attitude questionnaire (SAQ) improved, except the stress recognition dimension ^[5]. Haynes et al. implemented the checklist-based surgical safety intervention in operating rooms, and the results showed that the SAQ scores significantly increased, followed by a significant decrease in postoperative morbidity and mortality ^[6]. Only one study implementing CUSP in twelve departments of a tertiary hospital for 1 year in China indicated that the percentage of positive responses to dimensions in the SAQ increased, except the stress recognition dimension ^[7]. Thus, a follow-up study of the implementation of

comprehensive interventions in a tertiary hospital was carried out to improve the patient safety culture and decrease adverse events. In the present study, we used three quantitative questionnaires to evaluate the effect of the comprehensive interventions over a 10-month period to provide evidence-based data and practical experience to improve patient safety.

Methods

Design

This study describes a series of interventions related to patient safety implemented in Shengjing Hospital in 2017. Comprehensive interventions of safety culture were conducted from the first day of 2017. A total of 1066 subjects from several departments were enrolled. Quantitative questionnaires were used to interview the caregivers in the same departments on the last day of March, June and December in 2017.

Setting

Shengjing Hospital is the affiliated hospital of China Medical University (<http://www.sj-hospital.org/>), and is the biggest comprehensive, tertiary and teaching hospital in three provinces (Heilongjiang, Jilin, Liaoning) in northeast China. In this study, the executive department established the implementation plans, set up the leadership committee and arranged the activities. Moreover, related deans in each department were the persons in charge of the patient safety interventions. To build the idea of a safety culture, the propaganda department used magazines, TV, publicity boards and news media as propaganda tools. The themes of the plan included medical safety, nursing safety, student safety, teachers' safety awareness, research safety, and monthly logistic service safety. Therefore, all these activities ensured the leadership and execution in the study.

Participants and Inclusion Criteria

All staff members were encouraged to study the contents of the interventions and put them into practice. Participants who had worked in their departments for at least one year before the intervention were included in the study, while those who had worked for less than 1 year or left during the interventions were excluded.

Interventions

The scope of these interventions covered the entire hospital. The intervention items in several managerial, clinical and technical departments were introduced (**Table 1**). Briefly, we carried out safety culture education, safety knowledge and operation practice with each department as a unit.

Evaluation of the interventions

In this study, three types of questionnaires were introduced [Safety Attitudes Questionnaire, frequency of events reported and number of events reported in Hospital Survey of Patient Safety Culture (HSOPSC), and barriers to incident reporting questionnaire]. A simple random sampling method was used, and the evaluation process was divided into three parts, the beginning, the middle and the end of the intervention. At each time point, we investigated the caregivers who worked in the selected departments. The caregivers who participated in each survey met the following criteria: he or she had worked in the selected department for at least 1 year before the interventions, and persons who left during or at the end of the interventions were excluded. The three questionnaires introduced were as follows: (1) The SAQ which was described previously [11, 12]. The SAQ developed by Sexton JB had six dimensions and 32 items in total, and the dimensions were teamwork climate, safety climate, job satisfaction, stress recognition, perception of management and working conditions. All the items were scored on a five-point Likert scale (1=disagree strongly, 2=disagree, 3=neither agree nor disagree, 4=agree, 5=agree strongly), and negatively worded items were reversely scored with higher scores indicating better safety attitudes. (2) The HSOPSC, which was developed by American Healthcare Research and Quality. The Frequency of Events Reported section had three items and they were scored using a five-point Likert scale (1=never, 2=rarely, 3=sometimes, 4=often, 5=always). The Number of Events Reported section had one item with six options: 1=no events reported, 2=1 to 5 events reported, 3=6 to 10 events reported, 4=11 to 15 events reported, 5=16 to 20 events reported, and 6=21 or more events reported. Higher scores indicated a high frequency of events reported and better patient safety. This questionnaire is described elsewhere [13]. (3) Barriers to incident reporting questionnaire. This questionnaire was developed by Vincent and adapted by Evans [14]. The adapted version has nineteen items, whereas in this study we used the version translated by Tian Huanhuan and added the last three items from Evans. All 22 items were scored on a five-point Likert scale (1=disagree strongly, 2=disagree, 3=neutral, 4=agree, 5=agree strongly), in which item 15, 16, and 19-22 were negatively worded, and were reversely scored. Higher scores indicated fewer incident reporting barriers and better patient safety.

