

Original Article

Study on the effect of quality control circle activities on hospital infection control

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Abstract: Objective: To investigate the effect of quality control circle activities on improvement of hospital infection control. Methods: From January 2019 to December 2019, the data of hospital infection were selected and analyzed. A quality control circle named hospital infection circle was established and the theme of reducing the hospital infection rate was determined. The effective countermeasures were conducted. The tangible achievements including hand hygiene compliance rate, nosocomial infection rate, catheter-related blood stream infection rate, ventilator associated pneumonia rate, catheter-associated urinary tract infection rate and the eligible rates for the washing quality and sterilization of medical devices and intangible achievements before and after quality control circle activities were evaluated. Results: Compared with those before quality control circle activities, hand hygiene compliance rate, nosocomial infection rate, catheter-related blood stream infection rate, ventilator associated pneumonia rate, catheter-associated urinary tract infection rate and the ineligible rates for the washing quality and sterilization of medical devices after quality control circle activities were significantly decreased (all $P < 0.05$). Moreover, the satisfaction rate for hospital infection control after quality control circle activities was obviously increased. The scores for responsibility, enthusiasm, communication ability, harmonious degree, team cohesion of members, application of quality control circle technique in medical staffs were remarkably improved (all $P < 0.001$). Conclusions: The implementation of quality control circle activities could significantly reduce the rate of hospital infection, enhance the satisfaction rate and improve the ability of medical staffs.

Keywords: Quality control circle, quality management, hospital infection, effectiveness

Introduction

Hospital infections refer to the hospital-acquired infection in patients who have no infections or not in the incubation period on admission to the hospital [1, 2]. It was reported that hospital infections affected about two million hospitalized patients in USA annually and could lead to obvious morbidity and mortality [3]. It poses a significant burden to patients' safety [4]. Because the pathogens responsible for hospital infections could persist on body surfaces for a long time and patients could carry pathogens among different wards, it is not satisfactory for implementation of hospital infection control measures to reduce the impact of hospital infections [5, 6]. It was shown that patients admitted to intensive care unit were at particular risk for hospital infections with a prevalence rate as high as 30% [7]. Moreover, in carrying out hospital infections management

work in some hospitals, more attention was paid to theoretical explanations, the implementation of relevant measures was not in place, the degree of management and supervision was insufficient, and the hand hygiene compliance of medical staffs was low, which made it difficult to achieve effective control of nosocomial infections [8, 9]. Therefore, how to effectively reduce the rate of hospital infections has become a crucial challenge for hospital administrators.

Quality control circle was first proposed in 1962 [10]. It was defined that a group of grass-roots persons with similar work nature at the same work site spontaneously conducted quality management activities, and scientifically coped with problems by inspiring individual potential, so as to improve the quality of management [11]. As a new intervention mode, more and more attention has been paid to the impor-

tance of quality control circle in hospital management [12]. Many studies have shown that quality control circle activities could significantly improve prognosis of patients [13]. However, there were few reports on the application of quality control circle management model in reducing the rate of hospital infections. Thus, quality control circle activities were performed in this study, in order to explore the effect on reducing the rate of hospital infections and application value in hospital infections control.

Materials and methods

General information

The data such as hospital infection and the ability of medical staffs in The First Affiliated Hospital Zhejiang University School of Medicine before and after quality control circle management performed from January 2019 to December 2019 were collected and the change of these data between before and after the quality control circle activities was analyzed.

Quality control circle activities

Establishment of quality control circle group and theme: Eight medical staffs in each department of our hospital were selected to establish a quality control circle activity group, in which the person in charge of the inpatient ward became the circle leader and other 7 medical staffs were circle members. According to the brainstorming methods [14], the circle name was determined as hospital infection circle. And the theme of the quality control circle was to reduce the rate of hospital infection.

Implementation of countermeasures: In the progress of reducing hospital infection, the main causes were confirmed by Pareto Principle [15]. According to the 5W1H (who, what, whom, when, where and how) method, the circle members jointly investigate the main cause. And relevant countermeasures were established following the plan-do-check-act (PDCA) cycle method [16]. The PDCA cycle method included four stages: planning, design and execution, inspection and processing. The countermeasures were as follows: (1) A professional hospital infection management control evaluation form was developed to regulate each stage of activities. (2) To ensure the quality of the entire activity, the content of the activities was incorporated

into the evaluation system of hospital infection management, and the special personnel was assigned to supervise the unqualified activities until they were qualified. (3) The training for medical staff was regularly performed to enhance disinfection awareness and pay attention to the relationship of hospital infection with sanitary disinfection. (4) The medical staffs were informed to understand the Seven-step hand-washing method and correct hand cleaning process; (5) The management of hand sanitizers was strengthened and it was needed to ensure sufficient quantity and ease of use; (6) Strengthen the learning of medical staff, organize the training regularly and consolidate the professional knowledge.

