

Application of Quality Control Circle in Improving the Compliance Rate of Final Rinse Water for Respiratory Endoscopes

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Abstract

Objective To investigate the application effect of Quality Control Circle (QCC) activities in improving the qualification rate of final rinse water for respiratory endoscopes. **Methods** A QCC team was established and a theme was formulated. The theme “Improving the qualification rate of final rinse water for respiratory endoscopes” with the highest score of 18.80 points was selected as the topic for this QCC activity. The causes of the low qualification rate of final rinse water were analyzed, countermeasures and measures were formulated, and the qualification rates of final rinse water before and after the QCC activity were compared. **Results** After the QCC activity, the qualification rate of final rinse water increased from 58.33% before implementation to 100%, and the difference was statistically significant ($P < 0.05$). **Conclusion** Implementing QCC activities can improve the qualification rate of final rinse water and enhance team cohesion.

Full Text

Application of Quality Control Circle in Improving the Qualification Rate of Final Rinse Water for Respiratory Endoscopes

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Abstract

Objective: To investigate the effectiveness of Quality Control Circle (QCC) activities in improving the qualification rate of final rinse water for respiratory endoscopes.

Methods: A QCC team was established to develop the project theme. The highest-scoring theme, “Improving the qualification rate of final rinse water for respiratory endoscopes” (score: 18.80), was selected for this QCC initiative. The causes of low qualification rates were analyzed, and countermeasures were formulated and implemented. The qualification rates of final rinse water were compared before and after the QCC activity.

Results: Following the QCC activity, the qualification rate of final rinse water increased from 58.33% to 100%, with a statistically significant difference ($P < 0.05$).

Conclusion: Implementing QCC activities can effectively improve the qualification rate of final rinse water while enhancing team cohesion.

Keywords: Respiratory endoscope; Final rinse water; Quality Control Circle

Quality Control Circle (QCC) refers to a voluntary team formed by individuals in the same, similar, or complementary workplace. Through collective cooperation and brainstorming, and by following a systematic activity procedure, scientific statistical tools and quality control methods are applied to solve problems and issues related to the workplace, management, and culture [1].

Since the implementation of the WS 507–2016 *Technical Specifications for Cleaning and Disinfection of Flexible Endoscopes* in 2017, more stringent requirements have been imposed on endoscope reprocessing [2]. Water represents the most critical consumable in the endoscope cleaning and disinfection process. Studies both domestically and internationally have shown that the qualification rate of final rinse water in endoscopy centers ranges from 35.8% to 70.3% [3-6]. Specifically, 85.58% of medical institutions use purified water for final rinsing, while 14.42% still use non-purified water. For water pipelines in service for more than five years, the qualification rate of final disinfection water is only 54.34%, and merely 26.4% of medical institutions have established equipment-related quality inspection, maintenance, and servicing protocols. Unqualified final rinse water constitutes the primary cause of “secondary contamination” of disinfected endoscopes and poses a hidden risk for nosocomial infections. In response, our department applied QCC activities to quality management of final rinse water in the respiratory endoscopy center from May to December 2023. This report documents our findings.

1. Subjects and Methods

1.1 Establishment of QCC Team

A QCC team was voluntarily formed, comprising seven nurses and one infection control staff member. A senior nurse from the respiratory endoscopy center served as the team leader, while the head nurse acted as the facilitator. The team leader was primarily responsible for planning, task tracking, and evaluation, whereas the facilitator provided guidance and promoted the activity. The team convened biweekly meetings to discuss progress and address issues.

1.2 Theme Selection

Through brainstorming, the team identified four potential themes for daily operations in the respiratory endoscopy center: improving the success rate of EBUS-TBNA sampling, enhancing compliance with respiratory endoscopy procedures, reducing the incidence of major hemorrhage related to bronchoscopic procedures, and improving the qualification rate of final rinse water for respiratory endoscopes. All team members scored these alternatives using the 5-3-1 scoring method [7] based on four criteria: feasibility, importance, urgency, and team capability. The scores were summed for each item, and “Improving the qualification rate of final rinse water for respiratory endoscopes” received the highest score of 18.80, thus becoming the selected theme.

