



Construction of a Quality Evaluation system for Emergency Pre-examination and Triage under the Normalization of the COVID-19 Epidemic based on the SERVQUAL Model

Hongquan Fan¹, Zhe Chu^{1*}, Huimin Li¹ and Wei Wang¹

¹Emergency nursing Department, First Hospital of Jilin University Changchun China

* **Corresponding author:** Zhe Chu, Emergency nursing Department, First Hospital of Jilin University Changchun China. Email:chuzhe@jlu.edu.cn

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Abstract

Background: The effect of emergency epidemic prevention and control and the quality of emergency pre-testing and triage under the normalization of COVID-19 epidemics was evaluated by quality evaluation system based on the SERVQUAL model.

Objectives: This study aimed to develop a quality evaluation system for emergency pre-test and triage under a normal COVID-19 epidemic, based on the SERVQUAL model.

Methods: Based on the SERVQUAL model, a quality evaluation system of emergency pre-examination and triage under the normalization of the COVID-19 epidemic was developed. Two rounds of expert consultation were conducted by the Delphi method, involving 15 experts.

Results: The recovery rates for the two rounds of expert consultation were 100 %, the expert authority coefficient was 0.954, and the Kendall coordination coefficients were 0.273 and 0.182. The coefficients of variation of the three-level indicators of the two rounds of expert consultation were 0.003-0.275 and 0.052-0.125, respectively. An evaluation system including 5 first-level indicators, 14 second-level indicators, and 42 third-level indicators of 5 dimensions (tangibility, reliability, responsiveness, assurance, and empathy) of the SERVQUAL model was established.

Conclusion: Based on the SERVQUAL model, a quality evaluation system for emergency pre-examination and triage under the normalization of the COVID-19 epidemic situation was completed. It reflected the medical services, triage, and epidemic prevention and control required to provide the requisite quality of emergency pre-examination and triage under the normalization of the COVID-19 epidemic situation. It provided a reference for the quality supervision of emergency pre-examination and triage under the normalization of the COVID-19 epidemic situation.

Keywords: COVID-19 normalized, Emergency pre-examination and triage, SERVQUAL model

1. Background

Emergency pre-examination and triage are the first links in the whole emergency medical service system, and also the core of the emergency process (1). The operation of pre-examination and triage directly affects medical safety and the effective utilization of emergency resources (2). The epidemic situation of COVID-19 is tending to become normalized. As an outpost for the prevention and control of COVID-19 in hospitals (3), the quality management of emergency pre-examination and triage involves medical services, epidemic prevention and control, and disease pre-examination and triage. Determining the best method of supervising the quality of emergency pre-examination and triage under the normalization of the COVID-19 epidemic is an urgent problem. However, there is no uniform quality evaluation standard for emergency pre-examination and triage in China. Therefore, it is highly important to establish an emergency pre-examination and triage evaluation system that can improve the quality of medical services and epidemic prevention and control from multiple perspectives (4).

The SERVQUAL model is a management model that links services (serv) to quality (qual), using the

satisfaction of service personnel as a method of assessing industry quality (5). It includes five dimensions, namely tangibility, reliability, responsiveness, assurance, and empathy. At present, the SERVQUAL model is widely used in nursing procedures and services; however, there are few studies on medical services and emergency triage. All studies of this research team were carried out in the First Hospital of Jilin University in Changchun City, Jilin Province.

2. Objectives

The purpose of this study was to construct a quality evaluation system for emergency pre-examination and triage under the normalization of COVID-19 based on the SERVQUAL model within the framework of an emergency pre-examination and triage system and COVID-19 epidemic prevention and control guidelines. A secondary objective was to provide regulatory tools for improving the quality of emergency medical services, epidemic prevention and control, and pre-examination and triage under a normal state of COVID-19 prevalence.

