



**Methodology Article**

# PDCA Circulation in the Prevention of Clinical Rust Effect Observation

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**Abstract:** Objective: The study aims to prevent rusting of clinical instruments by using PDCA circulation. Methods: The routine recovery and cleaning rusty instruments management for clinical diagnosis and treatment instruments from October to December in 2018 are chosen as before implementation. And after the PDCA continuous quality improvement measures from January to September in 2019, the implementation of recovery and cleaning rusty instruments management for clinical diagnosis and treatment instruments from October to December in 2019 are chosen as post-experiment. And the rust situation before and after the implementation of clinical diagnosis and treatment instruments will be compared. And the study investigates the satisfaction of clinical departments with the improvement measures of Central sterile supply department before and after the implementation. Results: After implementing PDCA continuous quality improvement measures, the rust rate of clinical diagnosis and treatment instruments was significantly lower than before implementation ( $P < 0.05$ ), and the difference was statistically significant. After implementation, the satisfaction of 58 clinical departments was 100%, significantly higher than that before (100.00% vs 81.03%,  $P < 0.05$ ). Conclusion: PDCA continuous quality improvement measures can effectively prevent the rust of medical devices, improve the quality of instruments of cleaning and sterilization, reduce hospital sense risk and medical cost, improve the satisfaction of clinical departments, and the application value is remarkable.

**Keywords:** PDCA, Apparatus Rust, Effect, Central Sterile Supply Department

## 1. Introduction

The central sterile supply department (CSSD) is the department which is responsible for the cleaning, disinfection, sterilization and supply of sterile items for all reused diagnostic and therapeutic instruments, appliances and articles in all departments of the hospital [1]. After clinical use of reusable diagnosis and treatment instrument, timely pretreatment is required; improper pretreatment leads to corrosion and rust of instrument [2], proper pretreatment can improve the cleaning and sterilization effect of the instruments [3]. The focus of clinical departments is on nursing patients, and less attention is paid to the pretreatment of instruments after use. CSSD analyzed that the recovery quality of the apparatus, and found that the clinical department repeatedly appeared the rust caused by the apparatus

pretreatment not in place. In 2019, CSSD used PDCA cycle to strengthen the pretreatment of clinical departments and improve the management of the reprocessing process of CSSD, and achieved good results in the prevention of apparatus rust. The report is as follows:

## 2. Data and Methods

### 2.1. General Data

Retrospective analysis of the rust rate of clinical diagnosis and treatment instruments in our hospital from October to December in 2018, sets as before implementation; analysis of the rust rate of clinical diagnosis and treatment instruments in our hospital from October to December in 2019, sets as after implementation. And then, it compares the rust rate of clinical diagnosis and treatment instruments before and after implementation.

## 2.2. Method

Before the implementation, the clinical diagnosis and treatment instruments were treated according to the conventional way, and after the implementation, the improved way was adopted, as follows:

### 2.2.1. Propaganda and Education of Clinical Departments

In view of the phenomenon of rusting of clinical diagnosis and treatment instruments after use, CSSD publicizes and educates clinical departments through we-chat and OA, so as to let them understand the relevant industry standards of pretreatment of clinical diagnosis and treatment instruments, and the relevant knowledge of the CSSD about the pretreatment of clinical diagnosis and treatment instruments after use. It is clearly informed that because the department can not deal with the blood stains and stains on the instruments in time after use, the instruments are dried up, the bio film is formed, which seriously increases the difficulty of cleaning the instruments, intensifies the wear and tear of the instruments, shortens the service life, and increases the material cost of the clinical department.

### 2.2.2. Optimize CSSD Service

Before the implementation, CSSD the whole hospital clinical diagnosis and treatment instruments recovery work unified arrangement in the morning. After investigation and analysis, it was found that the clinical department also had partial post-use instruments produced in the afternoon, and the earlier the instruments were cleaned after use, the lower the chance of rusting [4]. The improvement measures of CSSD are as follows: (1) Instruct the clinical department to apply for recycling of reused items on the disinfection supply system in time according to the use time of the instruments. (2) In the afternoon, add a recycling instruments arrangement before the end of work, and the instruments used in the clinical afternoon should be recycled to CSSD for treatment in time, so as to reduce the stay time of the instruments in the clinical department and avoid the instruments being exposed to the air for too long time, resulting in oxidation and rust.

