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Study on the application of multimedia technology in the tracing system of laparoscopic instruments

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ABSTRACT: Objective This study used multimedia technology to add component diagrams and video functions to the endoscopic instrument traceability system to explore its application effect in endoscopic instrument management. **Methods** The 134,081 laparoscopic instruments and 24,091 laparoscopic instrument packages used and disposed of in the hospital from January to December 2020 were set as the control group. The 134 261 laparoscopic instruments and 24 141 laparoscopic instrument packages with the application of multimedia technology in the tracing system from April to March 2021 were set as the experimental group. The unqualified rates of instrument recycling, cleaning, and packaging were compared before and after the application of multimedia technology to the tracing system, and the work satisfaction of the staff of the laparoscopic sector, the operating room staff, and the interns was investigated. **Results** After multimedia technology was applied in the tracing system, the unqualified rate of instrument recycling was reduced from 0.35% to 0.04%, the unqualified rate of cleaning was decreased from 1.0% to 0.43%, and the unqualified rate of packaging was dropped from 0.56% to 0.19%; the difference between the control group and the experimental group was statistically significant (P<0.001). Work satisfaction was increased from 96% to 100%, with a statistically significant difference between before and after the application (P<0.05). **Conclusion** Adding component diagrams and videos to the laparoscopic instrument tracing system through multimedia technology can effectively improve the quality of instrument recycling, cleaning, and packaging, increase the staff's work satisfaction and efficiency, and enhance the centralized management of laparoscopic instruments, which is thus worth promoting and applying.

KEY WORDS: Tracing system; Multimedia technology; Laparoscopic instrument; Component diagram; Process video

Introduction

The central sterile supply department (CSSD) is a place for cleaning, disinfecting, and sterilizing reusable medical devices and instruments in hospitals. As it evolves and progresses, more and more hospitals dispose of laparoscopic instruments in the centralized CSSD[1-3]. The laparoscopic instrument has complex structures, multiple types, and expensive prices, thus there are many difficulties in its processing and disposal, such as the complex structure that may lead to incomplete cleaning, and various specifications that may cause errors in package preparation. These challenges not only increase the number of unqualified packages and raise the rate of rewashing, thus delaying the patient's surgery, but also make it difficult for the staff to process and dispose of the packages and reduce their work efficiency.

In order to solve the above problems, since 2019 our CSSD has centralized the processing of laparoscopic instruments and upgraded the previous

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tracing system. Since 2021, we have applied multimedia technology to the informationized tracing system. By means of the technology, the system adds component diagrams and process videos of the laparoscopic instruments, labeling and explaining the highlights of the processing of each instrument set. We compared the processing and disposal of laparoscopic instruments before and after this application, and found that this application can effectively improve the quality of laparoscopic instrument recycling, cleaning, and packaging, as well as work satisfaction. Therefore, we consider that the application of multimedia technology in the laparoscopic instrument tracing system is worth promoting and applying.

1. Materials and methods

1.1 Sample collection The 134,081 laparoscopic instruments and 24,091 laparoscopic instrument packages used and disposed of in the hospital from January to December 2020 were set as the control group. The 134 261 laparoscopic instruments and 24 141 laparoscopic instrument packages with the application of multimedia technology in the tracing system from April to March 2021 were set as the experimental group. All laparoscopic instruments were collected from the departments of cerebral surgery, head and neck surgery, thoracic surgery, general surgery, obstetrics and gynecology, urology, and orthopedics.

1.2 Methods

1.2.1 Application of multimedia technology in informationized tracing system

1.2.1.1 The electronic files of classified laparoscopic instruments were established, different catalogs were named according to the operating departments, and sub-catalogs of laparoscopic instruments were set up according to the surgical sites, labeled with the names of laparoscopic instrument packages.

1.2.1.2 The instruments were photographed against a non-woven fabric blue and flat background (Figure 1). For single instruments, the whole instrument was photographed first, then the individual parts were photographed after disassembling, and the details of the key parts were highlighted. Instrument sets were arranged in an orderly manner and photographed as a whole set, with details of the key parts being marked.

1.2.1.3 Making process videos According to the different types of laparoscopic instrument packages, the standardized processing flow of each type of instrument from recycling to packaging was filmed and made into a video with text as well as voice explanation, such as the precautions for the inspection of the instrument, what kind of errors were likely to occur, how to inspect, which joints and screws were easy to be damaged, how to assemble the package, how to clean, inspect and maintain, etc.