3. Methods

The pre-examination and triage quality evaluation system is established by using the Delphi method for questionnaire inquiry. The consultation experts were from the emergency professional committee of the Chinese Medical Association / Nursing Association and had to be the head nurses of the emergency department, infection control experts, emergency medical experts, emergency nursing team leaders, or pre-examination triage nurses. The selection criteria were having the ability to actively participate in this study, having an intermediate or above professional title, and being engaged in clinical work for more than 6 years. Finally, 15 experts from different regions were identified, including Beijing (n=2), Shanghai (n=2), Tianjin (n=1), Chongqing (n=1), Jilin Province (n=2), Shandong Province (n=1), Henan Province (n=1), Sichuan Province (n=1), Guangdong Province (n=1), Liaoning Province (n=2), and Heilongjiang Province (n=1), which rendered a total of 11 tertiary hospitals in 11 provinces/municipalities, and the participants were 2 emergency medical experts, 5 head nurses, 3 emergency team leaders, 3 emergency preview triage personnel, and 2 sensory control experts. Eight of the individuals had worked in related fields for 6-10 years, 5 for 10-15 years, and 2 for over 15 years; 8 were chief nurses/attending physicians, and 7 were deputy chief nurses/chief physicians.

3.1. Formulation of the quality evaluation index of emergency pre-examination and triage under the normalization of COVID-19

This study searched for the following keywords: "Emergency preview triage", "New outbreak normalized", "Quality evaluation", and other related Chinese and English search keywords in the Cochrane Library, Internet, Pubmed, Wanfang, WHIP, and other Chinese and foreign language databases. The literature search referenced the tertiary general hospital review criteria (2011 edition), the hospital outpatient and emergency infection management specification, the hospital emergency department standardization process, the emergency department construction and management guide (trial), COVID-19 prevention and control plan (eighth edition), and other ones, combined with the analysis results of the data on emergency pre-examination and triage in the last 3 years. We took all the important links of emergency pre-examination and triage under the normalization of COVID-19 as the entry point, in conjunction with the theoretical framework of the SERVQUAL model. Through discussion and modification by the research team members, the first-level index of the quality evaluation system for emergency pre-examination and triage under COVID-19 normalization was preliminarily formulated using the dimensions ("tangibility, reliability, responsiveness, assurance, and empathy") in the

SERVQUAL model. At the same time, this was combined with the actual clinical situation. After two rounds of expert correspondence, 14 secondary indicators and 42 tertiary-level indicators were formulated.

3.2. Preparation of the questionnaire

The emergency quality evaluation index under COVID-19 normalization based on the SERVQUAL model included three parts. The first part was a letter to experts explaining the purpose and significance of an emergency pre-examination and triage quality evaluation system based on the SERVQUAL model under COVID-19 normalization. The second part consisted of questions on the experts' situation, including their general information, familiarity, and basis for judgment. The familiarity was divided into five levels: very familiar (1.0), familiar (0.8), general (0.6), unfamiliar (0.4), and unaware (0.2) (6). The assessment of judgment in the questionnaire covered four dimensions, namely intuition, reference to domestic and foreign literature, theoretical analysis, and work experience, which were assigned a score of 0.2, 0.4, 0.6, or 0.8. The third part was the assessment of the COVID-19 outbreak normalized preview triage quality evaluation index, using a 5-point Likert scale of 1=unimportant to 5=very important; experts assessed the importance of indicators according to their own opinions to modify, remove, or add the items.

3.3. Expert survey from January 2022 to June 2022

Fifteen experts conducted two rounds of online questionnaire responses, scoring the importance of each index, putting forward suggestions and opinions in the modification column, or recommending the addition and deletion of items. The research team discussed the results of the first round of expert consultation, consulted the relevant literature for testimony, and finally formed the second-round questionnaire by modifying, adding, or deleting items. The results of the second round showed that the experts had consistent opinions on the evaluation indicators, thus forming the quality evaluation indicators for pre-examination and triage under the final normalization of COVID-19.