Statistical analysis

In this survey, we invited investigators to the selected departments. They addressed the survey and provided the questionnaires in the morning meeting, respondents were asked to complete the questionnaires, and the investigators then collected the questionnaires. In some cases, the head nurses in each selected department provided and collected the questionnaires completed by the few respondents who did not attend the meeting. The interview period for each survey lasted 2 weeks, and a telephone reminder was sent to non-respondents after one week.

The chi-square test was used to compare differences in the composition ratio (%) of demographic characteristics between different months. The Komogorov-Smirnov test was used to identify whether the data were normally distributed. If the data were not normally distributed, the median and interquartile range were used to describe the data. The Kruskal-Wallis H test was applied to compare the scores of the scales with non-normal distribution. The Mann-Whitney U test was used to compare the scores of the scales from two independent samples with non-normal distribution. A p -value less than 0.05 was considered statistically significant.

Results

Demographic characteristics

As shown in **Table 2**, there was no overall significant difference in the composition ratios of respondent demographic characteristics between the three time points during follow-up, such as age, sex, position classification and job title. Furthermore, no significance differences were found between each two time points during follow-up.

SAQ assessment

We compared the scale scores obtained in March with those in June (**Table 3**). The scores for teamwork climate, safety climate, job satisfaction, perception of management and the total scale dimensions in June were significantly higher than those in March. However, we found that the scores for teamwork climate, job satisfaction and perception of management dimensions in June were significantly higher than those in December. Furthermore, we compared the scores between March and December.

Frequency of adverse event reports and barriers to incident reporting questionnaire

The results in **Table 4** showed that there was no significant difference in the frequency of adverse events reported in December compared with that in March and June. The results in **Table 5** show that 15 of 22 items had significantly higher scores in December as compared with those in June and March.

Discussion

In the present study, an almost 9-month follow-up period was carried out at Shengjing Hospital from March to December in 2017, and it was found that the safety culture after the interventions had improved markedly using multiple questionnaire assessment.

The scores for teamwork climate, safety climate, job satisfaction, perception of management and total scale dimensions in June were significantly higher than those in March, indicating that the safety

interventions had a remarkable effect. However, the scores for teamwork climate, job satisfaction and perception of management dimensions in December were significantly reduced compared with those in June, which indicated that the intensity of the interventions needs to be increased and the intervention time needed to be extended to achieve satisfactory results. The reason for this may be due to seasonal changes, the number of patients and the various disease stages, and these factors may have affected these dimension scores. Scores for the five dimensions, except perception of management and the total scale in December, were higher than those in March, demonstrating that the interventions enhanced the safety culture. The results for teamwork and safety climate were similar to those in previous studies. The comprehensive interventions in this study were similar to those in Paine's study [5], and our results demonstrated the success of the interventions.

The study by Vigorito [15] included changes in the central line-related blood infection rate and ventilator-associated pneumonia incidence before and after the intervention, but in our study no other patient safety indices were observed. Hefner et al. [16] implemented an intervention on crew resource management, and Gupta et al. [17] implemented the TeamSTEPPS intervention; however, these two methods were not implemented in the present study. With regard to stress recognition, Meurling [18] implemented the systematic simulation-based team training intervention, which significantly increased the stress recognition scores, and no significant differences were observed between any two time periods, suggesting that managers need to implement special interventions for caregiver stress in order to reduce stress and improve the safety culture. With respect to management of the hospital, the score in December was significantly lower than that in June and March. This indicated that management adjustments were required in accordance with changes in the actual situation in a timely manner, and managers needed to strengthen the intensity of management interventions to improve safety culture. With the exception of perception of management, the results of this study were consistent with the study by McGuide et al. Their study implemented an electronic medical records system intervention the same as the system in this study, and both studies demonstrated the success of the intervention [19]. Furthermore, the interventions in this study included the use of a surgical checklist, and it was found that after the interventions the SAQ scores increased which was similar to that in the study by Haynes [6]. The interventions in this study included a three level round system and difficult case discussion system, which were similar to the structured interdisciplinary rounds in Leary's study. Both studies showed a higher teamwork score after the interventions, suggesting that the interventions were effective [20].