1.2.1.4 Application of multimedia technology Combined with the video and audio functions in the informationized tracing system developed by the software company, the complete component diagram and video would be taken and uploaded to the system, and this serves as a standard to regulate the subsequent instrument processing process. When the laparoscopic instruments were being used, if any type or model of the item in the package changes, the

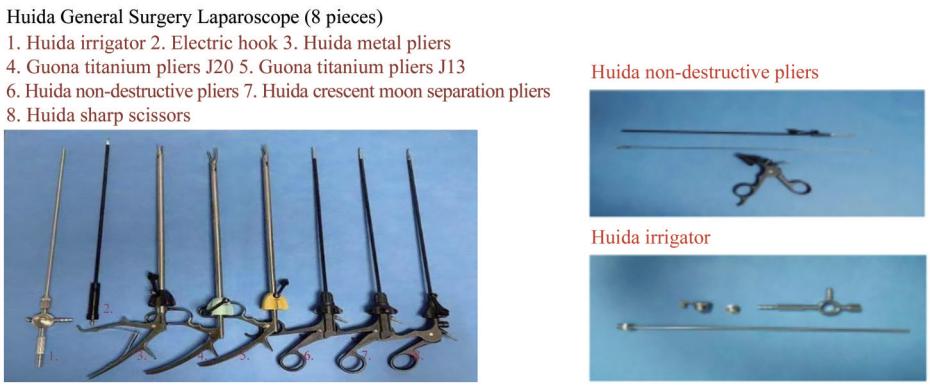

Figure 1 The instruments photographed against a non-woven fabric blue and flat background

standard diagram and video should be taken and uploaded again, and the old one should be deleted. Each computer used to process and dispose of laparoscopic instruments at CSSD has the system installed on it so that the diagrams and videos could be viewed at any time during the work process, and a download function has been developed to make it easier for personnel to view and learn at any time and any place.

1.2.2 Application in groups

1.2.2.1 Control group: The staff of the operating room handed over the used instrument packs to the staff of the laparoscopic sector. Then the staff of the laparoscopic sector scanned the barcode outside the package and recycles and cleans the instruments. After cleaning, the staff in the packaging area checked the cleaning quality of the instruments one by one, distribute, check, and package the instruments according to the instrument list card inside the package.

1.2.2.2 Experimental group: (1) Recycling process: The staff of the operating room handed over the used instrument packages to the staff of the laparoscopic sector, and the staff of the laparoscopic sector scanned the barcode and enters into the catalog of the corresponding instrument packages in the tracing system. Then they checked according to the component diagram and the instrument list of the packages, focusing on checking the parts that were easy to be lost or loose. After checking, the staff scanned the barcode on the outside of the package and received the instruments. If the instruments were not the same as the component diagram, the staff should give timely feedback to the operating room staff to find out where the missing instruments or parts went. (2) Cleaning process: For laparoscopic packages with low frequency of use or high frequency of change of instruments, the staff of the laparoscopic sector could watch the standard operation video of the cleaning process in the package and learn the special precautions of the cleaning process. (3) Packaging process: The staff in the packaging area checked the cleaning quality of the instruments regarding the component diagrams and process videos, verify instruments carefully according to the instrument list cards and diagrams, assembled them accordingly, arranged the instruments in the packages properly, and packaged them.

1.2.3 Indicators for further observation The unqualified rates of instrument recycling, cleaning, and packaging were compared before and after the application of multimedia technology to the tracing system, and the work satisfaction of the staff of the laparoscopic sector, the operating room staff, and the interns was investigated. The total satisfaction score was 100 points, 80-100 points was very satisfied, 60-79 points was satisfied, and <60 points was dissatisfied [4]. It was calculated as Satisfaction = (number of very satisfied+number of satisfied)/total×100%.

1.2.4 Statistical analysis SPSS22.0 statistical software was used to analyze the data on the unqualified rates of instrument recovery, cleaning, and packaging, as well as the satisfaction of the laparoscopic sector staff, the operating room staff, and the interns before and after the application of multimedia technology to the tracing system. The counting data were expressed as frequency and percentage, and the comparison between groups was analyzed by χ^2 test. $P<0.05$ was considered statistically significant.

2. Results

2.1 Comparison of unqualified rates of instrument disposal before and after application

The unqualified rates of instrument disposal before and after the application of multimedia technology were shown in Table 1, Table 2, and Table 3. Table 1 showed that after the application, the unqualified rate of recycling was reduced from 0.35% to 0.04%, with a reduction rate of 88.57%. Table 2 revealed that the unqualified rate of cleaning decreased from 1.0% to 0.43%, with a decrease rate of 57.00%. Table 3 demonstrated that the unqualified rate of packaging dropped from 0.56% to 0.19%, with a drop rate of 66.07%. It is evident that after application, the unqualified rates of laparoscopic instrument recycling, cleaning, and pack-

Table 1 Comparison of unqualified rates of instrument recycling before and after the application of multimedia technology in the tracing system

Group	Total number of instrument packages (pcs)	Unqualified number of recycling (pcs)	Unqualified rate of recycling (%)
Control group	24 091	84	0. 35
Experimental group	24 141	10	0. 04

Comparison of unqualified rates in the two groups, χ^2=58. 523, P<0. 001.

