Evaluation of Washing Effect of Reusable Medical Devices by Different Pretreatment Methods and Its Application in Nosocomial Infection Control

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Abstract
In order to analyze the risk factors of nosocomial infection in the use of reusable medical devices, a retrospective analysis was made of 370 original data of biological monitoring of reusable medical devices filed in the Hospital Infection Department from January 2018 to December 2018. The possible risk factors in the use of reusable medical devices and the corresponding preventive measures were analyzed. The data were compared with 340 original data of air organisms from January 2017 to December 2017. The qualified rate of surveillance, surface biology and manual surveillance were compared. By analyzing the use of reusable medical devices in hospitals in 2018, it was found that the main risk factors of nosocomial infection were air pollution, surface pollution of objects and hand pollution of staff. After taking active and effective preventive measures, the qualified rates of air biological monitoring, surface biological monitoring and hand monitoring of staff in 2018 were significantly higher than those in 2017. There was statistical significance (P < 0.05), and the satisfaction rate of doctors and nurses with reused medical devices was 98.86% after the implementation of preventive measures, which was significantly higher than 89.77% before the implementation. The experiment result shows that the air environment around the reusable medical devices, the surface of the carrying objects and the staff all have certain risk factors of inducing infection. It is necessary to strengthen the training and supervision of infection in order to effectively prevent the occurrence of nosocomial infection.

Key words: Surgical Treatment, Reusable Medical Devices, Nosocomial Infection Control, Elderly Patients.

1. Introduction
Reusable medical devices refer to medical devices designed to be reused among different patients, which must undergo proper decontamination process before reuse. Although reused instruments were washed with clean water by clinical staff before they were recovered, stains and blood stains still remained in the parts where the instruments were difficult to wash, which affected the disinfection and sterilization effect of the articles. Centralized management is adopted in the disinfection and supply center. All medical instruments, instruments and articles requiring disinfection or reuse after sterilization are recycled, cleaned, sterilized and supplied centrally. In this way, there is often a time lag between use and recovery, during which the residual organic matter on the instrument will solidify and dry, and even form biofilm. Once the biofilm is formed, it will adhere to the bacteria to produce a gelatinous matrix, which will bring great difficulty to the cleaning work, and will bring great corrosiveness to the equipment, and affect the service life of the equipment. What is more terrible is that biofilm affects the penetration of sterilization factors, affects the effect of disinfection and sterilization, and easily leads to infection of patients.

WS-310 (including "Management Specification", "Technical Operation Specification for Cleaning and Disinfection" and "Monitoring Standard for Cleaning and Disinfection and Sterilization Effect"), proposed by the Professional Committee of Hospital Infection Control Standards of the Ministry of Health in 2009, is a compulsory industry standard for the treatment of medical reusable products, providing theoretical basis and practical guidance for the treatment of medical reusable products [1-3]. The operation process of diagnostic and therapeutic instruments, instruments and articles processing includes the following 10 steps [4]:

1) Recycling, 2) Classification, 3) Cleaning, 4) Disinfection, 5) Drying, 6) Inspection and Maintenance of Instruments, 7) Packaging, 8) Sterilization, 9) Storage, 10) Issuance of Sterile Items. Figure 1 shows the washing machine for the reusable medical devices using the above ten steps.

The above steps are completed in decontamination area, inspection and packaging sterilization area and sterilized articles store area respectively [5]. At the same time, in order to ensure the effective disposal of
reusable medical devices, it is necessary to monitor the cleaning quality, disinfection quality and sterilization quality and make traceable records.

Hospital reusable medical devices are used in operating rooms and other disposal rooms besides operating rooms. They are generally used in various kinds of operations, various treatment and examination operations, debridement and suture of minor injuries, dressing change and treatment of knife edge after operation, etc. [6] The reusable medical devices used after sterilization are usually sterile. The qualified rate of sterilization of reusable medical devices in the sterilization supply centers of most medical institutions in China is 100.00%. The reusable medical devices are sent to clinical departments through sports by relevant personnel. However, in the process of receiving, sending, handing over and counting, storage, use and pretreatment of reusable medical devices, there are many risk factors for nosocomial infections, which significantly increase the incidence of nosocomial infections in the use of reusable medical devices. This study retrospectively analyzed 370 bio-monitoring data of reused medical devices from January 2018 to December 2018 in the Hospital Infection Department. The risk factors and preventive measures were analyzed. The report is as follows.