In addition, the results of this study indicated a decrease in incident reporting barriers and a satisfactory effect of the interventions. The scores for item 5, 15, 16 and 19 decreased after the intervention, indicating that incident reporting training should be strengthened, and the principal in charge of reporting incidents should understand the concepts involved, such as knowing caregivers' needs, providing the most convenient reporting methods and training on the scope and content of the incidents to be reported. The scores for item 15, 16 and 19 decreased as they were negatively worded, suggesting that these three items should be positively worded to facilitate an accurate answer by the respondents. The findings on safety attitudes and incident reporting in this study were similar to those in other studies. Caregivers are

concerned that the reputation of individuals and hospitals would worsen, which may lead to punishments by organizations as they may be involved in unnecessary lawsuits or disputes if patients and their families are aware of the facts. On the other hand, physicians are reluctant to report adverse events including the risk of liability exposure, professional embarrassment, burdensome reporting methods, time required for reporting, the importance of adverse events and a lack of sense of ownership in the process [21]. Many factors can also influence the reporting of adverse events, such as a shortage of encouragement by the faculty and prompt high quality feedback on adverse events, fear of compromising one's career or personal reputation, time constraints, complex reporting systems, and forgetfulness [22]. The first step should be to create a non-punitive safety culture, improve the mechanism of medical dispute mediation and medical risk sharing. Hospitals also need to strengthen training on adverse event reporting, so that caregivers can report incidents without fear, and safety culture can be improved.

Conclusions

The safety culture interventions in Shengjing Hospital were successful, as teamwork climate, safety climate, job satisfaction and working conditions improved. However, the intensity of the interventions should be strengthened and the time should be prolonged to further improve safety culture. The stress recognition score showed no obvious change, and the perception of management score decreased. These findings indicated that management should be adjusted and strengthened in future. The number of adverse event reports increased and reporting barriers decreased, suggesting that a non-punitive safety culture should be created, the mechanism of medical dispute mediation and medical risk sharing should be enhanced, adverse event reporting training should be strengthened, and caregivers should be encouraged to report incidents, which would improve safety culture.

Abbreviations

SAQ:safety attitude questionnaire; HSOPSC:hospital survey of patient safety culture; CUSP:used a unit-based safety program.

Declarations

Ethics approval and consent to participate

This study was approved by the institutional review board of the Shengjing Hospital of China Medical University (2018PS21K). All participants in the study provided written informed consent.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

There are no conflicts of interest.

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Authors' contributors

ZY provided the funding for this study. ZY, CQ, ZX, WQ, WN, HJ and ZC contributed to designing the interventions. ZC carried out the three investigations and wrote the manuscript. All the authors contributed to article processing and approved the final version of the manuscript for submission.

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References

- [1] Organization WH. Conceptual Framework for the International Classification for Patient Safety In. https://www.who.int/patientsafety/taxonomy/icps_full_report.pdf; 2009: 1-154.
- [2] Anderson JG, Abrahamson K. Your Health Care May Kill You: Medical Errors. *Stud Health Technol Inform* 2017, 234:13-17.