3.4. Statistical methods

The data were analyzed using the SPSS 20.0 software. Means, standard deviations, and coefficients of variation were used to represent the significance of all levels of the indicators. The effective recovery rate of the questionnaire and the percentage of the expert's suggestions in agreement gave the average of the judgment coefficient and the coefficient of expert familiarity. The index weights of all levels were calculated by the hierarchical analysis method.

4. Results

4.1. Positive coefficient and authority coefficient of experts

In this study, 25 expert consultation questionnaires were distributed in the two rounds, respectively, and 25 were recovered, with an effective recovery rate of 100%. Eleven experts put forward opinions regarding revision in the first round of the survey, accounting for 73.3% of the total number of experts consulted. In the second round, five experts gave opinions on revision, indicating that the positive coefficient of agreement among the experts was high. After the significance test of the assigned expert familiarity and judgment, the expert familiarity coefficient was found to be 0.931, the judgment coefficient was 0.978, and the expert authority coefficient was 0.954.

After two rounds of expert inquiries, the data were analyzed using the SPSS 20.0 Kendall coordination coefficient, and the results are shown in Table 1. The three-level index variation coefficient for the two rounds of expert inquiry was between 0.003 and 0 and 0.052 and 0.125, respectively. The determined index selection criterion was the average of the importance value, 4.0, and the coefficient of

variation was 20%. The results were statistically significant ($P < 0.05$), indicating high expert agreement.

4.2. Quality evaluation index of emergency pre-test triage under COVID-19 based on the SERVQUAL model

After analysis of expert feedback data in the first round, the project team reviewed the literature, screened the selection criterion of 4.0, removed 4 items, and modified 3 items, then removed 8 more items and modified 3 other items. They increased the weighting of "strengthen the personal protection of patients and families" and "qualified rate of epidemiological screening" after a literature review and discussion by the research group. After the second round of expert inquiry, the experts tended to be consistent, forming the quality evaluation index of emergency pre-triage under the normal COVID-19 situation based on the SERVQUAL model. The quality evaluation index increased the relevant content of novel coronavirus screening. Finally, the quality evaluation index for emergency pre-examination and triage under COVID-19 normalization was formed. The importance scores, coefficients of variation, and weights of all indicators are presented in Table 2.

Table 1. Expert Kendall coordination coefficient and significance test

| Project | Number of entries | Coordinated system values | χ^2 Value | degree of freedom (df) | P-value |
|---------|-------------------|---------------------------|----------------|------------------------|---------|
| Round 1 | 44 | 0.273 | 138.015 | 43 | <0.001 |
| Round 2 | 42 | 0.182 | 112.194 | 41 | <0.001 |

Table 2. Quality evaluation indexes of emergency department pre-screening and triage system Level 1, 2, and 3 evaluation indexes, importance score, coefficient of variation and weighting