### 2.2.3. Guide Clinical Department to Implement the Pretreatment Correctly

CSSD improves the guidance of post-use pretreatment of clinical diagnosis and treatment instruments, prints and molds them and distributes them to 58 clinical departments of the whole hospital, pastes them in the storage place of post-use instruments of each department, and CSSD contact officer for on-site training and guidance, the contents include: (1) Take off the needles and blades in the instrument and put them into the sharps box, and put the sundries into the medical waste box. (2) The instruments has blood and pus visible to the naked eye washed with flowing water, and the instruments has obvious tincture of iodine sprayed with alcohol and put into a closed recovery box. (3) Instruments contaminated by gas gangrene, prions and sudden pathogens of unknown causes should be sealed in double layer medical garbage bags and marked with the name of infectious diseases before being put into a separate recycling box [5].

### 2.2.4. Reasonably Classified Cleaning

The instruments are classified into delicate instrument, sharp instrument, hollow device, and complex joint. Delicate instruments and sharp instruments are washed separately, then soaked and washed with multi enzyme solution, ultrasonic cleaning is prohibited, fixed protective device is used to load; hollow device and complex joint class are washed first, then multi enzyme solution liquid soaking and washing, ultrasonic cleaning; due to the difficulty of cleaning teeth, shaft joints and other parts, it is necessary to fully open them during cleaning [6], and taking apart instruments should be removed and cleaned, according to the type of instrument use special cleaning rack loading to protect the instrument, which aims to avoid collision during cleaning and packaging transfer, resulting in coating falling off [7].

### 2.2.5. Refinement of Rust Removal Guidelines

According to the severity of the surface corrosion of the instrument, it can be divided into light, moderate and severe degree, and then the grading rust removal guide is formulated. (1) Use Ruhof rust remover, the dilution ratio is 1:7 [8], all rusted instruments and joints are fully opened, and soaked under the liquid surface at room temperature; (2) Light rust instruments, soaked for 5 minutes; (3) Moderate rust instruments, soaked for 10 minutes; (4) Severe rust instruments, soaked for 20 minutes. (5) Equipped with timer, strictly control soaking time. (6) For severely rusted instruments, use soft brush, cleaning cloth and rust remover to brush or repeatedly soak them to avoid excessive friction during use, so as to avoid instrument damage [9]. (7) If there are still rust spots on the instrument that has been soaked for rust removal, it means that the chromium plating layer has been damaged and fallen off, and the instrument should be scrapped. Because the rust of this kind of instrument is infectious, take out the rusted instrument and handle it by hand separately before processing the instrument; avoid mixing into the disinfecting machine, which will cause the rust to spread to other instrument [10]. (8) Rust removal is strictly prohibited for non-rusted instruments [11].

### 2.2.6. Instrument Lubrication and Maintenance after Rust Removal

After rust removal, the instruments were thoroughly rinsed with pure water without rust removal agent residue, and the key parts such as joints, teeth, shaft joints, scissors cutting surfaces were lubricated and rust-proof by Canadian water-soluble lubricant [12-13]. The ratio was 1:5. After soaking in the soaking tank for 30 seconds, put it into the drying cabinet was fully dried, the joints and other parts were inspected. When it is found that there are not smooth and inflexible phenomena, the water is lubricated with 1:10 water soluble lubricant to spray and lubricate. After drying, the packaging and sterilization are completed.

### 2.2.7. Training and Examination

Organize the whole staff to study the instrument classification cleaning guide, rust removal guide and the instrument lubrication and maintenance operation method

after rust removal, and carry out the examination according to the assessment standard. Everyone must pass the test.

### 2.2.8. Evaluation Indicators

For each piece of instrument after rust removal and drying, visual inspection or use of light source is used for instrument quality inspection. The surface of the instrument and its joints and teeth should be smooth and clean, no blood stains, no stains, no scale and no rust spots, and the joint movement freely is qualified for cleaning quality; if it fails to meet the requirements, it is not qualified [14].