- [3] Donaldson L. An organisation with a memory. *Clin Med (Lond)* 2002, 2(5):452-457.
- [4] Zhang MM LY. Patient Safety-Global Challenges for Health Care Service (in chinese with English abstract). *Chinese Journal of Evidence-Based Medicine* 2008, 8(7):509-512.
- [5] Paine LA, Rosenstein BJ, Sexton JB, Kent P, Holzmueller CG, Pronovost PJ. Assessing and improving safety culture throughout an academic medical centre: a prospective cohort study. *Qual Saf Health Care* 2010, 19(6):547-554.
- [6] Haynes AB, Weiser TG, Berry WR, Lipsitz SR, Breizat AH, Dellinger EP, Dziekan G, Herbosa T, Kibatala PL, Lapitan MC et al. Changes in safety attitude and relationship to decreased postoperative morbidity and mortality following implementation of a checklist-based surgical safety intervention. *BMJ Qual Saf* 2011, 20(1):102-107.
- [7] Cui Y XX, Zhang JS, et al. Implementation and outcomes evaluation of the improvement project on patient safety culture (in Chinese with English abstracts). *Chinese Journal of Hospital Administration* 2016, 32(12):922-925.
- [8] CMDA. Patient safety objectives defined with Chinese Medical Doctor Association. In. <http://www.cha.org.cn/plus/view.php?aid=15131>; 2017.
- [9] Ren WA GY, Li LY, et al. Interpretation of revision of three standards of central sterile supply department (in Chinese with English abstracts). *Chinese Journal of Nosocomiology* 2017, 27(16):3601-3611.
- [10] M AC. *Clinical Technology Operational Norms-Anesthesiology*. Beijing: People's Military Medical Press; 2009.
- [11] Cui Y, Xi X, Zhang J, Feng J, Deng X, Li A, Zhou J. The safety attitudes questionnaire in Chinese: psychometric properties and benchmarking data of the safety culture in Beijing hospitals. *BMC Health Serv Res* 2017, 17(1):590.
- [12] Li Y, Zhao X, Zhang X, Zhang C, Ma H, Jiao M, Li X, Gao L, Hao M, Lv J et al. Validation study of the safety attitudes questionnaire (SAQ) in public hospitals of Heilongjiang province, China. *PLoS One* 2017, 12(6):e0179486.
- [13] AHRQ. Hospital Survey on Patient Safety Culture. In. <https://www.ahrq.gov/sops/surveys/hospital/index.html>; 2019
- [14] Evans SM, Berry JG, Smith BJ, Esterman A, Selim P, O'Shaughnessy J, DeWit M. Attitudes and barriers to incident reporting: a collaborative hospital study. *Qual Saf Health Care* 2006, 15(1):39-43.
- [15] Vigorito MC, McNicoll L, Adams L, Sexton B. Improving safety culture results in Rhode Island ICUs: lessons learned from the development of action-oriented plans. *Jt Comm J Qual Patient Saf* 2011,

37(11):509-514.

[16] Hefner JL, Hilligoss B, Knupp A, Bournique J, Sullivan J, Adkins E, Moffatt-Bruce SD. Cultural Transformation After Implementation of Crew Resource Management: Is It Really Possible? *Am J Med Qual* 2017, 32(4):384-390.

[17] Gupta RT, Sexton JB, Milne J, Frush DP. Practice and quality improvement: successful implementation of TeamSTEPPS tools into an academic interventional ultrasound practice. *AJR Am J Roentgenol* 2015, 204(1):105-110.

[18] Meurling L, Hedman L, Sandahl C, Fellander-Tsai L, Wallin CJ. Systematic simulation-based team training in a Swedish intensive care unit: a diverse response among critical care professions. *BMJ Qual Saf* 2013, 22(6):485-494.

[19] McGuire MJ, Noronha G, Samal L, Yeh HC, Crocetti S, Kravet S. Patient safety perceptions of primary care providers after implementation of an electronic medical record system. *J Gen Intern Med* 2013, 28(2):184-192.

[20] O'Leary KJ, Creden AJ, Slade ME, Landler MP, Kulkarni N, Lee J, Vozenilek JA, Pfeifer P, Eller S, Wayne DB et al. Implementation of unit-based interventions to improve teamwork and patient safety on a medical service. *Am J Med Qual* 2015, 30(5):409-416.

[21] Farley DO, Haviland A, Champagne S, Jain AK, Battles JB, Munier WB, Loeb JM. Adverse-event-reporting practices by US hospitals: results of a national survey. *Qual Saf Health Care* 2008, 17(6):416-423.

[22] Jansma JD, Wagner C, ten Kate RW, Bijnen AB. Effects on incident reporting after educating residents in patient safety: a controlled study. *BMC Health Serv Res* 2011, 11:335.