Observed indexes: Tangible achievement: Detailed information was recorded regarding the improvement of hospital infection control management after conducting the quality control circle activities. The observed indexes include hand hygiene compliance rate, nosocomial infection rate, catheter-related blood stream infection (CRBSI) rate, ventilator associated pneumonia (VAP) rate, catheter-associated urinary tract infection (CAUTI) rate and the eligible rates for the washing quality and sterilization of medical devices. Hand hygiene compliance was defined that medical staffs washed hands, and carried out hand antiseptics and surgical hand antiseptics according to the correct steps and procedures. Nosocomial infection rate referred to the number of new cases with hospital infections among all admitted patients within six months. CRBSI was defined that bacteremia or fungemia occurred in patients with intravascular catheters or within 48 h after removing intravascular catheters. VAP rate was defined that pneumonia occurred within the period from 48 h after mechanical ventilation to 48 h after extubation. CAUTI referred to urinary tract infection caused by retained urinary catheter. The washing quality and sterilization of medical devices reaching the hospital disinfection health standard was considered as eligibility [17].

Intangible achievements: The satisfaction degree for hospital infection control involved propaganda and education of hospital infection management, disinfection conditions and intervention effect. The total score was 100 points, with more than 90 points indicating very satisfaction, 70-90 points indicating satisfaction,

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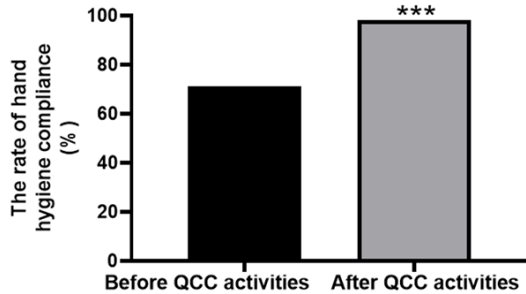


Figure 1. Comparison of hand hygiene compliance rate between before and after quality control circle activities. Compared with before quality control circle activities, *** $P < 0.001$. Note: QCC: Quality control circle.

and less than 70 points indicating dissatisfaction. Before and after the quality control circle activities, the responsibility, enthusiasm, communication ability, harmonious degree, team cohesion of members, application of quality control circle technique were scored and analyzed. The lowest score of each item was 1 point and the highest score was 5 points. The radar chart of intangible achievements was also conducted.

Statistical analysis

The data included in this study was analyzed by SPSS software (IBM, USA), version 23.0. The statistical charts were made by GraphPad Prism software (GraphPad Software Inc., San Diego, CA, USA), version 5.0. Measurement data were expressed as Mean \pm SD; Comparisons between before and after the quality control circle activities were conducted by T tests. The count data was presented as percentage; Comparisons were conducted by chi-square tests. $P < 0.05$ suggested statistical differences.

Results

Comparison of hand hygiene compliance rate between before and after quality control circle activities

As seen in **Figure 1** and **Table 1**, before quality control circle activities, the rate of hand hygiene compliance in medical staffs was 71.25% (285/400). And the hand hygiene compliance rate in medical staffs after quality control circle activities was 98.0% (392/400). There was the statistical difference for the rate of hand

hygiene compliance between before and after quality control circle activities ($P < 0.001$).

Comparison of nosocomial infection rate between before and after quality control circle activities

As shown in **Figure 2** and **Table 1**, the nosocomial infection rate in inpatients before quality control circle activities was 3.50% (14/400). And the nosocomial infection rate in inpatients after quality control circle activities was 1.25% (5/400). The statistical difference was found for the nosocomial infection rate between before and after quality control circle activities ($P = 0.037$).

Comparison of catheter-related blood stream infection rate, ventilator associated pneumonia rate, and catheter-associated urinary tract infection rate

As shown in **Table 2**, the catheter-related blood stream infection rate, ventilator associated pneumonia rate and catheter-associated urinary tract infection rate in inpatients before quality control circle activities was 11.11%, 10.0% and 13.33%, respectively. After quality control circle activities, the catheter-related blood stream infection rate, ventilator associated pneumonia rate and catheter-associated urinary tract infection rate were significantly decreased and there were remarkably statistical differences between before and after quality control circle activities ($P < 0.05$).

