ORIGINAL RESEARCH

Analysis of Effect of Quality Control Circle Management Model on the Error Rate of Disposable Item Distribution and Efficiency of Medical Workers in Sterilization Supply Center

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ABSTRACT

Objective • To explore the effectiveness of quality control circle (QCC) management model in reducing the error rate of dispensing disposable items.

Methods • Our hospital's sterilization supply center implemented QCC management model from May 2021 to December 2021 to compare the error rate of disposable items dispensed before and after the implementation of the QCC activities.

Results • The one-time item dispensing error rate was lower after the QCC activities, the order claim error rate, print order error rate, and inventory error rate were also reduced, and the required loading time and delivery time were shortened ($P < .05$).

Conclusion • QCC activities can reduce the error rate of dispensing disposable items, save time, improve efficiency, and enhance clinical satisfaction. (*Altern Ther Health Med.* [E-pub ahead of print.])

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INTRODUCTION

The establishment of a secondary warehouse of medical consumables ensures the management of supplies after entering the clinical departments from the central warehouse.[1] With the rapid development of various specialties in hospitals, the clinical demand for disposable items has been increasing. The sterilization supply center, as the transit station of the whole hospital, has a pivotal responsibility. The types of disposable sterile items stored has increased, involving many departments with a fast turnover. Therefore, how to distribute disposable items in a timely, accurate and intact manner to meet the needs of clinical work has put forward higher requirements for its management.[2] It has been pointed out that there is a close relationship between the quality of sterile item management and the level of medical safety, such as imperfect supply items and untimely distribution, which can directly affect patients' diagnosis and treatment.[3] The high error rate in dispensing disposable sterile items directly affects the use of supplies by clinical departments, wastes clinical service time for patients, which is detrimental to the orderly development of clinical medical care, and reduces the trust and satisfaction of clinical departments in the sterilization supply center.[4] Moreover, it wastes a lot of time for staff to communicate and check.[5] Dispensing errors create a lot of problems for inventory management and an inventory deficit will increase the cost of consumables for the hospital.[6]

The quality control circle (QCC) management model is a management tool to promote continuous quality improvement and enhancement. In the medical field, QCC is mainly used to identify and solve problems that may occur at this stage by spontaneously forming a small group (circle) that collaborates and follows certain procedures to achieve high-quality medical services, work efficiency, and reduce risk time.[7] Recently, many studies have pointed out that the QCC management model in several medical and technical departments has greatly improved the quality of services,[8] but its application in sterilization supply centers still lacks a reliable reference.

In order to further improve the management of disposable sterile items, the QCC management model group team was established in our department from May to December 2021, and QCC has been carried out in the sterilization supply center since then, with excellent application results achieved, which are reported below to provide reliable reference. These research results can provide a new reference basis for the future management of sterilization and supply centers, so as to improve the quality of medical services in sterilization and supply centers and protect the health and safety of all patients.

MATERIALS AND METHODS

Research objects

Our hospital established a QCC team in May 2021. The QCC activity team consists of 8 people, including 1 chief nurse practitioner, 1 deputy chief nurse practitioner, 4 nurse practitioners in charge, 1 nurse practitioner, and 1 staff member from the equipment department.

QCC group formation

One person from the group is selected as the circle leader, whose main job is to lead this QCC activity and coordinate the good interpersonal relationship of unity and cooperation among all circle members, such as theme selection, current situation analysis, activity goals, countermeasure thinking and activity evaluation. The chief nurse, as a counselor, is responsible for monitoring the progress of the various processes of the activities, the coordination and communication of various departments, and regular training of knowledge of QCC for all members.

Selected themes

The problems of the sterilization supply center were analyzed by brainstorming method through group discussion of all members. The issue was evaluated by policy, urgency, importance and circle capacity indicators, and the final discussion unanimously decided on the theme goal of "reducing the error rate of disposable items". The reason is that the high error rate of dispensing disposable items will affect the clinical supply demand, waste the valuable time of clinical departments and disinfection supply center, reduce the trust and satisfaction of clinical departments to disinfection supply center, and the inventory loss will increase the cost expenditure of hospital consumables.

Investigation of current situation and analysis of causes

By designing the Disposable Item Issuance Error Record Form and visiting clinical departments on site to understand clinical needs, we collected information on dispensing disposable item errors in the sterilization supply center from December 01, 2020 to April 30, 2021. According to the grasp of the current situation, root cause analysis, hand-drawn fishbone diagram, and analysis of the causes of various types of dispensing errors, all circle members discussed the main reasons for the high rate of errors in the distribution of disposable sterile items: (1) Clinical departments are unclear about the specifications and requested quantities of disposable items, and incorrect specifications and quantities when claiming items. (2) Disposable items are not clearly marked and are time-consuming to issue and easy to pick up by mistake. (3) Orders are not checked at the time of distribution, resulting in misdistribution, under- and over-distribution. (4) The Tutt system is defective in one way or another, and system errors lead to errors in issuance. (5) Incomplete or over-printed orders result in over- or under-distribution. (6) Insufficient transfer vehicles, long waiting times and clinical prodding prone to errors.