| Level 1, 2, and 3 evaluation indexes | Importance assignment(sub±s) χ | Coefficient of variation(CV) | Weight value (w) |
|--|-------------------------------------|------------------------------|------------------|
| A Availability-A1 triage desk environment | | | |
| A11 Fresh air and environmental hygiene | 4.13±0.52 | 0.125 | 0.036 |
| The A12 triage desk is set up reasonably, and the guidance mark is clear | 4.60±0.51 | 0.110 | 0.031 |
| A Availability-A2 triage desk equipment and facilities | | | |
| A21 Epidemic prevention and control, disinfection, and temperature measurement facilities are fully equipped | 4.93±0.26 | 0.052 | 0.015 |
| A22 Sphygmomanometer and blood oxygen detector instruments are in good condition | 4.67±0.49 | 0.105 | 0.030 |
| A23 Defibrillator, simple respirator, and other first-aid items are in good condition | 4.93±0.26 | 0.052 | 0.015 |
| A24 Pre-examination and triage system is perfect | 4.87±0.35 | 0.072 | 0.021 |
| A Availability-A3 pre-examination and triage-related system | | | |
| The relevant A31 epidemic prevention and control systems have been improved | 4.87±0.35 | 0.072 | 0.021 |
| A32 Emergency response plans for epidemic prevention and control were improved | 4.67±0.49 | 0.105 | 0.030 |
| A33 Pre-examination and triage criteria and medical procedures (both epidemic prevention and control) | 4.87±0.35 | 0.072 | 0.021 |
| A Availability-A4 pre-examination and triage staff | | | |
| A41 Triage numbers are reasonable | 4.73±0.46 | 0.097 | 0.028 |
| The A42 triage personnel qualification meets the criteria | 4.87±0.35 | 0.072 | 0.021 |
| B Reliability-B1 epidemic prevention and control management | | | |
| B11 Emergency pre-examination for fever is set before triage | 4.87±0.35 | 0.072 | 0.021 |
| Epidemiological screening for B12 patients and their families was effective | 4.87±0.35 | 0.072 | 0.021 |
| B13 Epidemiological screening registration was eligible | 4.87±0.35 | 0.072 | 0.021 |
| B14 The treatment process and path of COVID-19 patients are reasonable | 4.80±0.41 | 0.086 | 0.025 |
| The B15 triage personnel are qualified for personal protection | 4.87±0.35 | 0.072 | 0.021 |
| The frequency, concentration, and effect of B16 triage table are qualified | 4.87±0.35 | 0.072 | 0.021 |
| B17 Patients and their family members passed the personal protection, such as hand disinfection and wearing a mask | 4.73±0.46 | 0.097 | 0.028 |
| B Reliability-B2 pre-test and triage evaluation | | | |

Table 1. Continue

| | | | |
|---|-----------|-------|-------|
| B21 Objective patient information and vital signs were quickly collected and analyzed | 4.93±0.26 | 0.052 | 0.015 |
| B22 Quickly and accurately evaluates the patient's condition | 4.80±0.41 | 0.086 | 0.025 |
| B23 Arrange for patients to visit within the response time at the corresponding level | 4.80±0.41 | 0.086 | 0.025 |
| B24 Dynamically adjusted the patient visit levels | 4.27±0.46 | 0.107 | 0.031 |
| Key signs and examination indicators were interpreted in the B25 patient | 4.80±0.41 | 0.086 | 0.025 |
| B Reliability-B3 for pre-test and triage by green channel management | | | |
| B31 Correctly and effectively identify critical and green channel patients | 4.80±0.41 | 0.085 | 0.024 |
| B32 Critical and green channel patients are unobstructed | 4.80±0.41 | 0.085 | 0.024 |
| C Responsiveness-C1 pre-examination and triage coordination organization and emergency | | | |
| C11 Emergency treatment capacity for suspected COVID-19 patients | 4.93±0.26 | 0.052 | 0.015 |
| C12 Public health emergencies | 4.87±0.35 | 0.072 | 0.021 |
| C13 Group injury emergency treatment | 4.8±0.41 | 0.086 | 0.025 |
| D Allow-security-D1 pre-test and triage satisfaction | | | |
| D11 Patient and family satisfaction with the pre-test | 4.27±0.46 | 0.107 | 0.031 |
| D12 Medical care satisfaction with the effect of pre-examination and triage | 4.60±0.51 | 0.110 | 0.031 |
| D Guarantee-D2 pre-examination and triage accuracy | | | |
| Disease grading accuracy in D21 patients | 4.80±0.41 | 0.086 | 0.025 |
| D22 Patient partition accuracy | 4.93±0.26 | 0.052 | 0.015 |
| D Guarantee-D3 pre-test and triage time meeting the standard rate | | | |
| D31 Triage Grade 1 patients meet the standard rate | 4.80±0.41 | 0.086 | 0.025 |
| D32 Triage secondary patients meet the standard rate | 4.80±0.41 | 0.086 | 0.025 |
| D Guarantee-D4 epidemic prevention and control compliance rate | | | |
| D41 Pre-test triage staff mastery of epidemic risk areas | 4.80±0.41 | 0.086 | 0.025 |
| D42 Qualified rate of epidemiological screening | 4.87±0.35 | 0.072 | 0.021 |
| D43 Pre-examination and triage personnel to solve the contradiction between high-risk personnel and medical needs | 4.80±0.41 | 0.086 | 0.025 |
| E Transference-E1 pre-test and triage service attitude | | | |
| E11 Take the initiative to receive the diagnosis, enthusiastic consultation | 4.80±0.41 | 0.086 | 0.025 |
| E12 Asked the patient about his condition | 4.60±0.51 | 0.110 | 0.031 |
| E Empathy-E2 pre-examination and triage psychological care | | | |
| E21 Relieves adverse negative emotions in patients | 4.80±0.41 | 0.086 | 0.025 |
| E22 Gives humanistic care to the patients and their families | 4.60±0.51 | 0.110 | 0.031 |
| E23 Provide the necessary protective materials to the patient and the family members | 4.87±0.35 | 0.072 | 0.021 |