Comparison of the ineligible rates for the washing quality and sterilization of medical devices

As seen in **Table 3**, the ineligible rates for the washing quality and sterilization of medical devices before quality control circle activities was 1.80% and 1.4%, respectively, while after quality control circle activities they were 0.40% and 0.20%, respectively. There were significantly statistical differences between before and after quality control circle activities (all $P < 0.05$).

Comparison of satisfaction degree for hospital infection control

As seen in **Table 4**, the satisfaction rate for hospital infection control before quality control cir-

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Table 1. Comparison of hand hygiene compliance rate, nosocomial infection rate between before and after quality control circle activities [n (%)]

Groups	Hand hygiene compliance rate	Nosocomial infection rate
Before QCC activities	285/400 (71.25)	14/400 (3.50)
After QCC activities	392/400 (98.0)	5/400 (1.25)
χ^2 value	110.0	4.367
P value	<0.001	0.037

Note: QCC: Quality control circle.

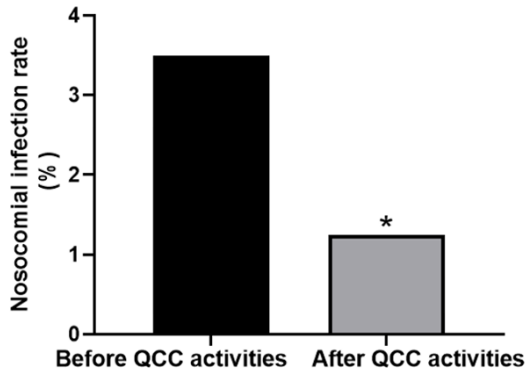


Figure 2. Comparison of nosocomial infection rate between before and after quality control circle activities. Compared with before quality control circle activities, *P<0.05. Note: QCC: Quality control circle.

cle activities was 95.50% (382/400). After quality control circle activities, the satisfaction rate for hospital infection control (99.25%) was significantly improved. And there were remarkably statistical differences (P<0.001).

Comparison of intangible achievements

After implementation of quality control circle activities, the scores for the responsibility, enthusiasm, communication ability, harmonious degree, team cohesion of members, application of quality control circle technique in medical staffs were significantly higher than those before implementation of quality control circle activities. And there were significantly statistical differences (all P<0.05), as seen in **Table 5** and **Figure 3**.

Discussion

The management of quality control circle is a significant breakthrough to the mode of traditional hospital management. It provides new ideas for the improvement of hospital infections management. Many studies reported that quality control circle activities could arouse the

positivity and enthusiasm of the circle members, which could result in each circle member to seriously discover, analyze and deal with problems. During the implementation of quality control circle activities, each circle member could obtain high-quality achievement by conducting a virtuous circle and experience the purpose and meaning of work by dealing with problems [18]. Based on the continuous improvement of detail work, the management effect of equality control circle activities could cover from part to whole, from bottom to top and from point to surface. With the implementation of quality control circle activities, the problems in the process of hospital infections control were proposed, the reasons were analyzed, and finally the targeted countermeasures were developed to enhance the refinement, scientificity and individuality of hospital management [19]. Some studies reported that in the process of hospital management, the problems were often demonstrated by multiple angles via quality control circle activities [20]. Quality control circle may not only help to improve the quality of hospital management, but also play an important role in cultivation of abilities of each circle member.

Hospital infections have become the major problem for patients. Some studies reported that as many as one third of hospital infections could be avoided if the hospital conducted the most effective infection management [21]. At present, a large number of hospitals tried to achieve the quality of hospital infections via developing the guidelines for infection management processes, without integrating medical staffs. The quality control circle was considered as a new model for any organized activity. The focus of quality control circles concept was the process [11]. And the chosen fields of process quality were assessed by medical staffs. In these processes, the quality was defined as a continuous effort by all the members to meet

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Table 2. Comparison of CRBSI rate, VAP rate and CAUTI rate between before and after quality control circle activities [n (%)]

Groups	CRBSI rate	VAP rate	CAUTI rate
Before QCC activities	10/90 (11.11)	9/90 (10.0)	12/90 (13.33)
After QCC activities	3/90 (3.33)	2/90 (2.22)	4/90 (4.44)
χ^2 value	4.063	4.744	4.390
P value	0.044	0.029	0.036

Note: QCC: Quality control circle; CRBSI: Catheter-related blood stream infection; VAP: Ventilator associated pneumonia; CAUTI: Catheter-associated urinary tract infection.

Table 3. Comparison of the ineligible rates for the washing quality and sterilization of medical devices between before and after quality control circle activities [n (%)]

Groups	Washing quality results	Sterilization results
Before QCC activities	9/500 (1.80)	7/500 (1.40)
After QCC activities	2/500 (0.40)	1/500 (0.20)
χ^2 value	4.504	4.536
P value	0.034	0.033

Note: QCC: Quality control circle.