Tables

Table 1 Interventions implemented in some departments to improve patient safety

Department	Training	Practice	Perfecting rules and regulations
Managerial			
Medical Department	Being on duty and shift change system training, clinical blood audit system training, total hospitalization training.	Checked the operative and non-operative duty and shift systems, checked the clinical blood audit system. Carried out the skill competitions in medical technical departments, anesthesia rooms and operating rooms. Examined the rescue system of critical and emergency patients, the operation safety verification system and the implementation of critical value reporting system. Carried out activities of “scientific and rational use of blood propaganda week”. Focused on perioperative safety in operation departments and quality of patients. Achieved quality management model by a “treatment group” as a unit and quality monitoring model by an “electronic medical record” as the basis. Carried out double quantitative evaluation of “medical quality management” and “medical safety management”. Ensured the safety of medication and the quality of patients in non-surgical departments. Checked the three level rounds system, difficult case discussion system, classification management system of antimicrobial drugs.	Organized and formulated the evaluating rules for the implementation of the medical core system, strengthened the work of the Medical Quality and Safety Management Committee, formulated and improved the hospital-related management system and norms.
Hospital Infection-Control	Self-examination, reporting, preventing and controlling of	elected Shengjing hospital infection prevention and control image ambassador. Self-examination, reported, prevented and controlled	None.

	infection risks, hazard events training.	infection risks and hidden dangers. Carried out hospital infection management safety month activities.	
Prevention	Strengthen training and publicity, enhance the staff of major infectious diseases, radiation protection, occupational safety and other protection awareness. Daily staff training, inviting experts outside for training, continuing medical education and training, office network training and assessment.	held the 2017 health education science popularization contest. Further improved the development of information platform for major infectious diseases such as tuberculosis. Strengthened the safety management of radiation protection in hospital radiological protection and diagnosis and treatment work. Strengthened the whole management of vaccination and promoted the safety of vaccination.	1 Improved the pre-warning mechanism and follow-up mechanism of infectious disease information. 2 Established the hospital radiation protection safety management manual system. 3 Established series of popular science system of hospital major infectious diseases, radiation protection, etc.
Clinical			
Nursing	all nurses training of nursing safety work,	studied and implemented the 2017 patient safety goals and regarded them as a key of security	None.

implementing “Ten Patient Safety Targets”^[8].

checks. Used the information platform to report adverse event anonymously, the e-mail address is shengjinghlaq@163.com. Quarterly checked care safety work (Safety Management Committee of Nursing Department). Quarterly published an issue of “Nursing Safety Warning”.

Operating Room

Drills and training of emergency plans.

held security discussion every quarter, each team leader reported security risks in the area where he/she was in charge of and proposed improvement measures. Set up a maintenance registration book, registered the periodical maintenance time of the logistics goods, worked with the equipment department to manage the large equipment overhaul to ensure the safety of the operation equipment. Worked with the functional departments to ensure the safety of infection control. Improve the operating room information flow management, used the surgical checklist scientifically to ensure the safety of operations. Expand safety culture construction in operating room.

1 Established and improved the characteristic emergency plan of the operating room. 2 Revised the standards of the assessment of nurse's capacity and the assessment of job responsibilities and training. 3 Improved the safety incident emergency plan in awakening room.

Anesthesiology

regularly study of business, discussion of critical and special cases on each Monday,

Checked the preoperative visit records of the chief anesthesiologist and the anesthesia implementation plan irregularly. Clarify the responsibility of the chief anesthesiologist and

1 Improved the management system of the Awakening

discussion of anesthesia plan for critical patients on each Thursday, monthly study of anesthesia technical specifications and operating procedures [9], strict operation in accordance with the medical norms, regular evaluation of the content of the study and discussion, study of emergencies in operations and drilling and dealing with emergencies.

strengthen anesthesia management in operations. Strengthen safety maintenance of medical equipment operations.

Room, improved the management process of the Awakening Room, emphasized the doctor responsibility system in the Awakening Room. 2 Developed the related rescue flow chart.

Technical

Ultrasound Regular study of the relevant medical laws and regulations, the medical security system, quarterly training of the whole safety plan, training of cardiopulmonary resuscitation by specialists, study of the weekly business.

Strengthened the safety management of ultrasound intervention and contrast-enhanced ultrasound. Supervised report reviews and difficult cases follow-up systems. Strengthened the daily safety management.

Standardized the rescue process for critically ill patients, standardized the emergency incident handling process.

