

Research on the Construction of an Emergency Group Injury Classification Management Model based on the Six Sigma Methodology

Jun Ding*, Ying Cao, Jintao Bao, Peng Yang, Rui Ding

General Hospital of Ningxia Medical University, Yinchuan 750004, Ningxia Hui Autonomous Region, China

*Corresponding author: Jun Ding, 13519212602@163.com

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Abstract: *Objective:* This study aimed to investigate an effective management model for coping with critical incident group injuries. *Methods:* The study started and ended from January 2022 to December 2023, in which 68 patients with critical incident group injuries admitted from January 2022 to December 2022 were selected as the control group in the conventional management mode, and 76 patients with critical incident group injuries admitted in the hospital were selected as the study group in the classification management mode based on the Six Sigma method to compare the management effects of the two groups. The management effects of the two groups were compared. *Results:* The study group took less time to rescue than the control group, and the resuscitation success rate was higher than that of the control group ($P < 0.05$). *Conclusion:* The classification management model based on the Six Sigma method is effective and can be popularized and applied in medical institutions.

Keywords: Six Sigma method; Critical incident; Group injury; Classification management

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1. Introduction

The main characteristics of emergency injuries are destructiveness, suddenness, complexity, and occurring in groups. Patient treatment time is tight and command and management are difficult, so the success rate of treating patients with group injuries in emergencies can reflect the comprehensive management capabilities and capabilities of medical institutions^[1-3]. This study extracted samples of patients with group injuries in emergencies and analyzed the construction and application effect of the classification and management model of group injuries in emergencies based on the Six Sigma method.

2. Information and methods

2.1. General information

The source of patients was either directly admitted to the hospital or transferred to the hospital from other

hospitals after natural disasters in the region. The study group consisted of 42 males and 34 females, with an age range of 8–69 years old and a mean of 37.48 ± 4.59 years old, including 25 cases of limb and spinal fractures, 7 cases of pelvic fractures, 3 cases of craniocerebral injuries, 5 cases of liver and spleen injuries, 4 cases of renal injuries, 8 cases of lung contusions, 20 cases of skin and soft-tissue injuries, and 4 cases of urethral injuries. In the control group, there were 35 males and 33 females, with the age range of 10–68 years old, mean 37.55 ± 4.52 years old, among which there were 22 cases of limb and spine fractures, 6 cases of pelvic fractures, 2 cases of craniocerebral injuries, 7 cases of liver and spleen injuries, 4 cases of renal injuries, 5 cases of lung contusion, 18 cases of skin and soft tissue injuries, and 4 cases of urethral injuries. There was no significant difference between the general information of the two groups ($P > 0.05$).

2.2. Methods

Patients in the control group were under the conventional management model. Medical staff arranged various examinations after receiving the patients. Physicians were responsible for diagnosis and determining treatment plans. Nursing staff were responsible for performing various operations and monitoring patients' vital signs. Hospital managers adjusted the allocation of medical staff according to the actual situation to formulate a handling plan.

The patients in the study group were all classified and managed based on the Six Sigma method. A research team was set up in the hospital, consisting of 10 front-line emergency nurses with more than 10 years of clinical experience, whose main responsibilities were to explore and initially establish the classification and management mode of patients with group injuries in emergencies, to select consulting experts, to summarize and organize the opinions of the experts after completing the expert consulting, to analyze the lack of data, and to formulate the final classification and management plan.

Preliminarily build a three-level management model for critical incident group injuries based on the Six Sigma method. Definition stage: Team members search PubMed, Wanfang, CNKI, and other domestic and international online resource databases, and select keywords for searching, including “group injuries”, “emergency pre-examination and triage”, and “public health emergencies”, to determine the level of management of emergency group injuries. Measurement phase: the researchers refer to the “Emergency pre-screening and triage grading standards (2018 edition)” and related literature, conduct field research in the emergency department, communicate with nursing staff who have been involved in the treatment of patients with group injuries in emergencies, and learn about the reception process, the environment of emergency wards, and so on, and organize discussions among the members of the research team to discuss and evaluate, develop a flow chart for the in-hospital classification and management of patients with critical incident group injuries, and organize team members to discuss and analyze the factors affecting the efficiency and quality of the pre-screening and triage of patients with critical incident group injuries through brainstorming, draw fishbone diagrams to determine the risk factors for the pre-screening and triage of patients with critical incident group injuries and deaths, and determine the risk priority coefficients (RPNs) of the risk factors by adopting the medical failure model and the method of effect analysis.