1.3 Baseline Survey

In June 2023, sampling was conducted on final rinse water from automated endoscope reprocessors. A total of 12 biological monitoring samples were collected, with seven qualified samples, yielding a qualification rate of 58.33%. The five unqualified samples showed results of >200 CFU/100ml, 100 CFU/100ml, 93 CFU/100ml, 85 CFU/100ml, and 60 CFU/100ml, respectively. Team members identified causes using a checklist. According to the 80/20 principle [8], three factors accounted for 80.9% of all causes: untimely filter replacement, contaminated inlet pipelines, and non-standardized documentation. These three items were identified as the key improvement targets for this QCC activity.

1.4 Target Setting

The target value was calculated using the formula: Target value = Current value + (1 - Current value) × Improvement focus × Team capability [9] = 58.33% + (1 - 58.33%) × 80.9% × 80% = 73.03%. Therefore, the target value was set at 73.03%, where the improvement focus (80.9%) was derived from baseline survey results and team capability was calculated at 80%. The goal of this QCC activity was to increase the qualification rate of final rinse water for endoscopes from 58.33% to 73.03%.

1.5 Cause Analysis and True Cause Verification

Through brainstorming, all team members developed a fishbone diagram covering four dimensions: personnel, materials, methods, and environment. Eighteen key factors were identified and formulated for selection. The final identified root causes included: lack of relevant management systems, inadequate monitoring practices, insufficient training for nurses, and unreasonable workflow processes.

1.6 Strategy Formulation and Implementation

Team members proposed corresponding implementable solutions for each root cause through brainstorming.

1.6.1 Establish a final rinse water management system: Create a maintenance and record log for final rinse water management. Operators should perform daily maintenance and biweekly self-disinfection of endoscope washers. Regularly inspect and replace all filters according to manufacturer requirements and actual usage conditions. Conduct monthly disinfection of final rinse water pipelines to prevent blockage and contamination of internal circulation pipes in endoscope washers. For washers in service for over five years, manufacturers should increase maintenance frequency as parameters are more prone to deviation, promptly troubleshooting to ensure effective operation.

1.6.2 Enhance monitoring of final rinse water: Conduct monthly microbial monitoring of final rinse water during the intervention period. Strictly follow aseptic sampling procedures, collecting samples from the inlet of external water filtration equipment, the terminal of water treatment equipment, and outlets A and B of final rinse pipelines. Samples were sent to the infection control department for specialized testing.

1.6.3 Appoint an infection control specialist: The specialist supervises workflow processes, conducts unannounced on-site inspections focusing on detail control in each 环节, disinfection and isolation implementation, and reviews documentation logs. Feedback is promptly communicated to the head nurse with assigned individual responsibility to enhance accountability among respiratory endoscopy center nurses.

1.6.4 Provide regular nurse training: Strengthen education on infection control knowledge for endoscopy center staff through regular professional training to standardize final rinse water management and procedures for automated endoscopy reprocessing, cleaning, disinfection, and maintenance.

1.6.5 Establish a contingency plan for positive microbial results in final rinse water: Increase microbial monitoring to identify causes. First, check whether filters have exceeded replacement intervals and replace immediately if necessary. Second, contact engineers to perform machine self-disinfection and pipeline flushing. Finally, replace components and pipelines at the external water filter connection outlets and install drain valves (open drain valves daily after work to remove residual water in pipelines). Additionally, strengthen training for department personnel.

1.7 Outcome Measures

1.7.1 Final rinse water qualification rate: Calculated as (Number of qualified samples / Total number of samples submitted) \times 100%. The qualification criterion for final rinse water samples is \leq \$10 colony-forming units per 100ml using membrane filtration [2].

1.7.2 QCC management scoring scale: Includes seven items: responsibility, teamwork, communication skills, sense of honor, problem-solving ability, organizational coordination ability, and QCC methodology. A 5-3-1 scoring method

is used, where 5 represents excellent, 3 represents good, and 1 represents poor.