Radiology	<p>training the technicians and nurses of skills, regularly training and practicing of treatment and transferring of the adverse reaction of contrast media.</p> <p>Regularly training and drilling of fire safety.</p>	<p>continue to insist on the early consultation, business learning, difficult case discussion, multi-disciplinary teams (MDT) consultation.</p> <p>Continuous optimizing the inspection process of the emergency and critical patients. Strictly implemented the operating norms of large-scale medical equipment, kept workplace access control, regular maintained equipment.</p> <p>Established a safety staff system in the workplace and let it be responsible for daily safety supervision and management.</p>	<p>1 Established the improved the safety rules and regulations covering all levels of medicine, technology and nursing departments. 2 Established the inspection norms of large-scale equipment for critical patients in Radiology Department. 3 Developed emergency plan of water, electricity and fire risks. 4 Improved the first aid handling process in Radiology Department.</p>
Medical	weekly study of	supervised and inspected the standard operation	None.

Laboratory	<p>medical system, training and assessment of laboratory safety at least two times per year.</p>	<p>of the biosafety management of laboratories and the strict implementation of the biosafety management system. All persons entering the laboratory should follow the biosafety access system and the security manager was responsible for supervision. Strengthened biological safety self-examination. Strengthened the safety management of occupational exposure of the staffs. Strengthened the management of laboratory waste and contaminants. Strengthened the quality control of the whole medical laboratory process to ensure medical safety. Strengthened the management of flammable and explosive chemical dangerous goods and bacteria strains. Strengthened the fire safety management of the medical laboratory and the management of information system security.</p>	
Others			
CSSD	<p>training the staffs National Health and Family Planning Commission (NHFPC) the three mandatory health industry standards on the management of CSSD^[10], training the staffs on the standard quality of visual</p>	<p>the infection management working group carried out quality inspection and guidance, following up and corrective action as planned. Held the management group working meeting monthly, summarized and analyzed the problems of the infection control quality, made corrective measures, and implemented and feedback in time, followed up the results simultaneously. For pressure vessels and large equipment, operators must had work license and used equipment canonically and proficiently, engineers did</p>	<p>1 Revised the department work quality standards. 2 Developed the consumables safety management system.</p>

infection management regular maintenance and equipment inspection work, training and every year. Manage dangerous chemicals assessing of canonically and kept safe use. Manage emergency plans and consumable supplies in accordance with the safety management standard and used them safely. system of pressure vessels and large equipment(once per year). Training and assessment of all the staffs the operating rules of the sterilizers and the technical standards of the sterilization (once per year).

Hematology Lab	training for patient safety.	Further standardized and completed the medical safety of the specimen receives, releasing the reports, the diagnosis and so on. Weekly held “business learning” and “special difficult case discussion”. Set up a medical quality commissioner and let he/she be responsible for the medical safety work comprehensively. Strengthened the management of instruments and reagents. Strengthened the infection control work in the hospital.	None.
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Pharmacy	professional skills training.	Gave full play to the professional characteristics of clinical pharmacists to ensure rational drug use. Improved the quality of hospital preparation products, enhanced the influence of agents.	Further refined the system and standardized the process to
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ensure the drug
transferring
quality.

Note: CSSD, central sterile supply department.

Table 2 Demographic characteristics

type	number (%)			Composition ratio comparisons between months			
	March	June	December	<i>P1</i>	<i>P2</i>	<i>P3</i>	<i>P4</i>
Sex				0.12	0.95	0.10	0.06
Male	75 (13.56)	41 (13.71)	53 (18.66)				
Female	478 (86.44)	258 (86.29)	231 (81.34)				
Age				0.93	0.97	0.78	0.72
<=40	484 (87.52)	262 (87.63)	251 (88.38)				
>40	69 (12.48)	37 (12.37)	33 (11.62)				
Position classification				1.00	0.96	1.00	0.99
doctor	91 (16.58)	52 (17.39)	49 (17.25)				
pharmacist	63 (11.48)	30 (10.03)	30 (10.56)				
nurse	280 (51.00)	153 (51.17)	144 (50.70)				
technician	104 (18.94)	59 (19.73)	56 (19.72)				
other	11 (2.00)	5 (1.67)	5 (1.76)				
Job title				0.21	0.08	0.32	0.54
Junior or below	417 (75.96)	242 (81.21)	218 (77.86)				
Middle or above	132 (24.04)	56 (18.79)	62 (22.14)				

Note: The chi-square test was used to compare the differences in composition ratios between different months. P1 refers to the P value of the comparison of ratios in March, June and December, P2 refers to the P value of the comparison of ratios in March and June, P3 refers to the P value of the comparison of ratios in June and December, and P4 refers to the P value of the comparison of ratios in March and December.