QCC implementation

After brainstorming discussions among group members, several implementable countermeasures are proposed, and a written countermeasure development schedule is developed. Eight countermeasures were formulated for the six main causes of the above problems, all of which were scored and evaluated by secret ballot. Evaluation items are divided into importance, urgency, and circle capacity. Evaluation results are divided into excellent (5 points), good (3 points), and poor (1 point). There are 6 items in total, each with 30 points, with a score ≥ 20 indicating an adopted response. Specific implementation: (1) The electronic list of disposable items was created to summarize the name, phonetic code, specification, manufacturer, packaging method, minimum quantity and unit price of all clinical disposable items used in the sterilization supply center and distributed to the clinic for easy reference. (2) Visual management and 4324 digital labeling methods[9] were used to optimize the classification, storage, and flow of disposable items. The production of disposable item areas in the storage room, item signage and drawings, the standardization of the storage and entry/exit process of items saves the issuance time and can avoid some of the mistakes caused by the hustle and bustle. (3) In response to the staff's carelessness resulting in wrong, over- or under-distribution, a double-checking method is used to check the orders again when loading the trucks to avoid mistakes. (4) Traditional manual management also prevents departments from monitoring inventory levels in real time, making them prone to expired supplies, out-of-stocks and excessive hoarding. Even if some departments have a more standardized management of secondary libraries, they consume a lot of human and material resources.[10] Tutor engineers were invited to improve the Tutor software system, fix the interface operation, and add changes to the error points that appear. (5) When printing and dispensing orders, the staff should check for missing orders or overprinting orders to avoid over- and under-distribution, which can cause trouble and decreased satisfaction to clinical practice. (6) The staff should also increase loading vehicles, improve loading methods, and reasonably arrange the time of down delivery personnel to deliver disposable items in a timely manner. (7) Using 6S management methods for storage and storage area organization, the sterile supply center is the intermediate link for storing and dispensing disposable medical supplies and sterile items. Among them, the management of items is directly related to the occurrence of nosocomial infections in hospitals. To ensure enhanced quality management of disposable medical supplies and sterile items, the storage room and warehouse for sterile items in the supply room were improved and perfected.[11] (8) Our own disposable item inventory count and purchase order forms suitable for application in our hospital can be designed to facilitate efficient and correct inventory of inventory materials and quick detection and problem solving. (9) Using inventory software and computerized management as well as self-designed inventory forms, we implement

regular inventory, temporary inventory, sample inventory, and individual item inventory; quantity inventory, goods-account reconciliation, and account reconciliation can identify problems and solve them in time, making item management more scientific.[12]

Observation content and evaluation methods

After the implementation of QCC activities, satisfaction investigation was conducted from September 2021 to October 2021 by visiting the clinic on site, and the error rate of dispensing disposable items was counted and compared with the error rate before the QCC activities. The target achievement rate was calculated according to the formula: target achievement rate = (before improvement - after improvement) / (before improvement - target value) × 100%. Progress rate = (before improvement - after improvement)/ before improvement × 100%. The improvement plateau and radar chart after improvement were plotted, and intangible results were evaluated. According to the "531" scale [13] the scores of circle members were calculated in terms of responsibility, motivation, problem solving, team cohesion, communication and coordination, sense of accomplishment, and quality control techniques.

Statistical methods

SPSS 26.0 statistical software was used for statistical analysis. The counting data were recorded as [n (%)] and compared using chi-square tests. The measurement data were recorded as ($\bar{x} \pm s$) and compared using paired t tests. Differences were considered statistically significant at $P < .05$.

RESULTS

Comparison of error rate of dispensing disposable items before and after QCC activities

The error rate of dispensing disposable items was reduced after the QCC activities, and the difference was statistically significant ($P < .05$) (Table 1).

Comparison of order claim error rate, print order error rate, and inventory error rate before and after the QCC activities

The order claim error rate, print order error rate, and inventory error rate of disposable items decreased after the QCC activities, and the difference was statistically significant ($P < .05$) (Table 2).

Comparison of loading time and delivery time before and after the QCC activities

To see if there was any difference in loading time and delivery time of disposable items before and after the QCC activities, we conducted a SW normality test first. Given that the loading time and delivery time of both groups obeyed normal distribution, we used a paired t-test to compare whether there was any difference in the loading time and delivery time between the two groups, and a statistically significant difference found ($P < .05$), Table 3.