Figure 1. The washing machine for the reusable medical devices

2. Materials and Methods

2.1. Test material

Experiment 1: 370 original data of bio-monitoring of reusable medical devices were collected from January 2018 to December 2018, including 140 samples of air bio-monitoring, 140 samples of surface bio-monitoring and 90 samples of manual monitoring. 340 samples of reusable medical devices were also selected from January 2017 to December 2017. The original data of biological monitoring of medical instruments include 130 air biological monitoring samples, 130 surface biological monitoring samples and 80 manual monitoring samples. Sample collection, cultivation and counting in the biennium were all operated according to the Technical Specification for Disinfection. A total of 100 medical staff in 2017 and 2018 were selected as subjects to investigate their satisfaction with reusable medical devices.

Experiment 2: The cleaning effect of adding pretreatment to reusable instruments and articles in hospital disinfection supply center was compared with that of using cleaning machine directly without pretreatment. The materials used include: Jieding 46 automatic double door cleaner; American alkaline cleaner, multi-enzyme cleaner, ATP biofluorescence tester. The cleaning effect test specimens include stainless steel bending plate, tweezers and hemostatic forceps.

2.2. Method

Experiment 1: A retrospective analysis was made of various links in the use of reusable medical devices in hospitals, and related risk factors were analyzed, including the following: (1) air pollution: particulate matter and dust in the air are one of the common vectors of clinical transmission diseases. According to relevant studies, 41 infectious diseases are transmitted through the air in the world, and their transmission rate accounts for all the transmission diseases. First, the lack of ventilation equipment in most departments of medical institutions prevents the air from circulating, and the patients and their families will carry a certain degree of germs into and out of the dressing room, which will lead to air pollution. In addition, the layout of the dressing room is usually
unreasonable, such as the door of the dressing room directly facing the ward, visiting personnel, health cleaners and patients are all connected from the same place. In addition, the working attitude of staff also affects the effect of air disinfection, resulting in the use of reusable medical devices being polluted. (2) Surface contamination of objects: due to the inability of disinfection and sterilization of the operating table, storage cabinet and observation bed in dressing changing room, and the failure of timely, standardized and thorough disinfection and wiping parts, the surface of reusable medical instruments is contaminated before and after application. In addition, the preparation and replacement of disinfectant is not timely, the proportion is unreasonable, and the storage method is incorrect. It will greatly reduce the disinfection effect, and then make the use of reusable medical devices have the risk of pollution. (3) Contamination caused by medical staff: due to the weak hygiene concept of relevant medical staff, irregular hand washing before and after clinical operation, or incorrect hand drying after hand washing, etc. In addition, medical staff in the process of medical operation did not wear gloves, hats and masks in accordance with relevant norms, or incorrect methods of wearing, can not play a preventive effect; Medical workers discard medical waste at will after operation, and medical waste collection containers are too much discarded to be disposed of in time or the treatment method is not standardized; in addition, the staff have poor aseptic operation concept, and the aseptic area, aseptic area and the distinction between aseptic and aseptic are not strictly implemented. (4) Insufficient knowledge of nosocomial infection: due to the lack of systematic learning of knowledge related to nosocomial infection among medical staff, the lack of systematic training for relevant medical staff by the hospital infection management department has increased the risk factors of nosocomial infection.