5. Discussion

5.1. Importance of establishing the quality evaluation criteria for emergency

5.1.1. Pre-examination and triage under the normalization of COVID-19 based on the SERVQUAL model

Triage decision-making is crucial for patients admitted to the emergency room as it influences the clinical outcome (7). The quality of emergency pre-examination and triage is directly related to treatment effectiveness and the work efficiency of emergency medical treatment, and is crucial to the operation and development of the emergency department (8). The emergency department evaluation content in the "Evaluation Standards of Tertiary General Hospitals (2011 edition)" emphasizes the need to strengthen emergency pre-examination and triage, strengthen hierarchical and regional treatment, improve the triage system, and improve the accuracy of emergency triage (9). However, the quality evaluation content in the process of emergency pre-examination and triage, the medical service effect of emergency pre-examination and triage, and the method of prevention of infectious diseases in emergency pre-examination and triage are not mentioned. There are few reports on the

evaluation criteria for the quality of emergency triage at home and abroad. In the pre-epidemic period of COVID-19, Liu et al. (8) constructed the quality evaluation criteria from three aspects, namely structural quality, link quality, and terminal quality. The evaluation content is the integrity of the nursing organizational structure, material and human resources, system guarantee, nursing service ability and utilization rate, the design and implementation of triage standards, the ability and experience of triage nurses, the qualified rate of nurses' triage indicators, the compliance rate of various time limits, the incidence of nursing adverse events, and the satisfaction of triage nursing. Human resource is an important evaluation content in the field of factor quality (10). Under the normalization of the COVID-19 epidemic, the emergency pre-triage system and the COVID-19 epidemic prevention and control guidelines were used as the framework to construct an emergency pre-triage quality evaluation system based on the SERVQUAL model and proposed to increase the quality of high-quality medical services and implement infection control standards and epidemiological screening, which can ensure correct triage, high-quality medical services, prevent in-hospital cross-infection and reduce the occupational exposure of medical staff. It is particularly important

to supervise the quality of medical services, epidemic prevention and control, and pre-triage effectiveness in the emergency pre-triage area.

5.2. Scientific and reliable quality evaluation criteria of emergency pre-test and triage under the normalization of COVID-19 based on the SERVQUAL model

In the preliminary literature search, the Delphi method was conducted for two rounds of expert questionnaire inquiry, and the evaluation criteria of this study were formed based on the actual situation of an emergency clinic under the normalization of the COVID-19 epidemic. The experts consulted had a high level of theoretical knowledge and rich clinical experience in emergency pre-examination and triage, hospital sense control, and nursing quality management, and were widely representative. In rounds 1 and 2, 25 expert inquiry questionnaires were issued, and 25 copies were recovered in both rounds: Round 1 and Round 2 were recovered at 100%. In Round 1, 11 experts proposed amendments (73.3%), and in Round 2, 5 experts proposed changes (33.3%). This indicated that the expert coefficient of the agreement was high: the two-round expert authority factors of this study were 0.945 and 0.954, significantly higher than the base validity of 0.7. This showed that the research results had high reliability. After calculating the Kendall coordination coefficient by SPSS 20.0, the expert coordination coefficient in round 1 was obtained at 0.273, and that in round 2 was 0.182. Moreover, the coefficient of variation of the three-level index in the two rounds of questionnaire inquiry was low, which indicated a high degree of coordination among the experts. The questionnaire inquiry results were therefore reliable. This study demonstrated that the quality evaluation criteria for emergency pre-testing and triage based on the SERVQUAL model under the normalization of COVID-19 were scientific and reliable