### 2.3. Statistical Analysis

SPSS 19.0 software was used for statistical analysis. Chi square test was used to compare the counting data.  $P < 0.05$ , the difference was statistically significant.

**Table 1.** Comparison of Rust Rate between the two Groups of Instruments.

Group	Severe	Moderate	Light	Rust rate(n)	$\chi^2$	P
Control group	137 (1.27)	674 (6.26)	945 (9.79)	1866 (17.32)	1004.106	0.000
Observation group	8 (0.06)	47 (0.37)	543 (4.23)	598 (4.66)		

**Table 2.** Comparison of Satisfaction of Clinical Departments before and after Implementation [n (%)].

Group	n	Very satisfied	Satisfied	Not satisfied	Satisfaction	$\chi^2$	P
Control group	58	29 (50.00)	18 (31.03)	11 (18.97)	47 (81.03)	15.266	0.001
Observation group	58	45 (77.59)	13 (22.41)	0 (0.00)	58 (100)		

## 4. Discussion

### 4.1. PDCA Circulation to Improve the Quality of Instrument Pretreatment

On-site inspection of the pretreatment quality of clinical diagnosis and treatment instrument, found that the pretreatment did not meet the requirements of the department, and then timely communication with the head nurse of the department is a must to ask the head nurse to retrain the parties until they master the correct pretreatment method. Every month, analyze the problems existing in the quality of instrument pretreatment in the whole hospital, using PDCA methods to continuously improve, so that the staff of the whole hospital realize that the instrument pretreatment is a prerequisite for cleaning thoroughly and the sterilization level is guaranteed, so as to improve the risk awareness of infection control in clinical departments and the implementation rate of pollution instrument pretreatment [15].

### 4.2. Reducing the Risk of Nosocomial Infection and Operating Costs

After the implementation of the comprehensive plan to prevent the rusting of the instrument, after the effective pretreatment of the used instrument, clear the obvious residues and dirt adhering to the surface of the instrument in time, reduce the pollutants adhering to the instrument for a long time, block the microbial reproduction on the surface of the instrument, improve the cleaning quality of the instrument, ensure the sterilization quality, and reduce the risk of

## 3. Results

Before the implementation of 1866 rusty instruments, rust rate is 17.32%; after the implementation of 598 rusty instruments, rust rate is 4.66%; the difference was statistically significant ( $\chi^2=1004.106$ ,  $P < 0.05$ ), indicating that the implementation of the measures can effectively prevent the rust of medical instruments, see Table 1. Before the implementation of 58 clinical departments, dissatisfaction 18.97%, satisfaction 81.03%, after the implementation, dissatisfaction 0.00%, satisfaction 100%, difference was statistically significant ( $\chi^2=15.266$ ,  $P < 0.05$ ), indicating that the implementation of the measures can effectively improve the satisfaction of clinical department use, see Table 2.

nosocomial infection. The timely recovery and cleaning of instruments, reducing the number of overnight instruments produced, can significantly reduce the incidence of apparatus rust, and directly reduce the labor cost and consumables cost of apparatus rust and waste [16].

### 4.3. Improved Service Satisfaction

By improving the rust removal process in CSSD, the rusting instrument is classified according to the severity of carrying out rust removal, which avoids the damage of the instrument matrix caused by the use of rust remover over time, and obtains a good rust removal effect, which improves the reuse rate of the instrument [17]. The supply quality of the instrument is guaranteed, and the clinical use is satisfactory; the pretreatment of the clinical department is in place, and CSSD adds a recycle, which reduces the rust rate of the instrument from 17.32% to 4.66%, reduces the rust rate of the instrument, improves the accuracy of use, ensures the safety of surgical treatment, and further improves the satisfaction of the clinical department.

## 5. Summary

The circulation operation of PDCA makes CSSD strengthen the communication with clinical departments and improve the initiative of all staff to participate in quality control. It is a strong support for CSSD and clinical departments to jointly prevent apparatus rust, and also the fundamental guarantee to obtain a good effect of preventing apparatus rust. For a small number of instruments after use at night, CSSD guides clinical

departments to use moisturizer to moisturize. The operation of the above measures greatly reduces the chance of apparatus rusting.

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