**Experiment 2:** Every day, 10 pieces of the recovered bending plate, tweezers and hemostatic forceps were selected and randomly divided into the experimental group and the control group with 5 pieces each. The test lasted for 10 days, totaling 300 pieces. The control group was cleaned directly by the cleaning machine without pretreatment; the experimental group was cleaned by the cleaning machine after pretreatment. Thermal disinfection method is preferred for cleaning instruments. A0 value 600 can be used for disinfection by using cleaning and disinfection machine. Boiling disinfection can be selected, tap water can not be used for boiling disinfection, and deionized water with conductivity less than 15 \( \mu \)S/cm should be used. For instruments that can neither be boiled nor boiled, more than 75% ethanol is selected for immersion or wiping disinfection.

### 2.3. Observation index

**Experiment 1:** Observing and comparing the qualified rate of air biological monitoring, surface biological monitoring and manual monitoring. The monitoring standards include: (1) Air biological monitoring qualified finger contains less than 200 CFU/m\(^3\), staff hand hygiene monitoring qualified finger contains less than 5 CFU/m\(^3\), surface biological monitoring qualified finger contains less than 10 CFU/m\(^2\). (2) After the implementation of preventive measures, the satisfaction of doctors and nurses with reused medical devices was evaluated by self-made survey. The total score was 100 points, 80-100 points were very satisfied, 60-80 points were relatively satisfied, and less than 60 points were unsatisfactory.

**Experiment 2:** Visual measurement: No stains or impurities on the surface of the equipment after cleaning are considered qualified, while obvious stains are considered unqualified. ATP bio-fluorescence test method: ATP fluorescence test is carried out on the equipment which has passed the visual inspection. The reading is qualified within the prescribed value, and it is deemed to be unqualified beyond the scope. Bacterial culture was carried out for the unqualified instruments detected by the two methods.

### 2.4. Statistical method

SPSS18.0 software was used for statistical analysis. \( X^2 \) test was used for counting data and t test was used for measuring data. The difference was statistically significant (\( P < 0.05 \)). The data procession equation is shown as:

\[
\left( \frac{\partial F(W)}{\partial W_{ij}^k} \right)_{n_k} = -2 \begin{bmatrix} y_{i-1}^{K-1} \\ y_{i}^{K-1} \\ \vdots \\ y_{n_k}^{K-1} \end{bmatrix} (B_k)^T \tag{1}
\]

The validity and accuracy of data depend mainly on the following factors:

\[
B_k = \text{diag} \begin{bmatrix} \frac{dy_{i1}^k}{dz_1^k}, \frac{dy_{i2}^k}{dz_2^k}, \cdots, \frac{dy_{in_k}^k}{dz_n_k} \end{bmatrix} W_{k+1}B_{k+1} \tag{2}
\]
The correction formula is:

\[
\left( \frac{\partial F(W)}{\partial W_{ij}^{k-1}} \right)_{n_k \times n_{k-1}} = -2 \begin{bmatrix} y_1^{k-2} \\ y_2^{k-2} \\ \vdots \\ y_{n_{k-1}}^{k-2} \end{bmatrix} (B_{k-2})^T \quad (3)
\]

Adjust the weight of the network until the minimum error of the entire training set:

\[
B_{k-1} = \text{diag} \left[ \frac{dy_1^{k-1}}{dz_1^{k-1}}, \frac{dy_2^{k-1}}{dz_2^{k-1}}, \ldots, \frac{dy_{n_k}^{k-1}}{dz_{n_k}^{k-1}} \right] W_k B_k \quad (4)
\]

Difference between actual output and ideal output:

\[
B_k = \text{diag} \left[ \frac{dy_1^k}{dz_1^k}, \frac{dy_2^k}{dz_2^k}, \ldots, \frac{dy_{n_k}^k}{dz_{n_k}^k} \right] W_{k+1} B_{k+1} \quad (6)
\]

The problem of finding a proper set of rights naturally comes down to finding the appropriate value of W, which reaches the minimum:

\[
\left( \frac{\partial F(W)}{\partial W_{ij}^k} \right)_{n_k \times n_k} = -2 \begin{bmatrix} y_1^{k-1} \\ y_2^{k-1} \\ \vdots \\ y_{n_k}^{k-1} \end{bmatrix} (B_k)^T \quad (7)
\]