5.3. The quality evaluation system for emergency pre-examination and triage under a normalized epidemic situation of novel coronavirus pneumonia can effectively improve the timeliness of emergency pre-examination and triage

In accordance with the requirements of 'Nosocomial Infection Management in Outpatient and Emergency Departments', an epidemiological investigation must be carried out during emergency pre-examination and triage in the epidemic period of infectious diseases (11). Therefore, emergency pre-examination and triage require clinical staff to check a patient's health codes and travel codes and measure body temperature, ask for an epidemiological history, and increase the time spent by patients in pre-examination and triage. The total retention time of patients in the fever clinic and emergency room during the outbreak of COVID-19 was significantly

longer than that before the beginning of the epidemic. The total duration of diagnosis and treatment for each critically ill patient in the fever clinic was 442 (374~636) min (12). Under the normalization of the COVID-19 epidemic, the quality evaluation system for emergency pre-examination and triage emphasizes that the pre-examination and triage desk is equipped with corresponding infection control facilities, and the pre-examination and triage personnel are familiar with the intermediate and high-risk areas for COVID-19, the cleaning and disinfection of the pre-examination and triage desk, and the correct pre-examination and triage processes for key diseases. Therefore, the improvement of the quality of pre-examination and triage can effectively improve the timeliness of pre-examination and triage and ensure the treatment of emergency patients.

5.4. Application of emergency pre-examination and triage quality evaluation system based on SERVQUAL model under the normalization of the COVID-19 epidemic

Based on a multi-center correspondence survey, we constructed an emergency pre-examination and triage quality evaluation system based on the SERVQUAL model under the normalization of the new crown pneumonia epidemic, which can effectively improve the quality of emergency pre-examination and triage (e.g., quality medical service quality, pre-examination and triage accuracy, the implementation rate of infection control measures, epidemiological screening rate, and occupational exposure rate of medical staff) during and after the epidemic. During a major epidemic, it can ensure high-quality pre-examination and triage and high-quality medical services in the emergency department, and at the same time prevent high-contagious patients from entering the emergency area or hospital due to inadequate infection control measures and imprecise epidemiological screening, thereby preventing in-hospital cross-infection, which can further improve the personal protection level of medical staff and reduce their occupational exposure. However, the specific clinical application value needs to be further verified. In addition, at present, only the basic evaluation system standard is proposed, and its application value will be verified in multi centers in China. After verification, it will be further promoted and certified with foreign countries according to the situation.

6. Conclusion

In this study, under the situation of the normalization of the novel coronavirus pneumonia epidemic, a quality evaluation system based on the SERVQUAL model was developed, incorporating the emergency pre-examination and triage system and the novel coronavirus pneumonia epidemic

prevention and control guidelines. The quality evaluation index system can be widely promoted and applied in normalized emergency work during and after the epidemic. Due to the limited time, it has not yet established a special operation mechanism for emergency pre-examination and triage quality evaluation through empirical research. This study has preliminarily explored the emergency pre-examination and triage quality evaluation system based on the SERVQUAL model under the normalization of new coronary pneumonia, which still needs to be verified by large-scale clinical trials. The next step will be to explore the practicality and operability of the tool in the quality evaluation of emergency pre-examination and triage, and further improve the index system in practice, improve the clinical use value, and promote the continuous quality improvement of emergency pre-examination and triage.

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