Table 3 Comparison of SAQ scores at the three time-points during follow-up

<i>P</i>	month	sample	Teamwork climate	Safety climate	Job satisfaction	Stress recognition	Perception of management	Working condition	Total score
	3	553	83.33	75.00	85.00	37.50	82.50	75.00	75.58
			(70.83, 91.67)	(67.86, 89.29)	(70.00, 100.00)	(25.00, 56.25)	(72.50, 95.00)	(68.75, 93.75)	(67.44, 85.47)
	6	299	83.33	78.57	90.00	43.75	85.00	75.00	78.49
			(75.00, 95.83)	(67.86, 92.86)	(75.00, 100.00)	(25.00, 62.50)	(72.50, 100.00)	(68.75, 93.75)	(68.60, 88.37)
	12	284	79.17	75.00	85.00	37.50	80.00	75.00	75.87
			(70.83, 95.83)	(67.86, 92.86)	(70.00, 100.00)	(25.00, 67.19)	(70.00, 97.50)	(68.75, 93.75)	(66.28, 87.79)
<i>P1</i>			< 0.01	<0.01	<0.01	0.41	0.07	0.98	<0.01
<i>P2</i>			< 0.01	< 0.01	< 0.01		< 0.01		<0.01
<i>P3</i>			<0.01	0.41	<0.01		<0.01		0.10
<i>P4</i>			0.76	0.11	0.25		0.58		0.51

Note: The Kruskal-Wallis H test was used to compare scores in March, June and December, the Mann-Whitney U test was used to compare scores in March and June, scores in June and December, and scores in March and December. P1 refers to the P value of the comparison of scores in March, June and December. P2 refers to the P

value of the comparison of scores in March and June, P3 refers to the P value of the comparison of scores in June and December, and P4 refers to the P value of the comparison of scores in March and December.

Table 4 Comparison of the frequency of adverse event reporting at the three time-points during follow-up

No	Item	March	June	December	<i>p</i>
1	When a mistake is made, but is caught and corrected before affecting the patient, how often is this reported?	3.00 (2.00,4.00)	3.00 (2.00,4.00)	3.00 (3.00,4.00)	0.48
2	When a mistake is made, but has no potential to harm the patient, how often is this reported?	3.00 (2.00,4.00)	3.00 (2.00,4.00)	3.00 (2.00,4.00)	0.11
3	When a mistake is made that could harm the patient, but does not, how often is this reported?	3.00 (2.00,4.00)	3.00 (2.00,4.00)	3.00 (2.00,4.00)	0.27
4	In the past 12 months, how many event reports have you filled out and submitted?	1.00 (1.00,1.00)	1.00 (1.00,1.00)	2.00 (1.00,2.00)	0.33

Note: The Kruskal-Wallis H test was used to compare scores in March, June and December.

Table 5. Average score and rank comparisons of barriers to incident reporting at the three time-points during follow-up

No	Item	March	June	December	P1	P2	P3	P4
1	The incident is too trivial.	5.00	5.00	5.00	<0.01	0.08	0.03	<0.01
		(4.00,	(4.00,	(4.00,	<0.05		<0.05	<0.05
		5.00)	5.00)	5.00)				
					<0.05		<0.05	<0.05
					<0.05		<0.05	<0.05
					0.20		0.20	0.20
					<0.05		<0.05	<0.05
					<0.05		<0.05	<0.05
					<0.05		<0.05	<0.05
					<0.05		<0.05	<0.05
					<0.05		<0.05	<0.05
					<0.05		<0.05	<0.05
					0.41		0.41	0.41
					0.06		0.06	0.06
					<0.05		<0.05	<0.05
					<0.05		<0.05	<0.05
					0.23		0.23	0.23
					<0.05		<0.05	<0.05
					<0.05		<0.05	<0.05
					0.90		0.90	0.90