The critical incident mass injury classification and management model is evaluated based on the Six Sigma method. Selection of experts: based on the relevant requirements of the law on expert meetings and following the principles of authority and representativeness, the following criteria for the selection of experts were determined: engaged in critical care, emergency medical care, clinical medical care, clinical emergency nursing, nursing expert management and so on; have more than 10 years of clinical work experience; master's degree or above in medical field, bachelor's degree or above in nursing field; intermediate or above title. Based

on the budget and the content of the study, the number of consulting experts was determined to be 20, taking into account the possible loss of visits. Meeting process: During the meeting, the group leader introduces the background of the topic and determines whether it is feasible to discuss the categorization and management model based on the Six Sigma method for patients with group injuries in emergencies; determines whether the content of the draft needs to be modified; and whether the process design plan is reasonable and needs to be modified. After the experts read the relevant materials, the team leader organizes the experts to discuss the draft, listens to the recorded expert opinions, communicates with the experts to confirm the unclear places in time, counts the experts' opinions at the end of the discussion, determines the treatment plan, and finally, the experts vote and determine the final classification and management mode of the patients with group injuries in emergencies based on the Six Sigma method.

Implementation of a classification and management model for critical incident group injury patients based on the Six Sigma method is as follows. First, determine the criteria for categorizing patients with critical incident group injuries. Based on the classification of simple injuries and the relevant content of the rapid treatment program, the implementation of the classification of patients with critical incident group injuries are classified as follows, class A for the respiratory rate is greater than 29 times/min or <10 times/min, such as the respiratory rate of 10–29 times/min, the capillary filling time is greater than 2 seconds, will also be included in the category of class A. Class B for the respiratory rate of 10–29 times/min, the capillary filling time is less than 2 seconds. Category C is patients who can walk around normally and have stable vital signs. Secondly, formulate an emergency rescue plan. The hospital develops an emergency response plan for emergency group injury patients, and the triage nursing staff notifies the department head, head nurse, medical department, and nursing department as soon as possible after receiving the patient. If the number of patients exceeds 15 cases, the first level rescue plan is activated, if the number of patients is 10–15 cases, the second level rescue plan is activated, and if the number of patients is 5–10 cases, the third level rescue plan is activated. During the emergency rescue process, the director of the medical department acted as the general index, and the medical staff cooperated to properly handle the patients. Thirdly, optimize and adjust the rescue procedure. The hospital optimizes and adjusts the rescue procedures to ensure that patients with multiple injuries in emergencies receive timely and effective treatment. The hospital set up a liaison and command group, pre-screening and diagnosis group, first aid group, treatment tour group, and transportation group. Members of each group cooperate to implement rescue procedures. The liaison and command team is responsible for contacting the personnel and material supply of each department; the pre-screening and triage team is responsible for completing the classification of patients; members of the first aid team are responsible for rescuing patients; physicians are responsible for the development of treatment plans and the implementation of medical operations; nursing staff are responsible for the management of respiratory and circulatory systems and the detection of changes in the patient's vital signs; the therapeutic circuit team is responsible for the patient's condition observation and routine therapeutic interventions; and the transportation team is responsible for the triage of patients. Category A patients are sent to emergency surgery for rescue, category B patients are sent to the emergency rescue area, and Category C patients are sent to the emergency treatment area. Fourthly, ensure the timeliness of resuscitation. Nursing staff should complete the classification of patients within 3 minutes, complete the triage within 5 minutes, and open the green channel for patients with acute and critical illnesses to avoid delays in patient treatment.

2.3. Evaluation criteria

The treatment time and rescue success rate between the two groups of patients are compared.

2.4. Statistical methods

SPSS 23.0 software is used to analyze the research data, measurement data (mean \pm SD) for the *t*-test, count data % for the χ^2 test, and $P < 0.05$ for the existence of statistical level differences.

3. Results

The treatment time of patients in the study group was lower than that of the control group, and the success rate of resuscitation was higher than that of the control group ($P < 0.05$), as shown in **Table 1**.