Table 1. Comparison of error rate of dispensing disposable items before and after the QCC activities

Time	Right	Wrong	Total	Error rate	χ^2	*P* value
Before the QCC activities	945	21	966	2.2	8.303	.004
After the QCC activities	860	5	865	0.6		

Table 2. Comparison of order claim error rate, print order error rate, and inventory error rate before and after the QCC activities

	Order claim error rate		Print order error rate		Inventory error rate	
Time	Total cases	Error rate	Total cases	Error rate	Total cases	Error rate
Before the QCC activities	966	9.3	966	1.0	1512	2.1
After the QCC activities	865	4.9	865	0.1	1512	0.5
Chi-square	13.578		6.446		14.593	
P value	<.001		.011		<.001	

Table 3. Comparison of loading time and delivery time before and after the QCC activities

	Before the QCC activities (n=12)	After the QCC activities (n = 12)	*t*	*P* value
Loading time	134.17±16.35	115.83±7.93	3.494	.003
Delivery time	159.17±14.43	139.17±13.29	3.532	.002

Goal achievement rate

Statistically, it can be seen that the goal achievement rate of this activity is 102% and the progress rate is 73%, which fulfills the expected set goal.

Intangible results

Through the QCC activities, the initiative of our staff has been greatly improved and everyone is working with the spirit of mastery. The circle members' knowledge and application of QCC management tools, self-confidence, sense of work responsibility, motivation, team cohesion, communication and coordination, sense of achievement, quality control techniques, problem identification and problem-solving skills, etc. are significantly improved. Identifying problems in the workplace and proposing solutions to them has improved the awareness of quality management of nurses.

DISCUSSION

QCC activities, which are now widely used in all aspects of society,[14] give employees a clear goal, change their mindset, and bring out their vigorous creativity. It is a lively form of quality management with planning and organization, allowing employees to participate spontaneously and actively, bringing into play the ingenuity of the group, creating a harmonious team atmosphere, and transforming the passive management mode of "want me to do" in the past, so that the difficult and key problems of the department can be solved effectively.[15]

As the departments throughout the hospital continue to change, it also makes it difficult for the sterilization supply center to manage disposable items. In order to better serve the clinic, we found issues contributing to a high error rate of dispensing disposable items. To reduce clinical workload, QCC was used with the goal of reducing the disposable item dispensing error rate, improving clinical satisfaction, allowing more time for better clinical service to patients, and improving service quality.[16] This activity started with raising the problems in the management

of disposable items. In response to the problem of high error rate in distribution, the whole team members worked hard, collected data, analyzed and summarized, and traced the root causes of errors in dispensing disposable items. The main causes were also analyzed, countermeasures were proposed, and practical measures were implemented step by step as planned to produce an electronic manual to reduce clinical claim errors.[17] Visual management saves dispensing staff time in and out of storage and the increase in loading vehicles saves dispensing time. Double-checking accurately avoids misdistribution, under- and over-distribution. The warehouse is organized so that the area is maximized, making it easy to enter and exit the warehouse and maximizing the efficiency of distribution. Inventory software and computerized management were applied to implement regular inventory, temporary inventory, sample inventory, and individual item inventory; quantity inventory, goods account reconciliation, and account reconciliation can identify problems and solve them in time, making item management more scientific.[18] The management quality before and after the implementation was compared: the management quality, assessed from the dimensions of account reconciliation, input-output warehouse management, inventory management, and expiration date management, has been improved, and the error rate of dispensing sterile items has been significantly reduced.

After implementing the QCC activities in the sterilization supply center, it not only improves the work quality and efficiency of the center, but also enhances the staff's own quality and personal quality, saves time and economic costs, and improves clinical satisfaction. Circle members have significantly improved their sense of responsibility, motivation, problem-solving skills, team cohesion, communication and coordination, sense of accomplishment and quality control practices. There is an intuitive feeling of QCC achievements, which can better improve the quality of work, improve the innovative thinking of departmental staff, promote the optimization of work processes, and improve the ability of scientific application of quality management tools by sterilization supply center staff, and also lay a very good foundation for the QCC activities to be carried out again.[19] Through determining this theme, the authors found that there are many aspects that need to be improved in the daily work in the sterilization supply center, which can be discussed and improved by continuously establishing various QCC activities in the center to continuously improve the work of the staff point by point and promote the center to provide better services to clinical work.[20] We recorded the problems in a timely manner, conducted regular monitoring, and considered all aspects of our work more holistically. Moreover, quality control techniques were utilized, goals that fit the development requirements of our department were set, and various countermeasures were implemented through close teamwork.

Nevertheless, since this study only compared the application effect before and after the QCC activities, there may be some result bias. So, we need to add the study on the difference of application effect between QCC and conventional management mode as soon as possible in the follow-up. In the meantime, since there is no unified guideline for the QCC management model, the specific details of QCC implemented in this study may still be worthy of optimization, which will be the focus of subsequent studies.

CONCLUSION

The results of this study show that after the implementation of QCC activities in our sterilization supply center, the disposable item claim error rate, order printing error rate, and inventory error rate were significantly reduced, the loading time and delivery time were reduced, and the dispensing error rate was significantly decreased. Moreover, the progress rate reached 73%, improving clinical satisfaction.

CONFLICTS OF INTEREST

The authors report no conflict of interest.

AVAILABILITY OF DATA AND MATERIALS

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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