					0.42	0.42	0.42
					<0.05	<0.05	<0.05
					0.38	0.38	0.38
2	If I discuss the case with the person involved nothing else needs to be done.	4.00 (4.00, 5.00)	4.00 (4.00, 5.00)	5.00 (4.00, 5.00)	<0.01	0.11	0.03 <0.01
3	I am worried about litigation.	3.00 (2.00, 4.00)	3.00 (2.00, 4.00)	4.00 (3.00, 5.00)	<0.01	0.18	0.04 <0.01
4	I am worried about disciplinary action.	2.00 (2.00, 5.00)	3.00 (2.00, 5.00)	3.00 (2.00, 5.00)	<0.01	0.13	0.03 <0.01
5	I don't know whose responsibility it is to make a report.	4.00 (4.00, 5.00)	4.00 (4.00, 5.00)	4.00 (3.00, 5.00)	0.22		
6	The incident form takes too long to fill out and I just don't have the time.	3.00 (3.00, 5.00)	4.00 (3.00, 5.00)	4.00 (4.00, 5.00)	<0.01	0.09	<0.01 <0.01
7	It's not my responsibility to report somebody else's mistakes.	4.00 (3.00, 5.00)	4.00 (3.00, 5.00)	4.00 (3.00, 5.00)	<0.01	0.14	<0.05 <0.01
8	I'm afraid the supervisor has a negative opinion of me after the report.	4.00 (3.00, 5.00)	4.00 (3.00, 5.00)	4.00 (3.00, 5.00)	<0.01	0.16	<0.05 <0.01
9	I will not report because the supervisor's attitude towards the report is not positive.	4.00 (3.00, 4.00)	4.00 (3.00, 5.00)	4.00 (4.00, 5.00)	<0.01	0.16	<0.05 <0.01

10	My co-workers may be unsupportive.	4.00	4.00	4.00	<0.01	0.29	0.04	0.01
		(3.00,	(3.00,	(4.00,				
		5.00)	5.00)	5.00)				
11	I am concerned that the reporting of other people's events will affect the relationship between colleagues.	3.00	3.00	4.00	<0.01	0.22	0.04	0.02
		(2.00,	(2.00,	(3.00,				
		5.00)	5.00)	5.00)				
12	Health care workers will be discriminated against in the event of adverse events.	4.00	4.00	4.00	0.47			
		(3.00,	(3.00,	(3.00,				
		5.00)	5.00)	5.00)				
13	Adverse incident reporting is unlikely to lead to system changes.	4.00	4.00	4.00	<0.05	0.41	0.04	<0.01
		(3.00,	(3.00,	(3.00,				
		5.00)	5.00)	5.00)				
14	Health care workers are concerned that the adverse events will be recorded in their personnel files.	3.00	3.00	3.00	<0.05	0.05	<0.01	<0.01
		(2.00,	(2.00,	(2.00,				
		4.00)	4.00)	5.00)				
15	The form is too complicated and requires too much detail.	3.00	4.00	4.00	0.19			
		(3.00,	(3.00,	(2.00,				
		4.00)	4.00)	4.00)				
16	Increasing the way of reports, such as telephone, email and fax, will increase my willingness of report.	4.00	4.00	4.00	0.23			
		(3.00,	(3.00,	(2.00,				
		4.00)	4.00)	4.00)				
17	I do not feel confident the form is kept anonymous.	3.00	3.00	4.00	<0.05	0.07	<0.01	<0.01
		(2.00,	(2.00,	(3.00,				
		4.00)	4.00)	5.00)				
18	Even if I don't give my details, I'm sure that they'll track me down.	3.00	3.00	3.00	<0.05	0.08	<0.01	<0.01
		(2.00,	(2.00,	(2.00,				
		3.00)	3.00)	5.00)				
19	It would increase my willingness of report to specify the scope and content of the adverse events that need to be reported.	4.00	4.00	4.00	0.29			
		(3.00,	(3.00,	(2.00,				
		4.00)	4.00)	4.00)				

20	If a certain bonus or reward is set up, it will increase my willingness to report	3.00 (3.00, 4.00)	3.00 (3.00, 4.00)	3.50 (2.00, 4.00)	0.41				
21	If feedback is received in a timely manner (e.g. if the hospital has taken corrective action based on the report analysis), it will increase the willingness of my report	4.00 (3.00, 4.00)	4.00 (3.00, 4.00)	4.00 (3.00, 5.00)	<0.05	0.16	0.02	<0.01	
22	If the hospital analyzed the reports and released the results of the analysis periodically, it will increase my willingness to report	4.00 (3.00, 4.00)	4.00 (3.00, 4.00)	4.00 (3.00, 5.00)	0.33				

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