1.8 Statistical Methods

Data were entered into Excel and analyzed using SPSS 21.0. Categorical data were described using frequency and percentage, with Fisher' s exact test for pre-post comparisons. Continuous data were described as mean \pm standard deviation, with pre-post comparisons using t-tests. Statistical significance was set at $P < 0.05$.

2. Results

2.1 Comparison of Final Rinse Water Qualification Rate Before and After the Intervention

Following the QCC activity, the qualification rate of final rinse water in the respiratory endoscopy center reached 100%. The target achievement rate was calculated as $(\text{Post-improvement} - \text{Pre-improvement}) / (\text{Target value} - \text{Pre-improvement}) \times 100\% = 283.41\%$. The qualification rate increased from 58.33% before implementation to 100% after implementation, with a statistically significant difference ($P < 0.05$).

Comparison of final rinse water qualification rate before and after the activity: Sample size (n), Qualified quantity (n), Qualification rate (%), $P < 0.01$

2.2 Comparison of QCC Management Scores Before and After the Activity

After the QCC activity, team members demonstrated varying degrees of improvement in responsibility, teamwork, communication skills, sense of honor, problem-solving ability, organizational coordination ability, and QCC methodology, with statistically significant differences between pre- and post-activity scores ($P < 0.05$). Notably, QCC methodology skills showed significant enhancement.

Comparison of QCC management scores before and after the activity: The inline data appears corrupted in the original manuscript, showing numerical values without clear labels.

3. Discussion

3.1 QCC Activities Can Improve the Qualification Rate of Final Rinse Water

Final rinsing involves repeatedly flushing disinfected endoscopes with rinse water, and the quality of this water directly affects the final qualification rate of endoscopes. Contamination can directly lead to nosocomial infections in

patients. During the baseline survey, the qualification rate of final rinse water was 58.33%, slightly lower than the 63.09% reported by Shi Qingfeng et al. [3] in their survey of 30 tertiary medical institutions in Shanghai. This difference is attributable to their study including samples from gastroscopes, colonoscopes, bronchoscopes, and automated reprocessors, with automated reprocessors showing only a 33.33% qualification rate. Our study focused exclusively on automated reprocessors, and our qualification rate was actually higher than Shanghai's overall level, likely because our institution leads in medical standards in Shanghai and emphasizes infection control and daily management. This QCC activity increased the qualification rate from 58.33% to 100%, achieving the established target. The activity revealed that prolonged use of final water treatment system pipelines without disinfection or extended disuse leading to stagnant water deposition can cause bacterial growth and affect water supply quality. After disinfection, bacterial counts in pipelines were essentially zero. Therefore, following recommendations from Alfa et al. [10], we established monthly pipeline disinfection and incorporated it into our final rinse water management system to prevent secondary contamination of disinfected endoscopes. Scientific approaches to quality management and monitoring of final rinse water are particularly crucial. Integrating final rinse water management with QCC activities enables timely identification and resolution of issues in the final stage of endoscope reprocessing, filling management gaps and ensuring reprocessing quality.

3.2 QCC Activities Can Enhance Team Members' Individual Capabilities and Team Collaboration

Following the QCC activity, team members demonstrated comprehensive improvement in overall quality, consistent with findings from Sun Ting's research [11]. This aligns with the inherent advantages of QCC's bottom-up management approach, characterized by high efficiency and scientific rigor [12-13]. On one hand, QCC activities fully mobilize nurses' initiative, enhancing their ability to identify and solve problems while fostering teamwork and collaboration with engineers and infection control personnel. On the other hand, QCC activities elevate team members' comprehensive qualities through literature retrieval, reading, and mutual exchange and learning, enabling mastery of tools such as checklists and fishbone diagrams and positively advancing the development of the respiratory endoscopy center nursing team.

Conclusion

Implementing QCC activities can effectively improve the qualification rate of final rinse water. Additionally, the activity revealed that current national standards lack unified specifications for final water pipeline system maintenance, testing, disinfection, and replacement cycles for purified water filter membranes. Further research on water supply pipeline design and quality control of automated reprocessors represents the future direction of our efforts.

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