The steepest descent method is an iterative algorithm and it is the key core for the SPSS algorithm. The valid deformed data processed by the modified algorithm should have the following format:

\[
\partial W_k = \frac{1}{2} \varepsilon_k \left( \frac{\partial F(W)}{\partial W_{ij}^k} \right)_{n_k \times n_k} = \varepsilon_k \begin{bmatrix} y_1^{k-1} \\ y_2^{k-1} \\ \vdots \\ y_{n_k}^{k-1} \end{bmatrix} (B_k)^T \quad (8)
\]

Where \[
\begin{bmatrix} y_1^{k-1}(t) \\ y_2^{k-1}(t) \\ \vdots \\ y_{n_k}^{k-1}(t) \end{bmatrix}
\]

is noted as the mapping matrix from raw data to SPSS processing set data; \((B_k)^T\) is noted as raw data sets collected in different time periods; \(\varepsilon_k\) is the corresponding data weight ratio.

Quantitative data were expressed by mean (+standard deviation) (\(x \pm s\)). The comparison of mean between groups was performed by t-test of independent samples. \(P \leq 0.05\) is statistically significant.

3. Results

3.1. Experiment 1

By analyzing the use of reusable medical devices in hospitals in 2016, it was found that the main risk factors of nosocomial infection were air pollution, surface pollution of objects and hand pollution of staff. Active and effective preventive measures were taken against the identified risk factors. Compared with 2015, the qualified rates of air biological monitoring, surface biological monitoring and hand monitoring of staff in
2016 were higher. Significant improvement, the difference was statistically significant (P < 0.05), see Table 1. Through the investigation of 88 medical staff, it was found that after the implementation of preventive measures, the satisfaction of medical staff with reused medical devices was significantly higher than that before the implementation, and the difference was statistically significant (P < 0.05), as shown in Table 2.

### Table 1. Qualification rate of biomonitoring related to reusable medical devices in 2017 and 2018 (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>Air Biomonitoring</th>
<th>Surface Biomonitoring</th>
<th>Surface Biomonitoring of Operators</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Qualified number</td>
<td>Pass rate</td>
<td>Qualified number</td>
</tr>
<tr>
<td>2017</td>
<td>65</td>
<td>50.00</td>
<td>60</td>
</tr>
<tr>
<td>2018</td>
<td>117</td>
<td>90.00</td>
<td>114</td>
</tr>
</tbody>
</table>

### Table 2. Satisfaction (%) of doctors and nurses with reused medical devices before and after the implementation of preventive measures

<table>
<thead>
<tr>
<th>Health care workers</th>
<th>Number of cases investigated</th>
<th>Very satisfied</th>
<th>Satisfied</th>
<th>Dissatisfied</th>
<th>Satisfaction rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before implementation</td>
<td>100</td>
<td>56</td>
<td>11</td>
<td>33</td>
<td>67</td>
</tr>
<tr>
<td>After implementation</td>
<td>100</td>
<td>77</td>
<td>19</td>
<td>4</td>
<td>96</td>
</tr>
</tbody>
</table>

### 3.2. Experiment 2

**Qualification rate of cleaning reusable instruments:** There was a significant difference between the two groups (P < 0.05). The qualified rate of cleaning instruments in the two groups was shown in Table 3.

**Bacterial culture results of unqualified instruments:** Bacterial culture results of unqualified instruments are shown in Table 4.

**Re-cleaning eligible results:** After testing, the unqualified instruments and articles were sent back to the cleaning area, soaked in multi-enzyme detergent and brushed manually, then rinsed several times with purified water, and tested by visual inspection and ATP biofluorescence, all of them were qualified after re-cleaning. Returning to the decontamination area for cleaning equipment takes 15 minutes longer than pretreatment, 4 batches per day and 60 minutes more.