Table 4. Comparison of satisfaction degree for hospital infection control

Groups	Dissatisfaction	Satisfaction	Very Satisfaction	Satisfaction rate
Before QCC activities	4.50% (18/400)	45.50% (182/400)	50.0% (200/400)	95.50%
After QCC activities	0.75 (3/400)	47.75% (191/400)	51.50% (206/400)	99.25%
χ^2 value				11.000
P value				0.001

Note: QCC: Quality control circle.

Table 5. Comparison of intangible achievements in medical staffs before and after quality control circle activities

Parameters	Before QCC activities	After QCC activities	T value	P value
Responsibility	1.90±0.65	4.3±0.78	23.640	<0.001
Enthusiasm	1.70±0.47	4.7±0.61	38.960	<0.001
Communication ability	2.10±0.50	4.5±0.54	32.610	<0.001
Harmonious degree	2.20±0.59	4.8±0.67	29.120	<0.001
Team cohesion of members	2.50±0.37	4.6±0.49	34.200	<0.001
Application of quality control circle technique	1.20±0.35	4.8±0.43	64.930	<0.001

the expectations and needs of the subjects [22]. In term of healthcare, patients became the most important subjects [23]. Previous studies reported that continuous quality improvement methods could reduce the incidence of certain hospital infections in intensive care units [24]. In contrast to previous studies, we have assessed the effect of quality control circles on hospital infections. The quality control circles were conducted in this research according to the detailed process, such as theme de-

termination, countermeasure formulation, organization and implementation, and so on. The results of this study showed that the implementation of quality control circles could significantly reduce hand hygiene compliance rate, nosocomial infection rate, catheter-related blood stream infection rate, ventilator associated pneumonia rate, catheter-associated urinary tract infection rate and increase the eligible rates for the washing quality and sterilization of medical devices, which indicated that quality control

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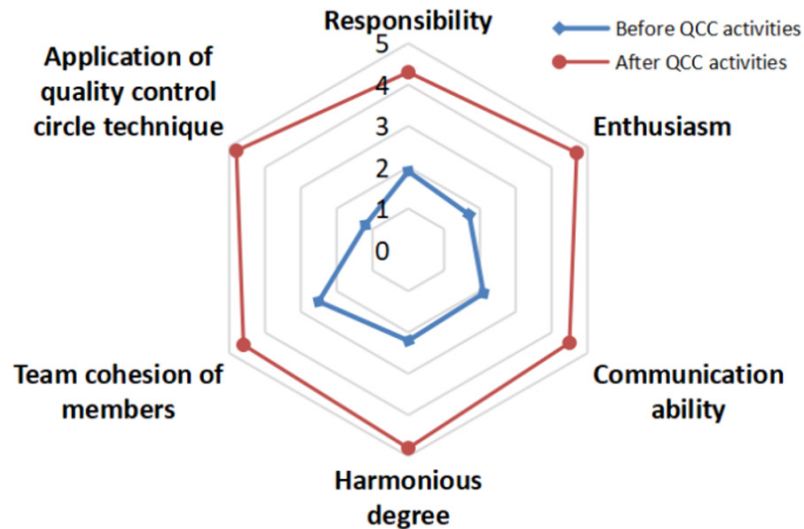


Figure 3. Radar chart of intangible achievements comparison in medical staffs before and after quality control circle activities.

circles could effectively enhance hospital infections management and obviously improved the quality of hospital infection control. These results were in accordance with the study reported by Joiner et al [25]. Moreover, some studies reported that quality control circle activities had a certain promotion role in improving abilities for circle members [26]. This study showed that after quality control circle activities, the satisfactory rate was obviously increased and the scores for the responsibility, enthusiasm, communication ability, harmonious degree, team cohesion of members, and application of quality control circle technique in medical staffs were significantly improved, which was similar with Zhang et al's report [11].

In conclusions, the implementation of quality control circle activities could effectively reduce the rate of hospital infections, improve the satisfactory rate of hospital infections control and enhance the individual abilities and team cohesion of medical staffs, finally improving the quality of hospital infections management. It is worthy of recommendation in departments or hospitals. However, there were some limitations as follows: this quality control circle of hospital infections management might not be suitable for all hospitals. The self-chosen subjects in the process of quality control circle may result in a certain time pressure. The quality control circle activities developed on the initiative of medical staff in this hospital should focus on only a few important priority areas. In

the future, a larger sample size studies with multi-center would be required for further validation.

Disclosure of conflict of interest

None.

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