Table 1. Comparison of treatment time and success rate of resuscitation in two groups

Groups	Treatment time (min)	The success rate of resuscitation
Study group ($n = 76$)	32.58 \pm 6.44	76 (100.0%)
Control group ($n = 68$)	51.97 \pm 9.72	64 (94.1%)
<i>t</i> -value	14.246	4.598
<i>P</i> -value	0.000	0.032

4. Discussion

Relevant information and data statistics show that the number of deaths due to trauma in China each year is about 100,000 people, and the number of injured people is more than millions [4]. Most of the trauma patients in emergencies are injured in groups. Their main characteristics are the large number of injured, sudden onset, complex injuries, tight rescue time, and difficulty in rescue. How to effectively manage patients with group injuries in emergencies is an important problem that medical institutions need to deal with.

Under the conventional emergency group injury management model, hospital emergency patients are not classified and instead are based purely on the injury to select targeted treatment programs. The responsibilities of the nursing staff are not clear, the cooperation of the medical staff is not adequate, and the responsibilities of each hospital department in the treatment are not clear, which leads to the patient's condition not being controlled in a timely and effective manner, resulting in prolonged patient rescue time, significantly reducing the success rate of the treatment [5]. The Six Sigma method is an effective method of enterprise management. It enables enterprises to improve the technology of enterprise quality process management, with zero defects as the main goal, promote cost reduction and quality improvement, and then promote the enterprise's financial performance and comprehensive competitiveness. The Six Sigma method includes definition, measurement, analysis, improvement, control, and other aspects. It focuses on process transformation and process management, which can improve process input and output and the process itself, to achieve the role of improving the overall efficiency. The Six Sigma method focuses on collaboration between teams, and can fully mobilize the enthusiasm of team members during the implementation process, thereby ensuring that management achieves the expected results [6]. In the specific management process, nursing staff accurately classify emergency group injury patients, quickly complete the classification, and coordinate with various departments to ensure that the rescue personnel and materials are sufficient. The medical staff work together to efficiently complete the classification of treatment. Nursing staff need to improve the observation of the condition and timely handle the abnormalities to significantly improve the overall effect of the rescue treatment.

The results of this study show that the time taken to treat the patients in the study group is lower than that of the control group, and the success rate of rescue is higher than that of the control group, so it can be assumed

that the classification management mode based on the Six Sigma method can shorten the rescue time and significantly improve the success rate of rescue for the patients with group injuries in emergencies. Analyzing the specific reasons, it can be found that under the classification management mode based on the Six Sigma method, a professional research team was set up in the hospital, which reviewed all kinds of literature in the definition stage to determine the pre-screening and triage process suitable for the patients with group injuries in emergencies. In the measurement stage, the researchers communicated with nursing staff involved in the treatment of patients with group injuries in emergencies to understand the existing emergency environment and reception process, analyze its deficiencies and influencing factors, and develop optimization and improvement measures through collective discussion. In the data analysis stage, the researchers clarified the measures for handling risk factors and improved and adjusted the relevant measures in the improvement stage. Through the above operation process, the hospital initially establishes a classification management model for patients with group injuries in emergencies. Based on this, the researchers invite experts to demonstrate and analyze the relevant content to further improve the model. In the process of implementing the Six Sigma-based emergency group injury management model, the hospital has formulated an emergency rescue plan in advance, with clear responsibilities for medical and nursing staff and a clear division of labor among various departments in the hospital. In the process of receiving patients with group injuries in emergencies, nursing staff divided patients into three categories according to the pre-established criteria and escorted each category of patients to different areas to implement differentiated treatment plans. In the treatment process, the nursing staff establishes a sense of responsibility, closely monitors the patient's condition changes, and follows the doctor's instructions to complete the debridement, bandaging, infusion, and other operations, properly fix the fracture area, and cooperate with the physician to complete the operation to ensure that the patient's injuries can be controlled in a timely and effective way. Timely and effective control can ensure the safety of patients' lives, and its actual application effect is significantly better than conventional treatment options ^[7].

In conclusion, the classification management model based on the Six Sigma method for patients with critical incident group injuries is effective and can be popularized and applied in medical institutions. At the same time, the number of samples in the process of this study is relatively small, the process of the study is not perfect, the research time is relatively short, and the program of the classification management model based on the Six Sigma method for patients with critical incident group injuries still needs to be researched.

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