### Table 3. Qualification rate of cleaning equipment and articles in two groups (%)

<table>
<thead>
<tr>
<th>Apparatus</th>
<th>Experimental group(n=50)</th>
<th>Control group(n=50)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Qualified number</td>
<td>Pass rate</td>
</tr>
<tr>
<td>Tweezers</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Bending plate</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Hemostatic forceps</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

### Table 4. Bacterial Culture Result and Composition Ratio of Unqualified Multiplexed Instruments

<table>
<thead>
<tr>
<th>Pathogenic bacteria</th>
<th>Number of plants</th>
<th>Constituent ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staphylococcus aureus</td>
<td>7</td>
<td>0.1429</td>
</tr>
<tr>
<td>Acinetobacter baumannii</td>
<td>5</td>
<td>0.1021</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>11</td>
<td>0.2244</td>
</tr>
<tr>
<td>Klebsiella</td>
<td>9</td>
<td>0.1836</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>14</td>
<td>0.2857</td>
</tr>
<tr>
<td>Enterobacter cloacae</td>
<td>3</td>
<td>0.0613</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>1</td>
</tr>
</tbody>
</table>

### 4. Discussion

Risk factors of nosocomial infection were found through reuse of medical devices in 2016, and the following preventive measures were put forward according to relevant research reports:

1) Air pollution prevention measures: regular ventilation in the changing room of the department, disinfection by ultraviolet air after each changing operation, disinfection time is 30 minutes, every day. Wipe the ultraviolet lamp tube, update the ultraviolet lamp tube regularly, and cultivate the air once a month.
2) Preventive measures against surface contamination of surface materials: the administrators of department dressing changing room must prepare disinfectant solution strictly according to relevant requirements, and replace it every day, wipe and disinfect the surface of objects twice a day, and tow and disinfect the ground twice a day, so as to achieve the special purpose of articles.

3) Measures to prevent contamination of staff: Hand hygiene of staff is the simplest, convenient and effective way to reduce and control nosocomial infection, and it is also an important link to control nosocomial infection. Medical staff in departments should not wear jewelry or cut their nails frequently. Hand hygiene should be strictly carried out before and after operation. Besides setting hand washing facilities in dressing changing rooms, they should also be equipped with quick-drying hand disinfectants. Set up a paper towel rack beside the hand-washing pool to prevent secondary contamination of medical staff after washing hands. Strengthen the concept of personal protection. Medical staff should wear gloves, masks and hats according to the requirements. During dressing change operation, they should not do anything unrelated to dressing change. After dressing change operation, they should remove gloves in time. During operation, they should strictly follow aseptic operation rules and should not cross over during operation. In sterile areas, sterile and sterile articles should be strictly distinguished. Medical waste should be put into prescribed containers and treated in time.

4) Improving the management system: Infection control teams are set up in the medical department, which are composed of competent doctors and nurses, and the relevant personnel should have more than one year's work experience; the competent personnel supervise and inspect the departments every day, and the infection department supervises and evaluates the biological monitoring situation of the departments every month, and reports it to the director of the hospital for the implementation of comprehensive quality control management [7-8].

5) Strengthen hospital-wide training: hospitals or departments carry out hospital-wide training by referring to disinfection and isolation system, relevant laws and regulations and knowledge of nosocomial infection. Through lecture training, questionnaire assessment and publicity of results, the awareness and mastery of relevant personnel are improved, so as to ensure hospital medical safety. Stainless steel medical instruments after clinical use for a period of time, due to the impurities in water, body fluids and medicinal liquids in the process of cleaning and drying, it is easy to deposit on the surface of the instruments, long-term accumulation will form visible, varying degrees of scale deposits, especially large bowls, basins, plates, which are easier to deposit scale, white. Scale and golden or grey-brown scale [9-10]. White scale is mainly formed by the deposition of calcium ions, and its structure is relatively loose, and its adhesion with instruments is relatively small, which is easy to remove. Golden or gray-brown scale is mainly formed by the deposition of magnesium ions, with compact structure and relatively close adhesion with instruments, which is difficult to remove. Scale is one of the main inorganic pollutants in medical devices. The presence of scale will not only damage the equipment and affect the appearance, but also affect the effect of cleaning, disinfection and sterilization, thus causing the occurrence of medical infections and other situations. Therefore, it is necessary to remove scales from scaled instruments [11].