Table 2 Comparison of unqualified rates of instrument cleaning before and after the application of multimedia technology in the tracing system

Group	Total number of instrument cleaning (pcs)	Unqualified number of cleaning (pcs)	Unqualified rate of cleaning (%)
Control group	134 081	1 350	1. 0
Experimental group	134 261	582	0. 43

Comparison of unqualified rates in the two groups, χ^2=308. 545, P<0. 001.

Table 3 Comparison of unqualified rates of instrument packaging before and after the application of multimedia technology in the tracing system

Group	Total number of instrument packaging (pcs)	Unqualified number of packaging (pcs)	Unqualified rate of packaging (%)
Control group	24 091	135	0. 56
Experimental group	24 141	45	0. 19

Comparison of unqualified rates in the two groups, χ^2=45. 356, P<0. 001.

aging in CSSD were significantly lower than those before application (P<0.001). Therefore, it can effectively improve the quality of instrument disposal by applying this technology.

2.2 Comparison of work satisfaction before and after application

After the application of multimedia technology to the tracing system, the work satisfaction of the staff in the laparoscopic sector increased from 96% to 100%, which was significantly higher than that before the application (P<0.05) (Table 4). It indicates that the motivation of the staff has been improved.

3. Discussion

3.1 The qualities of laparoscopic instrument recycling, cleaning, and packaging are improved. By applying multimedia technology to the tracing system, the instrument's structure, form, quantity, name, cleaning process, packaging, placing, and other information are visualized in graphic and video format, which is convenient to understand and remember, provides instant guidance for the staff and standardizes the processing of laparoscopic instruments. When the staff of the laparoscopic sector and the staff of the operating room hand over the instruments, the staff of the laparoscopic sector enters the multimedia interface of the tracing system and counts the instruments and items according to the corresponding component diagram and the instrument list. If any type or quantity of instruments and items are found to be inconsistent with theirs, the laparoscopic sector staff gives feedback to the operating room staff directly, and the instrument users find out the causes of the inconsistency as soon as possible, so as to improve the accuracy of recycling of instruments[5]. laparoscopic instruments have complex structures, various types, and special materials, and thus are easily damaged during the cleaning process. Therefore, cleaning and packaging staff operate according to the diagrams and videos in the

Table 4 Comparison of work satisfaction before and after the application of multimedia technology in the tracing system

Time	Number of cases (persons)			Very satisfied (person)	Satisfied (person)	Dissatisfied (person)	Satisfaction (%)
	Laparoscopic sector staff	Operating room staff	Interns				
Before application	35	55	10	42	54	4	96. 0
After application	35	55	10	81	19	0	100. 0

Comparison of unqualified rates in the two groups, χ^2=4. 082, P<0. 05.

system, disassembling, cleaning, inspecting, maintaining, assembling, and arranging, which greatly reduces the incidence of unqualified rates of cleaning and packaging[6]. As a result, the cleaning quality of the laparoscopic instrument is ensured, which facilitates its daily maintenance, ensures the quality of instruments and items, and prolongs the average service life of instruments.

3.2 Work satisfaction and efficiency are improved. The CSSD processes, disposes of and supplies all reusable medical equipment, instruments, and items in the hospital, and the laparoscopic sector has complex and burdensome processing procedures. The application of multimedia technology to the tracing system effectively supports the staff in the laparoscopic sector. The component diagram and process video in the system make the process of disassembly, cleaning, assembly, and packaging more intuitive, clearly indicate the errors that are prone to occur in the process of processing and disposing of instruments by the staff, and accelerate the speed of counting the instruments and items[7]. Thus it reduces the pressure on the staff in processing instruments, improves the efficiency, and increases the work satisfaction of the CSSD staff and surgical personnel, which is consistent with the findings of XU Shiqin et al[8].

3.3 Training effectiveness is improved. The interns need to rotate in many departments, thus the duration of their stay in each department is quite short. Due to the distinctiveness of CSSD, the interns are given less time to train in the laparoscopic sector. On-site teaching with multimedia technology enables them to master the process of laparoscopic instruments in a short time. Component diagrams and process videos make the teaching more intuitive, detailed, visual, and easy to memorize, thus improving the quality of teaching and operation[9], and enhancing their satisfaction with the internship work at CSSD.

3.4 Informationized management promotes efficiency and energy saving. Previously, the paper instrument list was inefficient to view, inconvenient to use, low compliance, and lacked videos of the instrument disposal process, which led to higher work pressure for the staff. However, the application of multimedia technology in the tracing system facilitates the staff to learn and refer to it, which makes the work simpler and more efficient and enables the management of CSSD to be more standardized, thus improving the working quality and effectiveness of CSSD.

4. Conclusion

In conclusion, the application of multimedia technology in the management of laparoscopic instruments in CSSD achieves remarkable results, improves the qualified rate of laparoscopic instrument recycling, cleaning, and packaging, guarantees the quality of work, ensures the safety of the patients, increases the staff's work satisfaction and efficiency, facilitates teaching and training, and further effectively improves the centralized management of laparoscopic instruments in CSSD, which is thus worth promoting and applying.

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