6) Conventional cleaning processes generally use multi-enzyme cleaning, multi-enzyme can effectively remove organic matter, but the removal effect of inorganic matter is poor. If the scale is removed by physical methods such as scraping and friction with hard objects, it will cause permanent damage to stainless steel instruments, shorten the service life of the instruments and affect the use effect. Scale remover is a weak acidic solution, which can remove the scale formed by sediments and minerals in water, as well as other inorganic fouling and spots. Corrosion will occur during the long-term contact with blood stains, and rust will occur due to the destruction of oxide layer or coating on the surface of the instrument. The rust remover is a mild acidic solution, which can effectively remove rust and corrosion on stainless steel instruments. Both scale remover and rust remover are acid cleaning agents. The mixing of the two agents will not affect the reduction effect, and can achieve the purpose of rust removing and scale removing at the same time.

In order to ensure the cleaning quality of reusable instruments, it is necessary to classify them first. The instruments with residual stains and bloodstains on the surface must be pretreated separately and then cleaned by machines. Only in this way can the biological load on the surface of reusable instruments be completely removed and sterilized successfully. Otherwise, there are not only residues in the cleaning machine, but also the drying up of pollutants will increase the difficulty of back-washing. The surface of unqualified reusable instruments remains various stains, bloodstains and so on, which are easy to breed bacteria. Once it enters the clinic, the patient's resistance is low and easily causes infection. It not only brings pain to the patients, but also prolongs the hospitalization time and increases the burden of the patients.

The quality of disinfection and sterilization is the key link to ensure the safety of instruments. The new regulations put forward a series of management requirements on how to ensure the quality of disinfection and sterilization of instruments.

1) The new standard clearly defines the preferred thermal disinfection method for cleaning instruments, which can be disinfected with A0 value 600 by using a cleaning and disinfection machine; boiling disinfection
can be selected; tap water can not be used when boiling disinfection, and deionized water with conductivity less than 15 μS/cm should be used. Equipment that can neither be boiled on the machine nor disinfected can be soaked or wiped with more than 75% ethanol. It is not recommended to use acidic oxidation potential water and chlorine-containing disinfectant for immersion disinfection after instrument cleaning. Otherwise, rinse and disinfect after disinfection.

2) For the first time, the new specification requires CSSD to test the performance parameters of disinfection and sterilization equipment in use every year to assess whether the disinfection and sterilization equipment used is qualified. In the past, CSSD paid too much attention to physical monitoring, chemical monitoring and biological monitoring, but did not pay attention to whether the equipment used is qualified, there are management loopholes and risks. How to test the parameters of disinfection and sterilization equipment? At present, hospitals do not have testing conditions. It is suggested that suppliers should be required to test once a year when purchasing equipment. Third-party testing companies can also be entrusted to complete testing according to standards. Conditional hospital CSSD can configure corresponding testing equipment to complete parameter testing and validation by itself.

3) When physically monitored disinfectors record sterilization parameters, they should record at least the temperature range, maintenance time and pressure range of sterilization stage according to instrument readings or print data, rather than simple single temperature and time, such as 121 and 20min. When testing the temperature, pressure and time of sterilization procedure every year, it is necessary to know the difference of sterilization parameters caused by the different placement of sterilizer instruments and controller sensors (probes), recording system sensors (probes) and temperature detectors. It is suggested that the sterilization parameters of super heavy packages, foreign medical instruments and implants, hard containers, which are first used in hospitals, should be taken into consideration at the same time. The validity was tested and the wet package was checked.

4) Pre-vacuum pressure steam sterilizer with chemical monitoring less than 60 L generally does not need BD test. The standard stipulates that "chemical indicators should be placed in the bag of highly dangerous articles and placed in the most difficult sterilizing parts", but it is not necessary for some hospitals to put four kinds of bag cards and five kinds of crawling cards in the bag at the same time. One kind of crawling cards can be placed, especially five kinds of crawling cards, which in principle involve foreign medical devices and implants when they need to be released in advance. Specific sterilization procedures for prolonging sterilization time (e.g. 134 and 18 min) require the use of corresponding indicators, which are usually used to indicate the six types of cards for the sterilization cycle, with relatively high accuracy for temperature and time detection.

5) In the biological monitoring of small pressure steam sterilizers, the monitoring packaging of biological indicators should be in accordance with the requirements of sterilization cycle (B/N/S) and the packaging of sterilized articles. The biological monitoring methods of large pressure steam sterilizers are in accordance with the 2009 edition of the Code.

6) Ethylene oxide sterilization has good penetration and effect stability. It is suitable for the sterilization of complex and slender lumen instruments. But after sterilization, the products must be analyzed by ethylene oxide. The whole sterilization cycle needs at least 10 hours. Humidity has a great influence on the sterilization effect of ethylene oxide. The relative humidity of sterilization process should not be less than 30% (60% recommended control), otherwise it will lead to sterilization failure. Therefore, when purchasing ethylene oxide sterilizer by CSSD, attention should be paid to whether the equipment has the ability of preheating and pre-humidifying the sterilization package. Relative humidity monitoring requirements have also been added to the new specification for physical monitoring; chemical and biological monitoring requirements for ethylene oxide sterilization are in line with the requirements of the 2009 edition of the specification [12-15].

7) Low temperature plasma sterilization of hydrogen peroxide has been widely used for sterilization of receptacle endoscope instruments because of its relatively fast sterilization time; however, its sterilization effect mainly depends on the gasification and dispersion of hydrogen peroxide of more than 58%, and its penetration capacity is limited. It requires that sterilization instruments must be thoroughly cleaned, fully dried (air gun alone is not feasible), packaging materials can not dissociate and absorb hydrogen peroxide (recommended). Packaging with Tevek, sterilization bag/bag can not be overloaded or over- loaded, otherwise it will easily lead to sterilization failure.

8) In addition to monitoring the temperature, time and pressure parameters of the sterilization process, the concentration of hydrogen peroxide in sterilization chamber is the key factor affecting sterilization. However, most of the sterilizers currently used in hospitals do not have hydrogen peroxide concentration monitoring devices, which is required in the newly revised GB27955 General Requirements for Hydrogen Peroxide Gas Plasma Low Temperature Sterilization Devices. Chemical monitoring of hydrogen peroxide low temperature plasma sterilization used in hospitals at present is a kind of card, which can only indicate whether the sterilization package has been sterilized, but can not indicate the sterilization effect; and the discoloration of the chemical indicator card is not stable, which requires attention in the use of CSSD [16-18].
9) Biological monitoring of hydrogen peroxide low-temperature plasma sterilization process has complex factors and relatively poor sterilization stability, so biological monitoring should be carried out every pot, but considering the cost of monitoring, the new specification still stipulates that biological monitoring should be carried out at least once a day, which is worth discussing. It is suggested that PCD containing the fifth chemical indicator should be selected to make up for each pot. In the past, when hydrogen peroxide low-temperature plasma sterilization biological monitoring was carried out, the biological indicators were placed in Teveqiang packaging bags for monitoring, which could not represent the effect of sterilization load (such as lumen instruments), nor could the problem of overload of sterilized articles be found. The new specification requires that when sterilizing lumen instruments, the lumen biological PCD should be selected for testing. At present, many of them have been found to be qualified for the original monitoring. The substandard problems are related to the excessive loading of sterilizing articles or the failure to update sterilizing procedures of sterilizers.

5. Conclusions

In this study, it analyzed the risk factors of nosocomial infection caused by reusable medical devices in 2018, and took preventive measures and strictly implemented them. At the same time, compared with the reusable medical devices in 2017, the results showed that the qualified rates of air biological monitoring, surface biological monitoring and manual monitoring of staff in 2018 were higher than those in 2017. The annual improvement was significant, and after the implementation of preventive measures, the satisfaction of doctors and nurses with reusable medical devices was significantly improved.

References


